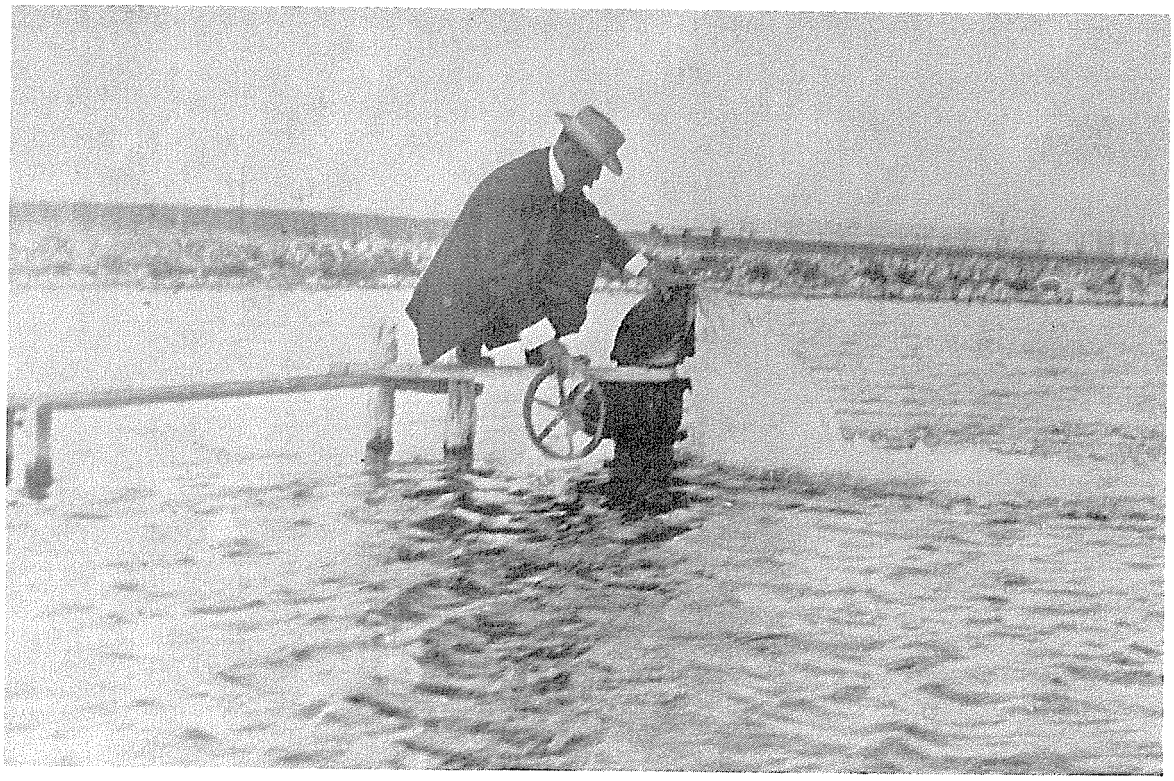
March 1990 WRRI Report No. 248

PROCEEDINGS

34TH ANNUAL NEW MEXICO WATER CONFERENCE

The Relationship of Water Issues: Southeastern New Mexico as a Case Study



October 26-27, 1989
Roswell Inn
Roswell, New Mexico

New Mexico Water Resources Research Institute
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The Roswell Inn
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New Mexico State University
Las Cruces, New Mexico 88003

March 1990

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Funds for the proceedings publication were provided by registration fees, the U.S. Department of the Interior, and state appropriations to the New Mexico Water Resources Research Institute.

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PREFACE

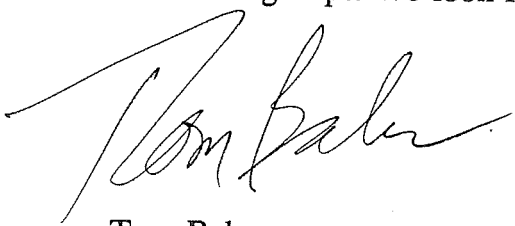
As in the previous 33 years, the 34th Annual New Mexico Water Conference brought together various groups interested in the status of water in our state. In the spring of 1989, the New Mexico Water Conference Advisory Committee, consisting of 39 members from throughout the state representing state and federal agencies, Indian governments, and academic and private concerns, met to discuss the focus of the 34th conference. At the Roswell Economic Forum's invitation, the committee decided to hold the conference in southeastern New Mexico. It was determined the theme would be southeastern New Mexico as a case study of current water issues facing the state. Problems facing that area are much the same as those facing other parts of the state including water quality, planning for future demand, and meeting out-of-state demands for water.

The first session provided an overview of the southeastern region. Fort Sumner Irrigation District, Carlsbad Irrigation District, the Pecos Valley Artesian Conservancy District, and Brantley Dam were described by speakers well-versed on their topics. Peter White of the State Engineer Office provided the background to the recently decided Pecos River suit. A panel of three then discussed their views of the Pecos case.

The Thursday afternoon session was devoted to water quality--a continuing concern in New Mexico. The impacts of the oil and gas industry and landfills on water quality were discussed. Federal initiatives and state programs dealing with water quality were reviewed. Bob Porter of the Farm Bureau described the concerns of the agricultural community as they relate to water quality. The session concluded with two academicians describing their research accomplishments related to conserving our water resources.

The final session focused on planning for the future. Governor Garrey Carruthers noted that water quality would be the issue of the 1990s. The Governor also discussed the currently hot topic of landfills. The session ended with a panel discussion by representatives of local governments including the mayors of Roswell, Carlsbad, Hobbs and Artesia, the Ruidoso city manager, and the president of the Mescalero Apache Tribe. This session was open to the public at no charge to encourage the participation of the general public and their understanding of current water issues.

This year's conference reconfirmed the need for forums of this type. The water problems facing the state are varied and require careful consideration and discussion by all interested groups. We look forward to continuing this tradition in the coming years.



Tom Bahr
Director

JEFF BINGAMAN
NEW MEXICO

United States Senate

WASHINGTON, DC 20510

October 25, 1989

Mr. Tom Bahr
Director
Mew Mexico Water Resources Research Institute
Box 30001, Dept. 3167
Las Cruces, New Mexico 88003

Dear Tom:

I'm sorry I can't be there with you in Roswell as you discuss the most pressing long term issue confronting New Mexico, how to protect and preserve the quality and quantity of New Mexico's water. The continuance of our present agricultural and industrial economies and the future expansion of our economy into new arenas is based on New Mexico being able to provide a safe and adequate water supply. As usual, your conference is correctly focusing on these important and basic issues, results of which I look forward to receiving.

In addition, I wish to congratulate you and your staff on not only the great job you do in researching the many technical aspects of our water issues but more importantly on how the Water Resources Research Institute continues to assist in bringing before all New Mexican's the importance of protecting our precious water.

Have a productive and energetic conference there in Roswell and continue to let me know how I may be of service on this most important of issues.

Sincerely,

Jeff Bingaman
United States Senator

JB/dmv

34TH ANNUAL NEW MEXICO WATER CONFERENCE

The Relationship of Water Issues:
Southeastern New Mexico as a Case Study

Roswell Inn
Roswell, New Mexico

WEDNESDAY, OCTOBER 25

4:00	-	6:00 p.m.	Registration
6:30	-	8:00 p.m.	Reception, Roswell Museum and Art Center Hosted by Roswell Chamber of Commerce

THURSDAY, OCTOBER 26

8:00	-	8:30 a.m.	Registration
8:30	-	8:35 a.m.	**Opening Remarks and Introductions** Tom Bahr Director New Mexico Water Resources Research Institute
8:35	-	8:45 a.m.	**Welcome** William F. Brainerd Mayor of Roswell

SESSION I: OVERVIEW OF SOUTHEASTERN NEW MEXICO

Session I Moderator:
Charlotte B. Crossland
State Engineer Office

8:45	-	9:30 a.m.	**Update on the Pecos River Adjudication** Peter T. White State Engineer Office
9:30	-	9:45 a.m.	**Fort Sumner Irrigation District** Jake West Retired, Agricultural Stabilization and Conservation Service

9:45 - 10:00 a.m.	**Carlsbad Irrigation District** Tom W. Davis Carlsbad Irrigation District
10:00 - 10:15 a.m.	**Water Conservation in the Pecos Valley Artesian Conservancy District** John F. Russell Attorney for PVACD
10:15 - 10:35 a.m.	**Break**
10:35 - 10:55 a.m.	**The Colorful History of Brantley Da.m.** Hal Brayman U.S. Senate Budget Committee
10:55 - 11:15 a.m.	**Recreational Issues on the Pecos River in New Mexico** Robert M. Findling State Parks and Recreation
11:15 - 11:45 a.m.	**Panel Discussion: Pecos River Issues** "Texas v. New Mexico: It's Time to Correct Some Mistakes" Charles T. DuMars University of New Mexico School of Law "Overview of the Texas V. New Mexico Settlement" Henry M. Bonhoff Rodey, Dickason, Sloan, Akin & Robb, P.A. "Future Outlook for Water Use in the Pecos Stream System" Fred Hennighausen Hennighausen & Olson Attorneys
12:00 - 1:30 p.m.	**Lunch**

SESSION II: WATER QUALITY

Session II Moderator:
George William Sherk
Department of Justice
Natural Resources Division

1:30 - 1:50 p.m.	**Environmental Issues in New Mexico's Oil and Gas Industry: Successes and Challenges** David G. Boyer Energy, Minerals, and Natural Resources Department Oil Conservation Division
1:50 - 2:10 p.m.	**Solid Waste Management and Protecting New Mexico's Ground Water** Richard Mitzelfelt Environmental Improvement Division
2:10 - 2:30 p.m.	**EPA Programs and Perspectives** Bruce Elliott EPA Dallas Regional Office
2:30 - 2:50 p.m.	**New Mexico Department of Agriculture's Program for the EPA's Pesticide/Ground Water Directive** Lonnie Mathews New Mexico Department of Agriculture
2:50 - 3:10 p.m.	**Break**
3:10 - 3:30 p.m.	**Soil Conservation Service Ground Water Quality Programs** Bob McQueen U.S. Department of Agriculture, Soil Conservation Service
3:30 - 3:50 p.m.	**Concerns of the Agricultural Community** Bob Porter New Mexico Farm and Livestock Bureau
3:50 - 4:10 p.m.	**New Plants for the 21st Century** John D. Kemp Plant Genetic Engineering Laboratory New Mexico State University
4:10 - 4:30 p.m.	**Using Algae to Clean Up Water** Dennis W. Darnall Bio-recovery Systems, Inc.
6:00 - 7:00 p.m.	**Social Hour** Hosted by Roswell Economic Forum
7:00 p.m.	**Banquet** Baxter Black Cowboy humorist and poet

FRIDAY, OCTOBER 27

SESSION III: PLANNING FOR THE FUTURE

Session III Moderator:
Ron Cummings
Economics Department
University of New Mexico

8:30 - 8:50 a.m. **Western Regional Overview**
Anthony G. Willardson
Western States Water Council

8:50 - 9:10 a.m. **Transfers of New Mexico Water: A Survey of Changes in Place and/or Purpose of Use, 1975-1987**
Susan Christopher Nunn
Economics Department
University of New Mexico

9:10 - 9:30 a.m. **Regional Water Planning**
J. Phelps White III
Interstate Stream Commission

9:30 - 9:50 a.m. **Wildlife and Associated Values of Wetlands**
Charles Ault
U.S. Fish and Wildlife Service

9:50 - 10:10 a.m. **Break**

10:10 - 10:30 a.m. **View from the Top**
Governor Garrey Carruthers

10:30 - 10:40 a.m. **EID's First Annual Ground Water Quality Awards**

10:40 - Noon **Planning by Local Governments: A Panel Discussion**

William F. Brainerd
Mayor of Roswell

Bob Forrest
Mayor of Carlsbad

Wendell Chino
President of
Mescalero Apache Tribe

Frank Potter
City Manager of Ruidoso

Max Clampitt
Mayor of Hobbs

Ernest Thompson
Mayor of Artesia

EID FIRST ANNUAL GROUND WATER QUALITY AWARDS ANNOUNCED

At the 34th Annual New Mexico Water Conference, the New Mexico Health and Environment Department's Environmental Improvement Division awarded its first annual Ground Water Quality Awards to three businesses that have shown excellence in their efforts to protect ground water. The three organizations were Romig Dairy, Browood Homeowners' Association, and the City of Albuquerque's Double Eagle Soil Amendment Facility.

The Romig Dairy north of Las Cruces has been run by B. J. Romig for forty years. Romig has taken actions beyond the EID discharge plan requirements for dairies by upgrading his disposal facility and has maintained a good record fulfilling the self-monitoring requirements of the discharge plan.

The water used to wash Romig's 300 cows twice daily is pumped into two holding ponds where the manure is allowed to settle before the remaining water is siphoned into a larger pond. After the manure dries in the holding ponds, it is spread as fertilizer in nearby fields. The waste water also is recycled for irrigation after it is diluted.

The Browood Homeowners' Association in Pueblo Los Cerros near Corrales operates a 50,000 gallons-per-day domestic waste-water treatment facility. The treated effluent is chlorinated to kill pathogens and used to spray irrigate landscapes in the subdivision with no ground water quality degradation. The effluent quality is tested monthly and two wells nearby are tested twice annually to determine any ground-water impacts.

The Double Eagle Soil Facility handles approximately 30 tons of treated sludge per day from Albuquerque's southside waste-water treatment plant at its 700-acre site. According to EID, the facility's excellent location and professional management ensure continual ground-water protection efforts.

David Brosman, assistant director of Albuquerque's Public Works Department says the site is "just a good application site" not only because it is remote, but also because there is no off-site drainage, it is 1200 feet above ground water and has "excellent geological characteristics."

The Double Eagle Facility began Phase I of its operations two years ago with an investment of approximately $5 million by the city to build roads and obtain power as well as build the facility. Although now the facility is only a depository for anaerobically digested sludge, Phase II of its operations will turn the sludge into environmentally approved compost.

David Brosman from the City of Albuquerque's Public Works Department, B. J. Romig of Romig Dairy Farm, and Nancy O'Neal from the Browood Homeowners' Association listen as Governor Garrey Carruthers announces the EID's First Annual Ground Water Quality Awards.

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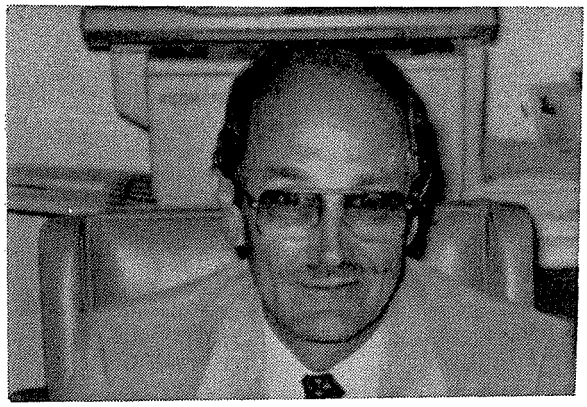
MODERATORS

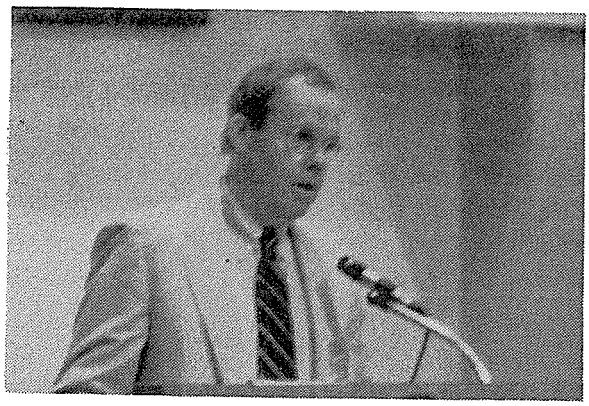
Charlotte B. Crossland *is a special assistant attorney general for the State Engineer Office and the Interstate Stream Commission. She is the author of " 'Breach' of an Interstate Water Compact: Texas v. New Mexico," which appeared in the Natural Resources Journal. She worked on the Jemez, Aamodt, and Mescalero adjudications and is currently working on the Taos adjudication. Before attending the University of New Mexico School of Law, she was an archaeologist for the U.S. Fish & Wildlife Service and the Corps of Engineers. She taught anthropology at Oregon State University and the University of New Mexico. Crossland received her J.D. with Natural Resources Certificate in May 1989.*

Ron Cummings *is chairman of the Department of Economics at the University of New Mexico. He is an Eminent Scholar in the New Mexico Eminent Scholars Program and is a member of the Economic Development and Tourism Board for the State of New Mexico. Cummings has served as the director of the Natural Resource Economics Program at UNM and has held many editorial, consulting, and advisory appointments in a variety of natural resources areas, including member of the Program Development and Review Board for the Water Resources Research Institute. He received his bachelor's and master's degrees from the University of Missouri and his doctorate from the University of Kansas.*



George William Sherk *is a trial attorney with the Land and Natural Resources Division, U.S. Department of Justice, specializing in water law. Before taking that position in 1983, he was a special assistant in the Office of Water Policy. Previously, he was staff associate with the National Conference of State Legislatures where he worked with 24 states regarding state legislation affecting water and alternative energy development. The Missouri native holds a bachelor's and a master's in political science (natural resources administration) from Colorado State University. He received his J.D. from the University of Denver College of Law.*

Peter T. White, general counsel for the State Engineer Office since 1983, has worked for that office since 1969 in the capacity of special assistant attorney general. He received a B.A. from The University of New Mexico with majors in government and philosophy and a J.D. from the UNM School of Law.



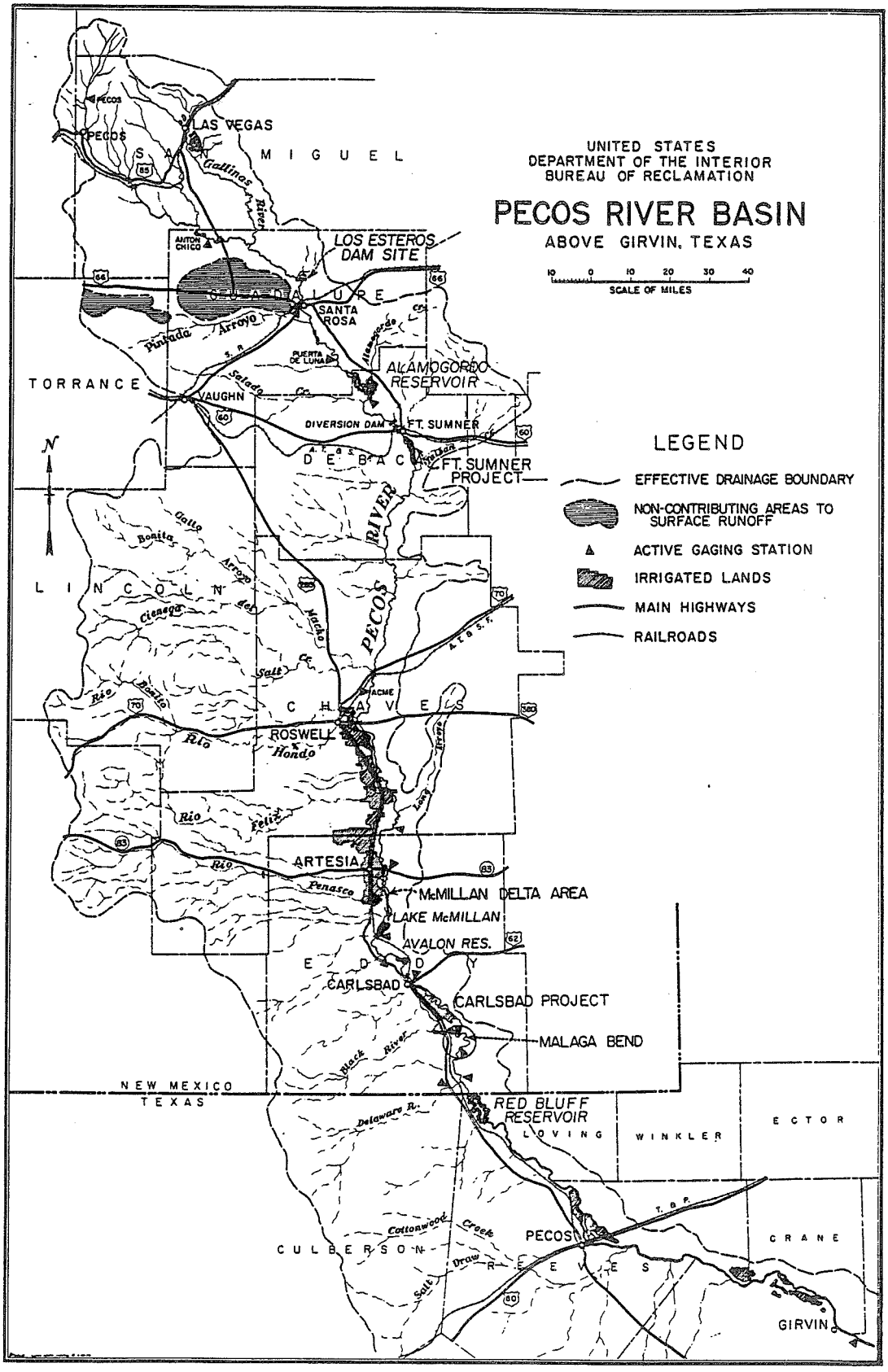
UPDATE ON THE PECOS RIVER ADJUDICATION

Peter T. White
General Counsel
New Mexico State Engineer Office
Bataan Memorial Building, Room 101
Santa Fe, New Mexico 87503

The Pecos River adjudication suit is one of the most important water right cases in New Mexico. It has been pending in the Chaves County District Court for 33 years and is the oldest and longest pending water case in New Mexico. Eighteen New Mexico Supreme Court opinions have been issued on appeals in the case and four appeals are now pending in the New Mexico Court of Appeals. Ultimately, the court will adjudicate the water right claims of over 6,000 defendants for the irrigation of approximately 190,000 acres. Cases recently filed in other western states have more claimants, but few cases equal the Pecos River adjudication suit in the difficult questions that have been or will have to be decided. To describe the status of this case, it is necessary to give some information on water supply and use in the Pecos River Basin and the proceedings in the case from its filing in 1956 to the present.

PECOS RIVER WATER SUPPLY

The Pecos River is the second longest river in New Mexico. It is 435 miles long and has a drainage area of 20,000 square miles. (PRJI:1) Rainfall in the basin ranges from 34 inches in the headwaters to 11 inches near the state line. (PRJI:12) Approximately 4 percent of the precipitation becomes stream run-off. The Pecos River Basin is divided into three areas: The upper basin from the headwaters to Sumner Dam (formerly Alamogordo), the middle basin from Sumner Dam to the New Mexico-Texas state line, and the lower basin from the state line to the Pecos River's confluence with the Rio Grande (see map of the Pecos River Basin). In the upper basin, 30 percent of the flow below Sumner Dam is made up of thunderstorm runoff. (Slingerland) In the middle basin, flood inflow constitutes 60 percent of stream flow. (PRJI:12) The flow of the Pecos River is extremely variable. The main river flow available for irrigation is largely made up of erratic flood inflow and, in the absence of these inflows, the river's base flow is lost and reestablished many times in the length of the stream. (PRJI:12) During the period 1950 through 1983, precipitation in the Pecos River Basin declined approximately 25 percent and the flows have become less predictable and more variable.


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PECOS RIVER BASIN
ABOVE GIRVIN, TEXAS
SCALE OF MILES
LEGEND
EFFECTIVE DRAINAGE BOUNDARY
NON-CONTRIBUTING AREAS TO SURFACE RUNOFF
ACTIVE GAGING STATION
IRRIGATED LANDS
MAIN HIGHWAYS
RAILROADS
LAS VEGAS
PECOS
SAN MIGUEL
Gallinas River
LOS ESTEROS DAM SITE
GUADALUPE
SANTA ROSA
Pintada Arroyo
ALAMOGORDO RESERVOIR
TORRANCE
VAUGHN
DIVERSION DAM
FT. SUMNER
FT. SUMNER PROJECT
DE BACA
PECOS RIVER
LINCOLN
Bonita Arroyo
Cienega
Salt Cr.
ROSWELL
CHAVES
Rio Hondo
Rio Feliz
ARTESIA
Penasco
McMILLAN DELTA AREA
LAKE McMILLAN
AVALON RES.
EDDY
CARLSBAD
CARLSBAD PROJECT
MALAGA BEND
Black River
NEW MEXICO
TEXAS
RED BLUFF RESERVOIR
Delaware R.
LOVING
WINKLER
ECTOR
CULBERSON
Cottonwood Creek
Salt Draw
PECOS
REEVES
CRANE
GIRVIN

Water quality deteriorates as the water flows downstream. The salinity of water at Santa Rosa is less than 1 ton per acre-foot of water. At the state line, it is 7 tons per acre-foot. The brine aquifer at Malaga Bend, just above the state line, discharges 170 to 210 tons of salt per acre-foot of water and contributes 120,000 tons of salt per year to the Texas water supply. The quality of water at the state line is not good except in years with high flood flows. At Girvin, Texas, below the irrigated area in Texas, the river carries 15 tons of salt per acre-foot. (PRJI:15--16; Sen.Doc. 109:4.)

PECOS RIVER WATER USE

In the upper basin, approximately 14,700 acres were irrigated in 1940. (PRJI:17; Sen.Doc. 109:2.) The only significant new water use after United States sovereignty was the Storrie Project on the Gallinas River. This project was initiated in 1909 and irrigates approximately 4,900 acres. The use of water in the upper basin has declined since 1940. Only about 9,000 acres were irrigated in 1988. (PRJI:1; PRC:79; Grigg)

In the middle basin, the first significant irrigation project on the mainstream Pecos River involved the construction of canals in 1887 and 1888 to irrigate lands at Carlsbad. At the time the United States Bureau of Reclamation acquired ownership of the Carlsbad Project in 1906, there were approximately 13,000 irrigated acres. The project acreage increased to 25,000 acres in 1926. The canal system is administered by the Carlsbad Irrigation District. The Ft. Sumner Project also takes water from the Pecos River mainstream. Its canal system was constructed in 1906 and irrigates approximately 6,500 acres within the Ft. Sumner Irrigation District. (PRJI:2; PRC:98.)

In the Roswell basin, the first irrigation uses were made in the 1870s and 1880s with ditches constructed to divert water from spring-fed streams tributary to the Pecos River. The first artesian well was drilled in 1891. (PRJI:2; PRC:98.) It has been estimated that the contribution to the surface water of the river from the artesian area prior to the drilling of wells was 325 cubic feet per second for about 235,000 acre-feet per year. (Sen.Doc. 109:3.) In 1931, the state engineer declared the Roswell artesian basin and closed it to future water appropriations and in 1937, the Roswell shallow basin was closed to future appropriations. In 1940, approximately 100,000 acres were irrigated with ground water in the Roswell basin. By 1946, ground water discharge from the Roswell basin declined to approximately 50,000 acre-feet per year. (PRJI:15.) In 1950, the state engineer estimated that almost 10 percent of the irrigated acreage in the basin was watered illegally. (Bliss)

ADJUDICATION PROCEEDINGS

In 1956, the state of New Mexico, acting through the state engineer, and the Pecos Valley Artesian Conservancy District filed a petition with the Chaves County District Court to determine and define water rights in the Roswell basin and to enjoin all illegal use of water. The petition also alleged that there were large quantities of water being diverted over and above the amounts required for properly irrigating the defendants' lands. This adjudication suit is commonly referred to as the Lewis case because the first-named defendant in the petition is L.T. Lewis.

In 1958, the state and the district filed a second petition requesting the court to adjudicate the surface and underground water rights of lands irrigated from the Hagerman Canal. In 1965, the court granted the request of the state and the district to consolidate the Lewis case and the Hagerman Canal case. The motion in support of this request stated that a common adjudication of all water rights to divert from the same source is essential in order to have a common administration of rights.

Before the two cases were consolidated, the court had adjudicated in the Lewis and Hagerman Canal cases 130,460 acres with ground-water rights, including 14,500 acres of rights supplemented by surface water. Water rights for 1,724 irrigation wells were adjudicated. Approximately 12,200 acres were dried up through the adjudication. (Hennighausen) Of the 9,026 acres of rights under the Hagerman Canal, about 5,000 acres were also served by individual wells. There were also about 2,600 acres with ground-water rights not served by the canal.

In 1966, the court entered a Partial Final Judgment and Decree. The decree confirmed and approved all orders adjudicating individual water rights. It also ordered the water users to install water meters on their wells and to make annual reports to the water master of the total amount of water diverted from each well. The decree provided that the annual duty of water, that is, the amount of water delivered to the farm on a per acre basis, could be exceeded in any one year provided that the total amount of water diverted during any period of five consecutive years did not exceed five times the

annual duty. The decree ordered the state engineer to appoint a water master, subject to court approval, and it ordered the district to reimburse the state engineer for water master expenses.

Prior to the entry of the Partial Final Judgment and Decree, the court denied two significant motions. The first motion requested the court to modify the reports of the special master so that no specific duty of water be designated. This motion was denied, and no appeal was taken. The second motion requested the court to reopen the adjudication orders so that evidence could be offered to show that the priorities of ground-water rights relate back in time to earlier surface water appropriations. The motion to reopen priorities was denied and an appeal was filed. The New Mexico Supreme Court ruled that the water right claimants should have been given an opportunity to establish the applicability of the relation back doctrine in showing priorities based upon the original appropriation of water from the same source as their wells. The court stated that the application of different standards in determining the relative priorities is "patently unfair and improper." (1967 Opinion)

Three years after the entry of the Partial Final Judgment and Decree, the Pecos Valley Artesian Conservancy District, acting in a representative capacity for all water right owners in the Roswell basin, requested the court to permit it to present evidence to establish a proper duty of water. It claimed in the motion that the 3 acre-foot duty was not adequate for successful farming operations in the basin and that the farmers have historically used in excess of 3 acre-feet. In the district's amended motion, it alleged that the adjudicated duty of water failed to consider and provide for carriage losses from the well to the place of beneficial use on the land.

In 1970, after an eleven-day trial, the district court found that the duty of water should be determined by the amount of water delivered on the land and that there should be added to the duty an amount of water to compensate for carriage loss from the well to the point of delivery on the land. The court found that the average carriage loss was 15 percent. On appeal, the New Mexico Supreme Court affirmed the district court's decision. (1973 Opinion)

In 1973, the state and the district requested permission from the court to file a consolidated petition for the adjudication of water rights in the Hondo River system. The petition alleged that the Hondo River is a major source of water for the recharge of the Roswell basin and that new appropriations from the Hondo River will adversely affect the water rights that have been adjudicated in the Roswell Basin. After the court granted the request in 1974, the state and the district obtained a temporary restraining order against the United States preventing it from diverting water from the Rio Ruidoso, a tributary of the Hondo River, for use on the Mescalero Apache Reservation. The United States asked the court to dismiss it as a party to the Hondo River adjudication proceedings based on its sovereign immunity from suit. The United States was dismissed, and the state and the district appealed.

The New Mexico Supreme Court ruled that the federal reserved water rights for the Mescalero Apache Reservation were held in trust by the United States as legal owner for the Indian beneficiaries. The court held that the state district court had jurisdiction to adjudicate the United States' reserved rights based on the 1952 McCarran Amendment. (1976 Opinion)

The Mescalero Apache Tribe intervened in the case in 1977. The district court heard evidence on the tribe's water right claims in 1986 and 1987 and entered a final judgment on the tribe's rights in July 1989. The court adjudicated to the tribe a right to divert 2,322 acre-feet per year for existing uses and future needs for domestic, recreational, and other nonagricultural uses on the reservation. The priorities for its rights are based on the dates of executive order reservations for the tribe. The earliest priority is 1873. The United States and the tribe have appealed the court's judgment. They have also challenged non-Indian claims for priorities before 1873.

In 1976, the Carlsbad Irrigation District requested the state engineer to administer the waters of the Pecos River pursuant to the doctrine of prior appropriation. Counsel for the state engineer concluded that the only way to facilitate priority administration of the Pecos River was to adjudicate in one case the interrelated rights to the use of surface and underground waters. The state therefore requested permission to file a supplemental complaint to adjudicate all water rights within the Pecos River Basin. The request was granted in 1978.

In 1982, the court granted the state's amended motion for interim decree on priorities affecting the Carlsbad Project. The court ordered that water users with priorities junior to January 1, 1947, may be enjoined under the constitutional provision that priority of appropriation shall give the better right. (N.M. Const. Art. XVI §2) The court issued this order subject to: (1) the right of each user to con-

test *inter se* the rights adjudicated for the Carlsbad Project and (2) the right of each user to establish in law or equity that his use of water should not be terminated to satisfy the senior right or rights for the Carlsbad Project.

The state offered evidence in support of the amended motion showing that as of 1982, the natural discharge of water from the Roswell basin to the Pecos River averaged a little less than 30 cubic feet per second for about 20,000 acre-feet per year and that the base flow of the Pecos River under the 1947 condition averaged 46,700 acre-feet per year. (Transcript (Tr.):69, 74) There was 19,100 acres with irrigation water rights in the Roswell basin with ground-water priorities after 1946. Within the Pecos River Basin, there was an estimated 26,900 acres with priorities after 1946. (Tr.94) Testimony was offered that it would be reasonable to cut off rights having priorities later than 1946 in order to begin to satisfy the senior rights for the Carlsbad Project with a margin of error. (Tr.109)

The district appealed the court's order. The district claimed that the procedure adopted by the court would violate due process because there can be no administration of junior rights as against senior rights until the court enters a comprehensive decree fixing all priorities. The New Mexico Supreme Court upheld the district court's order and ruled that there is nothing in the adjudication statute that precludes administration of water rights prior to the filing of a final decree. (1983 Opinion)

In order to administer water rights in the Pecos River Basin in accordance with the doctrine of prior appropriation, the state is serving owners of ground-water rights having priorities after 1946 with orders to show cause. The orders provide owners with an opportunity to establish an earlier priority date by relating their ground-water right to a prior surface water appropriation. The district court has entered final orders adjudicating post-1946 priorities for approximately 3,000 acres within the Roswell basin. There are two appeals pending in the New Mexico Court of Appeals from final orders. The principal issue addressed by the district court in these show cause proceedings is whether the water right owner must and can show that the appropriation of ground water recaptured water that had been a source of supply for a prior surface water appropriation, and that the surface water supply was diminished due to pumping of the contributing aquifer by junior appropriators.

CONCLUSION

In the Pecos River adjudication suit, significant legal and hydrological questions have been decided or are being tried by the New Mexico district and appellate courts. The answers to these questions will have far-reaching effects for the rest of New Mexico in the adjudication of Indian and non-Indian water rights and the enforcement of prior rights in hydrologically related surface and ground-water systems.

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N.M. Const. Art. XVI §2.

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84 N.M. 768, 508 P.2d 577 (1973)
88 N.M. 636, 545 P.2d 1014 (1976)
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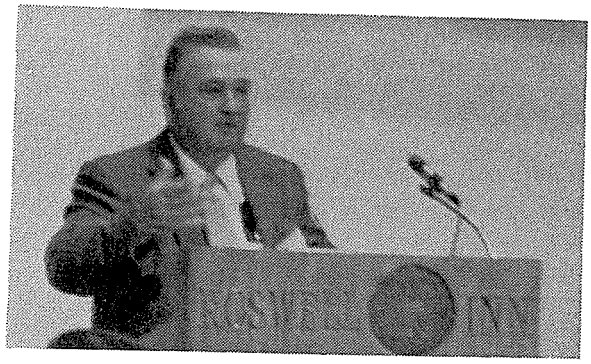
Jake West, farmer and Pecos Valley native, recently retired after thirty years with the Agricultural Stabilization and Conservation Service. He served as director of the Fort Sumner Irrigation District for eight years. West was president of the Rotary Club and is active in both the Rotary Club and Chamber of Commerce.



FORT SUMNER IRRIGATION DISTRICT

Jake West
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During my 30 years with the Agricultural Stabilization and Conservation Service (ASCS), we had very good cooperation with the farmers in the Fort Sumner Irrigation District (FSID). The farmers used the Agricultural Conservation Program, a cost share program, to level land, put in irrigation lined ditches, underground pipes, and metal gates. All these practices were performed to conserve the water and protect the soil from erosion and, of course, cut down on pollution. Some of the work accomplishments made in the district include:

1) approximately 90 percent of all fields in the district have been bench leveled and most of them leveled on a two-tenths fall per 100 feet slope
2) concrete ditches and laterals have been lined with help from the Bureau of Reclamation
3) nearly 110,000 feet of canals have been lined
4) farmers, on their own or with the help of the ASCS, lined 255,000 feet of field ditches
5) fifty-nine thousand feet of underground irrigation pipelines were installed

Approximately 35,000 feet of unlined ditches remain and six miles of the main canal have not been lined.

The Fort Sumner project is located in De Baca County on the east side of the river. It is served by a concrete diversion dam with necessary canals and laterals. The Fort Sumner Irrigation District includes 10,000 acres of which 6,500 acres are classified as arable. Some of the project lands were first put under irrigation by the military as early as 1863. The Mescalero Apaches and the Navajos were brought by Kit Carson to the Bosque Redondo Indian Reservation. The main canal we use today was dug with pick and shovel by the Indians. In 1868, a treaty was signed allowing the Indians to go back to their present reservations. At that same time, Lucien B. Maxwell, the land baron of the Maxwell land grant in northern New Mexico, sold the grant and moved to Fort Sumner bringing 35 families with him. He set up his headquarters at the old military post. Some of the land owned by those families have been irrigated continually through the years. The remaining land owned by the Maxwell families sold in 1981.

The Fort Sumner Irrigation District was formed in 1919 to purchase the works from the original development company. The water rights called for all flow of the Pecos River up to 100 cubic feet-per-second (cfs) during the irrigation season, March 1 through October 31, plus two short winter runs, thus providing a diversion of 3.36 acre-feet per acre in normal seasons for the 6,500 irrigable land.

Water was diverted from the river by temporary brush and dirt dams until 1934. The district then rehabilitated and built a concrete diversion dam. Portions of this dam washed out in the flood of 1941. I remember hauling brush and helping to fill in the dam with brush and dirt. In 1946, the Bureau of Reclamation came in, did a study, and obtained $60,000 from the legislature to make emergency repairs in case of failure. On July 29, 1949, the 81st Congress passed Public Law 192 giving the Secretary of Interior authority to rehabilitate the Fort Sumner Irrigation District.

The project's water supply is obtained by direct diversion of the natural flows from the Pecos River. The diversion is accomplished through a dam located 3 miles northwest of Fort Sumner, and the runoff from 4,950 square miles of drainage area above the diversion dam averaging about 47,000 acre-feet per annum. There are no storage facilities on the project.

Irrigation is the project's only purpose. The project was rehabilitated in 1950 and 1951 with the construction of a new diversion dam, concrete lining of 2 7/10 miles of the main canal and 8 miles of the highline canal. A new hydraulic turbine pumping plant that lifted 20 cfs from the main canal to the highline canal was constructed. All the ditches and drains were cleaned. Drainage areas were also extended. When I was a kid, a lot of the land couldn't be farmed due to subbing caused by the poor drainage system. The problem happened every year. I think all irrigation projects throughout the history of mankind have failed at some point on account of the salt buildup. About ten years ago, the Soil Conservation Service through the RC&D project with the help of the State Engineer and Four Corners, concrete lined four miles of the main canal in the lower end of the project.

The major crops produced in the district currently are alfalfa, wheat, corn, oats, milo, fruits, vegetables, and nuts. Livestock are also raised. Construction began on Sumner Dam in 1935 and was completed in 1937. It was thought to take 17 years to fill the dam. As chance would have it, they had a flood right away and I think the dam was filled in about 17 days. The flood nearly washed the dam away. I remember visiting the site of Sumner Dam in 1935 with my dad. All that was there were 55-gallon barrels and two 2x12 lumber on top for walkways across the river. My dad also took us to Roswell once to see an artesian well that was flowing 2500 gallons of water a minute. We sure wished we had that on our farm.

Building Sumner Dam has helped our district in a number of ways. The water is measured at Puerto de Luna, the measuring station located north of Sumner Dam, and then released in an average flow for the next two weeks. That provides a constant flow, whereas before, the amount released was up and down depending on whatever the river was producing. River water upstream from Santa Rosa Dam tests 9 parts salt per million. Springs below Santa Rosa Dam produce approximately 44 cubic feet per second and test 1900 parts per million.

The major disadvantage is silt from Sumner Lake when water is low and Carlsbad Irrigation District makes a release. Silt has filled our Diversion Dam and is a real problem in canals, laterals, and farm ditches. Several times the Fort Sumner Irrigation District has had to discontinue our release of irrigation water until the silt situation has cleared up.

I looked in the Encyclopedia Britannica and water was defined as "a disc-chemical compound having the form H_20, is one of the most abundant widely distributed and essential substance on the surface of the earth. It occurs in nature in solid, liquid, and gaseous states of ice, snow, water and steam or water vapor, respectively. Water is a necessary constituent in the cells of all animal and vegetable tissues and in many crystals or minerals."

Tom W. Davis has been manager of the Carlsbad Irrigation District for four years. Prior to joining CID he worked for the U.S. Forest Service for 15 years. He holds a B.S. from Oklahoma State University. At the 33rd Annual New Mexico Water Conference, he took part in a panel discussion concerning special interests in the water planning process.

CARLSBAD IRRIGATION DISTRICT

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First, I would like to thank the WRRI Advisory Committee, Tom Bahr, and Bobby Creel for having this meeting down in our corner of the state. Normally, we go to Santa Fe for the annual meeting. I think this meeting is good exposure for those of us in the water business, the farmers, and other water users in this part of the state. I hope we set a trend in having this annual meeting in different areas of the state each year. Hopefully all of you are enjoying the beautiful fall weather we are having in the lower Pecos Valley. This morning I will give you a briefing on the Carlsbad Irrigation District (CID), some important dates, and some of our future goals for the project.

Carlsbad Irrigation District actually began as one person's idea, the brain child of Charles Eddy, an original pioneer in southeastern New Mexico. A pioneer turned promoter, Eddy eventually promoted several projects in New Mexico and Colorado. I think he promoted a couple of railroad projects in New Mexico and some mining ventures in Colorado.

His first promotion was the Carlsbad Irrigation District, which at that time was called the Pecos Valley Land and Improvement Company. Originally, Eddy's concept was to secure public domain land by homesteading; provide a secure water supply by damming the Pecos River; construct canals and irrigation ditches to deliver water to the farm lands; promote the area's farming opportunities in the eastern United States and in Europe; and to guarantee the protection of water rights for homesteaders.

The original concept had a lot of support in the territory of New Mexico because it would bolster the chances of statehood and encourage settlement of the lower Pecos Valley. The original concept took in the area from just above Roswell all the way to the state line. I have the original survey in the CID office in Carlsbad. It is really an interesting survey. It covers about five miles on either side of the Pecos River, all the way from above Roswell to the state line, and it was all done by hand including all of the lettering. Eddy commissioned this survey in the mid-1880s.

The first area Eddy selected for this promotional development was about where Lakewood is today, which is about where the old McMillan Reservoir is located. The area selected went from Lakewood all the way to the state line. It turned out to be the only area ever developed due to lack of financing and other problems.

Investment capital shortages seemed to be Eddy's major problem. Eddy generally solicited money from eastern investors to begin this project. Those of you from Carlsbad will recognize many of the names of these investors because so many of the streets in Carlsbad are named for these people: Arthur Mermod, James McKay, Charles Greene, Edgar Bronson, and probably the best known, James

Hagerman. Hagerman was probably the stoutest investor involved in the project. He eventually went on to develop his own irrigation project, the Hagerman Canal.

McMillan and Avalon dams were built in the mid-1880s. The townsites of Carlsbad, Otis, Loving and Malaga were laid out, although at the time they were laid out and surveyed, they were called by different names. Carlsbad, for instance, was called Eddy. The towns have all survived today. Canals were built; farms were established; the operation looked like it was going to be a success. However, the Pecos River is known for its devastating floods. Avalon and McMillan dams were washed out a couple of times by 1903. The flume that carries the canal across the Pecos River just above Carlsbad was washed out. The cost of rebuilding drained the capital the company had available for continued development.

The Pecos Valley Land and Improvement Company soon was sold, reorganized, and became the Pecos Improvement Company. That company was soon reorganized to the Pecos Water Users Association.

By the turn of the century, Charles Eddy had moved on to promote other things. I think his next venture was the building of the railroad from Carrizozo down through Orogrande to El Paso. Hagerman was broke and things looked pretty tough for the Pecos Waterusers Association.

In 1902, federal legislation was passed to assist in developing the West. That legislation lead to the organization of the Bureau of Reclamation, and immediately the water users involved in the Carlsbad area saw the chance to get some federal assistance.

Negotiations started in 1905 and were completed in 1907. The Bureau of Reclamation bought out the water users in the Carlsbad area. The water users assigned their water rights to the Bureau of Reclamation. The bureau came in with engineering practices that were state of the art with all of the financing backed by the taxpayers in the United States. The Reclamation Service rebuilt McMillan Dam, Avalon Dam, the flume, and upgraded and rebuilt many of the laterals and canal systems that delivered water to the farms. In other words, the Reclamation Service really shored up the project. The project was established with 48,000 acres of land within its boundaries containing 25,055 acres of water rights. The project was well on its way to being a productive venture.

In 1933, the Hope Decree established the priority dates of 1887-1888 for water rights for theirrigation of the project, and established that the water rights are owned by the United States.

In 1938, the water users within the project contracted with the Bureau of Reclamation to operate and maintain the project. Up until that time, the Bureau of Reclamation actually ran day-to-day operations of the project. At that point, the Carlsbad Irrigation District was formed.

Fort Sumner Dam was constructed in the mid-1930s. The CID condemned and subsequently purchased the land on which the reservoir and the dam site. This land was then deeded to the federal government as an enticement for the government to build the dam. The dam was financed and built by the federal government under a repayment contract by the Carlsbad Irrigation District. The construction cost of Fort Sumner was repaid in full by the water users of the Carlsbad Irrigation District in 1987.

The Pecos River Compact was signed between Texas and New Mexico in 1947. This compact provided for setting a diversion in acre-feet to be enjoyed by the Carlsbad Irrigation District and setting priority dates on the water. The interpretation and compliance of this compact was actually the core of the recent *Texas v. New Mexico* lawsuit. There are many litigation matters Carlsbad Irrigation District has and is currently involved in to protect its water rights.

Santa Rosa Dam was completed in the mid-1970s. As required by the Pecos River Compact, some of Carlsbad Irrigation District's storage rights were moved to Santa Rosa at that time so water could be stored in Santa Rosa. Along came Brantley Dam, authorized in the 1970s and completed this year. Brantley Dam is on line to replace the water storage of McMillan Dam. Consequently, there is no longer a McMillan Reservoir; that storage is authorized to be stored at Brantley.

The Carlsbad Irrigation District is authorized by state engineer orders to store 176,500 acre-feet of water in four reservoirs: Avalon, Brantley, Fort Sumner, and Santa Rosa. Today, Carlsbad Irrigation District irrigates 25,055 acres of land when the water is available and serves in excess of 500 families. We are still at the mercy of the undependable water supply of the Pecos River. Even though we have an adequate storage authorization, even though we have four reservoirs in which we can store water, there are still many, many years during which we are unable to deliver 3 acre-feet to the farms. Fortunately, during the last five years, we have been able to deliver 3 acre-feet each year to the farms because of good rainfall. Next year looks like an entirely different picture. The water is not there

and unless some heavy rains occur in the Pecos drainage, the water is not going to be in storage for next year.

The project is restricted in the variety of crops that can be grown because of the high salt content of the water and the alkali buildup in the soil. Sometimes, the water is as high as 3,500 ppm of salt content. Basically, we are 60% alfalfa hay, 30% cotton, pecans, small grains, and some permanent pasture, and truck farming makes up the balance. In 1988, the total market value of crops produced from the project exceeded $11 million.

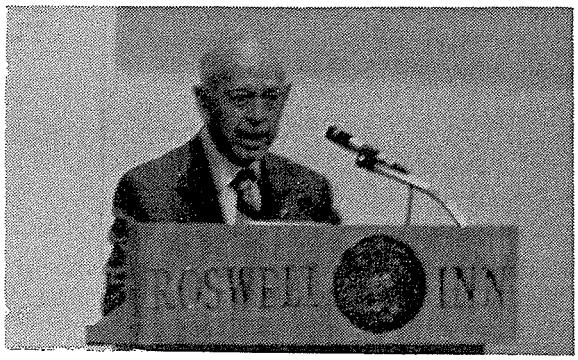
The Carlsbad Irrigation District has just signed a contract with the Bureau of Reclamation to assume the operation and maintenance of Fort Sumner Dam, Brantley Dam, and the Water Salvage Project. The Water Salvage Project involves the clearing of salt cedar along the Pecos River from just below Santa Rosa, New Mexico, down the river to just below Pecos, Texas. Up to now, these projects have been carried out with government financing and federal employees. The new concept involves the federal government contracting with the Carlsbad Irrigation District to do these jobs, which we feel we can do cheaper, resulting in lower costs to the taxpayer. Those of you in the Pecos Valley are going to see more and more Carlsbad Irrigation District employees along the lower Pecos River, either in salt cedar clearing or the operation and maintenance of the reservoirs.

The future goals of the Carlsbad Irrigation District are to meet our financial obligations and to repay our lenders. The Carlsbad Irrigation District has repaid all of its obligations to the federal government except the repayment obligations on a portion of Brantley Dam's construction costs. That repayment obligation goes into effect this year. Other goals include maintaining our existing structures so we can make adequate deliveries to the farms, keeping assessments to the farmers as low as possible, and keeping water rights for the citizens and farmers in the Carlsbad area.

It goes without saying, the overriding priority is to make the most efficient use of the water possible. We have been doing several things to continue to promote and implement new ideas to make efficient use of the available water.

Carlsbad Irrigation District has been faced with numerous challenges in the past. I am sure we will be facing more in the future. We have always been able to deal with these through the support we receive from our water users, local governments, elected officials, and state government. A good example of this is that just in the past year, CID was obligated by the Bureau of Reclamation to replace the needle valves that make the releases from Fort Sumner Reservoir with hydraulic gate valves. This cost the district somewhere close to $350,000. The legislators in the last session were generous enough to appropriate money to the district to cover those costs because of the public benefit received by the existence of Fort Sumner Dam. We have always been supported by elected officials and local people and I am optimistic this will continue into the future. I am very optimistic about the future of both the irrigation project and the Carlsbad area becoming more diversified and that this diversification will result in a more secure future.

John F. Russell has served as legal counsel for the Pecos Valley Artesian Conservancy District since 1951. He has been the New Mexico representative to the Western States Water Council and legal counsel to the New Mexico representative on the Pecos River Compact Commission. Russell also was president of the Chaves County Bar Association and a member of the New Mexico Supreme Court Disciplinary Board. He received a B.S. in economics from the Wharton School of the University of Pennsylvania and received his L.L.B. from the Colorado University School of Law.



WATER CONSERVATION IN THE PECOS VALLEY ARTESIAN CONSERVANCY DISTRICT

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The New Mexico Surface Water Code covering the use and administration of surface waters was adopted in 1907. It was not until later that laws governing the use and administration of the state's ground waters were enacted. This lapse of time was due mainly to the fact that not much was known about the ground-water supplies of the state. Another factor was the development of pumping systems technology, which enabled the large-scale production from the ground-water supply. Initially, settlers took water from the surface streams bordering their land. The water could be ditched to their land and provided for inexpensive irrigation. When the surface sources diminished or were fully appropriated, the settlers turned to the underground source, which was a more costly method for bringing water to the surface.

The artesian aquifer of the Roswell basin is overlain by a leaky confining bed, which in turn is overlain by an alluvial water-table aquifer. The water-table aquifer is hydraulically connected to the Pecos River. Permeable zones in the artesian aquifer are generally controlled by lithologic changes in the San Andres Limestone and Grayberg Formation and by fractures in the rock. The confining bed is composed of slightly to moderately permeable rocks. The shallow aquifer is composed of permeable beds of sand and gravel.

In the Roswell basin, water recharges the artesian-aquifer system principally by infiltration from precipitation, by runoff from streams that flow eastward across the outcrop of the aquifer to the Pecos River, and by subsurface underflow. Some recharge by downward leakage to the artesian aquifer from the shallow aquifer occurs in summer. The principal means of discharge from both aquifers is through wells.

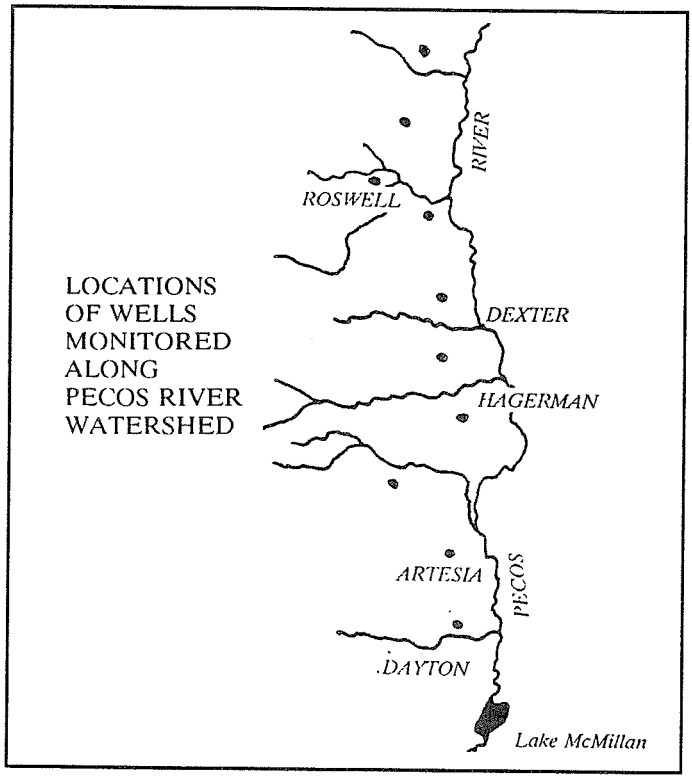
The San Andres Limestone receives its recharge from the rainfall to the west where it is close to or on the surface in its westward reaches. There are areas in the Hondo River in which the San Andres Limestone is in the river bed and the river waters flowing in this area directly recharge the artesian aquifer.

There are areas of saline water to the north and east of Roswell. When drilling and pumping of artesian wells in the Roswell basin reduces the pressure in that area, saline water encroaches on the fresh water.

In the late 1920s, some Roswell businessmen requested the Federal Land Bank to open a branch in Roswell. In a study of the Roswell area, the bankers cited the declining water levels in the Roswell basin as negatively impacting its decision to locate in Roswell. The Roswell businessmen went to the state legislature and were successful in getting

the adoption of the first Underground Water Law in 1931. The Federal Land Bank was again approached. The answer again was no. The bankers stated that a mere statute would not improve the falling water levels. They suggested some entity be created to police water use from the basin. The businessmen returned to the legislature and were successful in getting a statute authorizing the creation of an Artesian Conservancy District. The statutory definition of the district's purpose was to conserve, where necessary, the waters of the artesian aquifer. Following the statutory proceedings, the Pecos Valley Artesian Conservancy District was created. At a later date, the Federal Land Bank did establish a branch in Roswell.

It became obvious that to get the Roswell basin in balance, there had to be stringent control over the use of the basin's waters. Prior to the 1931 law, anybody who wanted to drill a well could do so, no one needed a permit. This resulted in water pressures and levels going down and it was clear something had to be done. The 1931 law only applied to an underground basin, the boundaries of which had been defined by the state engineer. No control existed outside of those areas.



Eventually, the boundaries of the Roswell basin were established with the state engineer presiding over the jurisdiction. Once the basin was declared, no further permits were issued to appropriate water from the artesian source, the deep water in the San Andres Limestone. They continued giving permits in the shallow aquifer, the valley fill overlying the San Andres Limestone. Those permits ceased in 1938.

However, to the north and west of Roswell, people began drilling wells outside the boundaries of the Roswell basin where permits were not required. The response was to extend the boundaries of the basin some four or five times. Subsequently, about 25,000 acres of irrigated land were put in use that never should have been allowed because it overdrafted the Roswell basin. We were, in effect, mining water. We were taking out of the basin more water than was coming in to recharge it. In 1956, a suit was started in District Court of Chaves County. The state engineer and the Pecos Valley Artesian Conservancy District adjudicated all of the underground water rights of the Roswell basin.

Upon motion by the district and state, a duty of water was established for 3 acre-feet per acre per annum with a carriage loss addition of 6 inches per acre per annum. A five-year accounting period was established giving the individuals 15 acre-feet per acre plus the carriage loss. Individuals could use the water in any way they wanted as long as they did not exceed the allotted 15 acre-feet per acre.

Any excess use of an allotted duty of water results in a penalty. A fine is assessed; the amount determined at the discretion of the court. The individual must also repay from the next accounting period, twice the amount of water by which he exceeded his allotment in the prior accounting period.

A complaint is filed against any individual who tampers with his meter to prevent the recording of the actual amount of water being pumped. A hearing is held in District Court and if convicted, the individual is subject to a fine established by the court. The highest fine given so far was $10,000.

The state and district have requested the court include in its order a requirement that all irrigation wells be metered and a court-appointed watermaster monitor the water use. Individuals must purchase and install their initial meters. Repairs and replacement of meters are provided by the district at no cost to the individual. The watermaster crew constantly monitors all meters. When an inoperative

meter is discovered, a radio call is made to the district office reporting the location of the inoperative meter. The district's repair crew is dispatched to the location. A replacement meter is installed if the old cannot be repaired on the spot. The inoperative meter is then taken back to the district's repair shop, repaired and placed in inventory.

The district has paid the watermaster's expenses, since the date of appointment in 1966, totaling $1,754,041. The watermaster's approved budget for 1989-1990 is $153,400.

The district has also expended $417,493 for the purchase of water meters used as replacements on individual wells. Repair parts for meters and wages for repair personnel have totaled $852,409.

In 1958, the district entered into a contract with the Interstate Stream Commission to borrow funds to loan to individual farmers. The funds can be used to develop water conservation projects on their farms. Projects qualifying for these loans include: land leveling, reservoir lining, concrete ditch lining, and sprinkler and drip irrigation systems. These loans are secured by a note and mortgage on the farm. To date, the district has borrowed and loaned to farmers $9,008,145 for these projects.

In addition to the water conservation loan program, the district has purchased water rights from 6,875 acres of irrigated land and placed them in its water bank. None of this acreage has been returned to irrigation. The cost of these purchases was $3,959,627.

The total expenditures by the district and individual farmers for conservation measures in the Roswell basin is $15,991,714. This amounts to nearly $2 million more than the settlement of the Texas suit against New Mexico for under deliveries of water under the Pecos River Compact.

In 1964, the district used five monitoring wells in the basin to determine the effects of its policies on the water levels within the basin. Five additional monitoring wells were installed between 1964 and 1970. The monitoring wells are spaced across the basin from north to south. The data are collected three times a month from the wells and provide a good picture of average water levels in the basin.

The recorded data for the wells in 1975 were compared with 1970 levels (Figure 1). Data indicated that except for a short time in January and February, the water levels were still below the 1970 levels. A further comparison was made for 1988 (Figure 2). The data showed that each month the water levels were higher than 1970 and at the end of 1988, the water level was 14 feet above the 1970 level.

These conservation programs are costly and take a long time to produce results, but they are certainly worth the time and money to improve this valuable natural resource.

The district feels its goals have not yet been fully realized. It is also feels present projects will be continued whenever feasible and further commitments should be made.

Figure 1. Monthly Average Water Level

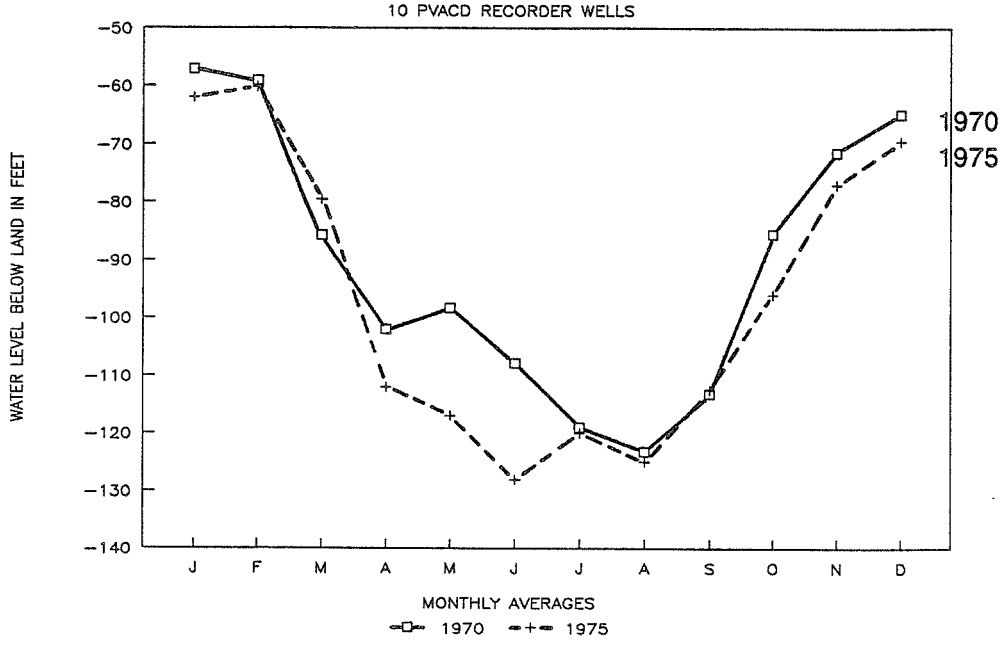
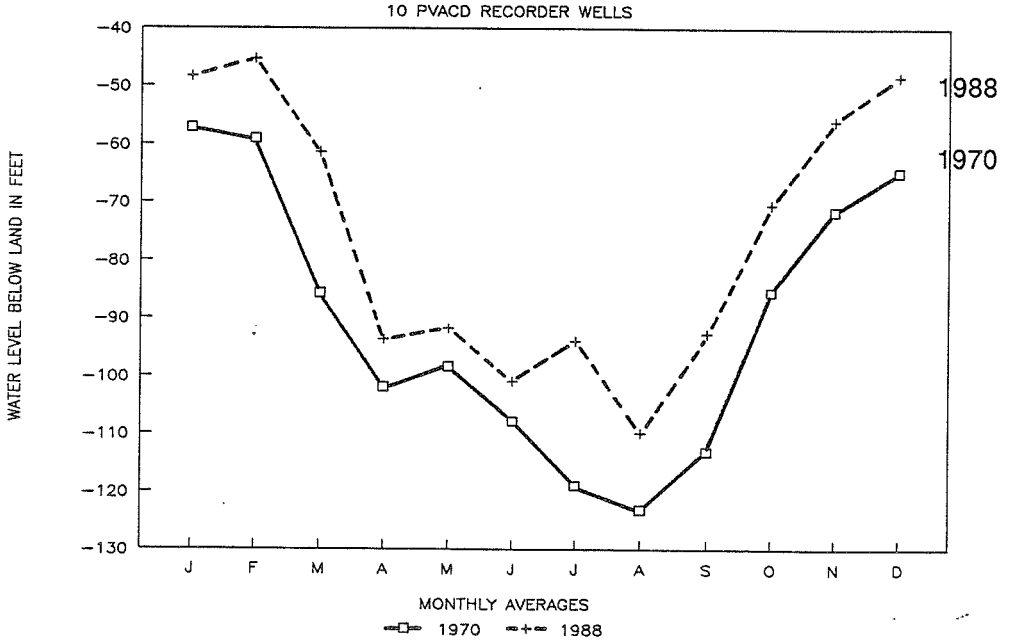
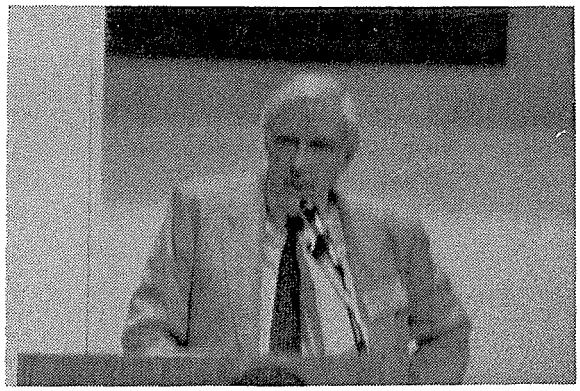


Figure 2. Monthly Average Water Level



Hal Brayman, serves as special advisor to the Senate Budget Committee. Brayman has worked with the Senate for over 20 years, mainly with the Senate Committee on Environmental and Public Works in a number of legislative areas including air, water and solid pollution control, and the federal water resources development program. Prior to working with the Senate, Brayman was a newspaperman for ten years and is a graduate of Princeton University, the Columbia School of Journalism, and the London School of Economics. This is the fifth water conference in which he has participated.



THE COLORFUL HISTORY OF BRANTLEY DAM

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Tom Bahr has asked me to give a talk on what he calls "The Colorful History of Brantley Dam." There certainly is no doubt of the Brantley project's importance----importance for safety, importance for water development, and importance for the future of southeastern New Mexico. And its history certainly is a long one. I will let you judge whether or not that history has been "colorful."

The history of Brantley demonstrates that, ultimately, government works. It is slow at times, but ultimately, it works in the public interest. Brantley's history is a tale of success---success for New Mexico, for the people of Carlsbad and Artesia, and for the Bureau of Reclamation. It is certainly a tribute to men like "Mud" Runnels, Steve Reynolds, Mayor Ernest Thompson of Artesia, former Mayor Walter Gerrells, Mayor Bob Forrest of Carlsbad, and Senator Pete Domenici.

The first thing you need to know about Brantley is that it is a project that predates a young man named Tom Bahr. It predates another young man named Garrey Carruthers. And it even predates the ultimate young fella, Steve Reynolds. It is a project with roots that extend back to a time before New Mexico was a state, before we had a national reclamation law.

Just over a century ago, in 1887, a private company, the Pecos Irrigation & Improvement Company was founded by Sheriff Pat Garrett and others to develop an irrigation system. It was called the Carlsbad Project. That system, which included the construction of Avalon Dam and McMillan Dam, was completed in 1893---not a bad pace by today's standards, which often seem to set delay and inaction as the goal of any water resources project.

It was not very long before we knew we had some problems. In that very first year, Avalon Dam was washed away by floods. And a large segment of the embankment of McMillan Dam had to be blasted away to save the structure. The dams were repaired, but Avalon was destroyed again by flooding in 1904, the same year that a man in his late 20s by the name of George Washington Brantley came to the town then called Eddy.

Although not associated with George Brantley's arrival, the Pecos Company developed financial problems. Early in 1906, the newly formed Pecos Water Users Association entered into a contract with the Reclamation Service to rehabilitate the project. The dams were subsequently rebuilt by November 1907, and the Carlsbad project became one of the earliest projects under the Federal Recla-

mation Act of 1902, one of the great legacies of President Teddy Roosevelt.

However, one of the continuing problems was the accumulation of sediment of McMillan Dam, reducing the dam's effectiveness. So in 1935, another President Roosevelt, Franklin, authorized construction of Alamogordo Dam 250 miles upstream on the Pecos as a way to augment the storage of the Carlsbad project and, in effect, replace some of McMillan.

Not long after the completion of the Alamogordo project, now known as Sumner Lake, floods occurred that exceeded any on record. This forced the federal government to reexamine the criteria used in the design of the spillway of the Alamogordo project. It was found to be seriously inadequate. Thus in 1954, a law was passed to enlarge the spillway of Alamogordo Dam, and it was carried out.

But problems continued downriver. Following a 1964 flood in Montana, the Bureau of Reclamation decided it needed to reexamine a number of dams using new meteorological and hydrologic data. Among the dams studied were McMillan and Avalon. In August 1966, new floods swept down the Pecos, reemphasizing the need for that study. Finally, in 1969, the commissioner of the Bureau of Reclamation concluded that McMillan and Avalon Dams were unsafe and needed to be replaced.

The projects were not unsafe because of structural deficiencies; no big voids existed. They were unsafe because of design. The spillways were inadequate to handle potential runoff. The commissioner determined that a replacement project was needed and justified.

The issue went to Congress, where legislation to build a project in honor of the late George Washington Brantley was finally introduced in 1971. Now, the Senate doesn't mess around. It held a hearing in Washington on January 25, 1972 and passed the Brantley bill two months later, on March 30.

However, the Brantley concept was not applauded universally. A group of 20 irrigators, the Pecos River Pumpers Association, took a position "unalterably opposed" to Brantley unless its members were given ironclad assurances that their irrigation rights were protected.

On April 14, the House Interior Committee visited Carlsbad for a hearing in the Stevens Motel. It was an interesting hearing, historically. Representative Manuel Lujan attended; you've heard of him. So did Representative Runnels, a strong Brantley proponent. Steve Reynolds was there. So were Mayor Thompson and Mayor Gerrells, State Representative Walker Bryan, Chairman Joe Hood of the Eddy County Commissioners, former Representative Tom Morris, Prentiss O'Neal of the Carlsbad Chamber of Commerce and Maynard Shearer of the Artesia Chamber, John Walker of the Pecos River Compact Commission, and Draper Brantley, who, like his father, served as board president of the Carlsbad Irrigation District.

It was a good hearing, an impressive hearing, one focusing on the need for the project and the problems raised by the Pecos Pumpers Association. Steve Reynolds, in his testimony, declared that "the rights of the Pecos River Pumpers and the Carlsbad Irrigation District are adjudicated and fully protected by a federal court decree and by existing law." He went on to say that the new dam was "so urgently needed that the opposition of the Pecos River Pumpers should not be allowed to delay the authorization of the Brantley project."

The Senate, of course, had already passed a bill to construct Brantley. After that hearing on July 19, the Senate passed a totally unrelated Colorado water storage bill, S. 520. When the House took up the Colorado bill on September 27, the House added the Brantley project as Title 2, including language protecting the Pecos Pumpers. The bill passed on a vote of 293 to 64. Relatively quickly, on October 5, 1972, the Senate passed the revised version of S. 520.

It might seem as if things were set. But that was not so. Throughout this period, there had been an issue hanging over the project: How was it to be financed? Was Brantley really a "safety" project to be constructed at federal expense, or was it designed as a backdoor way to obtain a vast increase in irrigation?

The commissioner of the Bureau of Reclamation stated:

> [I]t is proposed that the federal government recognize and accept the responsibility for the safety of McMillan and Avalon Dams and that the costs of the 'Safety of Dams' feature be non-reimbursable.

But there were those in the White House who argued that the project should be held up while the entire issue of unsafe federal structures and cost sharing was reexamined under the Water Resources Council's "Principles and Standards for Planning Water and Related Land Resources."

What would happen? This was October 1972, and a young Albuquerque lawyer was campaigning for the U.S. Senate. He wasn't a Senator yet, merely

a candidate. But as this young lawyer recalled to me earlier this week, Brantley was truly important.

Thus, in October 1972, Candidate Pete Domenici telephoned President Nixon. He told the President of the significance of Brantley, and urged Presidential approval. The President listened to Pete Domenici, and on October 20 signed the bill authorizing the construction of Brantley Dam at a cost of $45,605,000. It became Public Law 92-514.

When Pete Domenici took office in 1973, we had a project. But we had no money for it. President Nixon might have agreed to authorize the project, but he was not interested in funding it. After all, Pete Domenici was a Senator, and Mr. Nixon had his own problems.

When the Administration failed to request a planning start, Pete Domenici and Mud Runnels got together and saw to it that Congress appropriate $325,000 in fiscal 1974 to begin preconstruction planning. Congress added another $1.6 million in fiscal 1975.

But, as usual, things failed to proceed smoothly for the Brantley project. This time the problem was engineering. The initial site selected by the Bureau of Reclamation was at Seven River Hills. It was a good site, one that was relatively narrow, requiring a dam less than a mile in length. Unfortunately, the engineers discovered that the Seven River Hills site wouldn't work. It could not be grouted. The aquifer was simply too deep and porous. The Bureau's engineers had to move the dam 2,100 feet downriver to its current location, a site where the aquifer came closer to the surface, and a true barrier could be constructed. The problem with the change, of course, was that the dam at the new site had to be far longer---4 miles long.

This change, as well as the concerns that followed the Teton Dam disaster in Idaho, pushed costs far above the original estimate of $45.6 million.

I can recall clearly the concern in the Domenici office: the meetings, the search for a solution, the frustrations. I'm certain that frustration existed in Carlsbad and Artesia to a far greater extent. This continued through the 1970s.

On February 5, 1980, the House of Representatives passed H.R. 5278, a bill to authorize a number of Bureau feasibility studies. It was a bill that had absolutely nothing to do with Brantley. When that bill came up on the Senate floor on September 17, 1980, Senator Domenici made his move. He added a simple amendment, but one that was critical. The amendment simply raised the authorized cost of constructing Brantley to $172,728,000. The house accepted the Senate version on September 24 and on October 3, 1980, President Carter signed it as Public Law 96-375.

More than 90 years after the Pecos Irrigation & Improvement Company, more than 75 years after George Washington Brantley moved to what is now Carlsbad, the real Brantley success story began. Money was appropriated quickly, with a groundbreaking ceremony in October 1984.

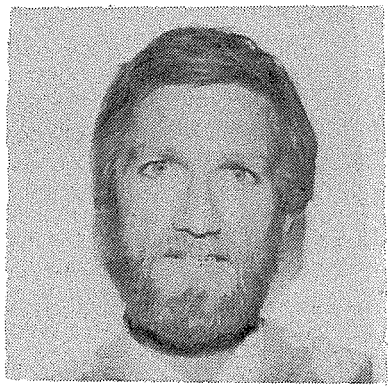
In fact, work proceeded so rapidly that the project was almost closed down in 1987 before Congress was able to get the Bureau to reprogram $6 million from work in other states so that Brantley could continue. That reprogramming of funds kept the Brantley project where the people of New Mexico wanted it: ahead of schedule. In fact, the project was completed more than one year ahead of schedule, a real tribute to the leadership of the Bureau and the citizens of the Pecos Valley.

And finally, on May 13 of this year, this great project was dedicated. And it is quite a project: 143 feet in total height---110 feet above the riverbed ---10.7 million cubic yards of rock and fill and 158,000 cubic yards of concrete. It can hold 966,000 acre-feet of water, with 149,000 acre-feet set aside for siltation, 42,000 acre-feet for irrigation and conservation, and 157,000 acre-feet for normal flood storage.

As I see it, this is a project that could never have been achieved without the strong support from the people of Carlsbad, Artesia, Dexter, Hageman, Lake Arthur, Midway, and Loving. This project is good for each and every one of those communities. It is a project that provides irrigation water and vital flood control for Carlsbad, as well as fish and wildlife benefits.

But there is one other thing that is particularly noteworthy about Brantley. As of September 30 of this year, the federal government has spent $138 million on the project. We have another $3.7 million to spend to complete the recreation facilities. And once that money is spent, we will have come in $31 million under budget. How many times can you recall the feds achieving that? We finally have the project, and did it right.

Robert M. Findling is a landscape architect and chief of planning and design for the New Mexico State Park and Recreation Division where he has supervised construction and planning activities since 1975. He received his B.A. in environmental design and architecture from the University of Colorado and has previously worked for both the Washington, D.C. office of Skidmore, Owings and Merrill, and the Southern Rio Grande Council of Governments in Las Cruces. Robert was also a speaker at the 31st WRRI annual conference in 1986.



RECREATIONAL ISSUES ON THE PECOS RIVER IN NEW MEXICO

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I appreciated the invitation from Tom Bahr to speak at this year's water conference regarding recreational issues along the Pecos River. It is especially significant that recreational issues are again a topic of discussion at the 34th Annual New Mexico Water Conference sponsored by the Water Resources Research Institute and I am pleased to be the flag bearer for this increasingly important issue in New Mexico water management.

The Pecos is an especially complex river system and as one might expect, that complexity carries over into any analysis one might attempt regarding recreational water issues. It is extremely difficult to speak with certainty given the many new and as yet unquantified variables existing in the Pecos system. Therefore, I will focus first on defining current recreation management issues and when possible, use quantitative terms. I will then speculate about the impacts new physical features and legal developments on the Pecos may have on the future resolution of these issues.

The first issue centers on recreational overuse of the upper Pecos, both on Santa Fe National Forest and New Mexico Department of Game and Fish lands. Water quality is more an issue here than water management since only limited upstream diversions exist. Basically, the situation is a fairly classic example of largely unregulated recreational use over many decades resulting in predictable impacts. Impacts include erosion as a result of a loss of riparian vegetative cover from indiscriminate vehicular use, and unsanitary conditions caused by a lack of appropriate restroom facilities.

Public agencies involved have attempted to address the problem in the last few years with limited success. This is because alternative suitable recreation facility locations have a severed mineral estate, and businesses relying upon recreational use in the area have understandably resisted interim closures that could impact their gross receipts. Until surface and subsurface ownership of appropriate replacement recreation facility development sites can be consolidated, it is unlikely much progress will be made in restoring the impacted areas and thereby reducing water quality impacts. Hopefully, recent Forest Service facility improvements will divert some use to a site which can accommodate it without resource damage.

Moving downstream we find some interest in whitewater boating between the Villanueva State Park and Anton Chico. Some whitewater enthusiasts have expressed an interest in seeing either minor modifications to irrigation diversions to reduce boating hazards or building portages to make circumnavigating those hazards easier. Little interest or attention has been placed on instream flow augmentation as river use is low and no upstream impoundment exists which could potentially make such an effort affordable.

The first significant storage reservoir on the Pecos is Santa Rosa Lake, formerly named "Los Esteros." Establishing a minimum pool at Santa Rosa has been a fairly controversial topic since the project's inception with primary obstacles being economic.

A 510 surface acre pool was cited as early as 1971 by fish and wildlife agencies as being an appropriate size for Santa Rosa Lake. The question of whether 510 surface acres represents a meaningful recreational water body is clearly subjective and until recently, I do not believe a clear understanding existed among minimum pool proponents regarding what size of pool was needed. In general, with regard to minimum pools, the "bigger the better" is usually preferred. Typically there is no magic cut-off point below which a pool is of no value. However, the ability of the pool to sustain a year-round fishery is commonly felt to be a good measure of a minimum pool's utility. The pool's ability to sustain a fishery is normally quantified by a depth over a sufficiently large percentage of its surface area necessary to maintain an appropriate water temperature for its resident fish species habitat requirements.

Basically, I believe the approach used by supporters of the minimum pool at Santa Rosa was simply to try to get a pool established, later increasing its size if it did not appear to be adequate. A reasonable strategy until you realize the extent to which water in the Pecos is either encumbered by irrigation district affiliation, a junior right of questionable value, or associated with a primarily northern New Mexico farming tradition which many consider threatened, as was recently portrayed in Robert Redford's film *The Milagro Beanfield War.*

More current estimates by Santa Rosa municipal officials of what they perceive to be an adequate minimum pool ranges between 10,000 to 20,000 acre-feet. While I don't have information regarding the specific quantity of water that would be required to establish and maintain such a pool, I believe it could require the purchase and retirement of every irrigated acre above Santa Rosa Lake. This strikes me as an extremely costly and controversial endeavor, possibly even more so than the state's past efforts to secure water for the pool from lands in the Carlsbad Irrigation District (CID). I do not believe the state of New Mexico has the financial resources to pay for the creation of a meaningful minimum pool at Santa Rosa Lake.

Working further downstream, the next spot with any significant level of recreational use is Sumner Reservoir, formerly Alamogordo Reservoir. Isn't it strange how things on the Pecos are always changing, even the names of the innocent don't stay the same? Sumner has a minimum pool as opposed to a minimum recreational pool, as it has little to do with recreation and a lot to do with sediment control and irrigation. The pool is 2,500 acre feet in size and was established by the state engineer in the Findings and Order document, which resulted from the application of the CID to transfer irrigation storage capacity in Alamogordo Reservoir to Los Esteros Dam and Lake (now Santa Rosa Lake).

The pool was established to control sediment in the irrigation water available to the Fort Sumner Irrigation District when Sumner has little water. In general, it is not viewed as providing sufficient volume for a carry-over fishery during periods of low-water storage. A second feature of this pool is the requirement that irrigation releases from Sumner can not be made until the pool's volume is at least 5,000 acre-feet. At the conclusion of the release, the pool can again be reduced to 2,500 acre-feet.

Brantley Dam and Reservoir are the newest water related features on the Pecos. Brantley, which replaces McMillan, has a 2,000 acre-foot minimum pool. The pool was created by the acquisition and transfer of approximately 1,626 acre-feet of water rights associated with 620 acres of farm land subject to inundation by the new reservoir.

Obviously, it is hoped that the minimum pool will provide some recreational benefits. If it had not rained about 2 inches a few weeks ago, we probably would have gotten a pretty good idea what Brantley looks like with its minimum pool in place and little to no sediment. Over time, the constant volume pool will become progressively shallower and its boating benefits will likely improve a bit at the expense of its

fishery. In general, it's safe to say that Brantley will be a better reservoir for fishing than was McMillan. However, at low-water volumes, its boating and sailboarding qualities will likely be inferior. There is some interest in increasing the size of Brantley's minimum pool and I believe that stands a much better chance of occurring than the creation of a meaningful minimum pool at Santa Rosa Lake.

I have received several phone calls from residents of southeastern New Mexico that begin, "I'm thinking of buying a new boat. How large is Brantley going to be compared to Elephant Butte?" It's always tough popping someone's bubble but the fact that there is now a new dam has done little to produce more water in the Pecos system. Dams consume water through evaporation, bank storage, and seepage. It is hoped that Brantley's relatively good storage characteristics as compared with McMillan will reduce some storage losses. However, we are not going to see anything resembling Elephant Butte Reservoir behind Brantley Dam, unless Brantley's probable maximum flood occurs, and even then, reservoir volume will only increase briefly.

A lot of the misconceptions about the size of Brantley Reservoir relate to the rather impressive size of Brantley Dam which is due largely to its flood control function, not to its conservation storage capacity. While Brantley will afford the CID with an improved conservation storage situation in Eddy County and could result in their storing more water closer to home, it's not going to provide any new water beyond that associated with Brantley's more efficient storage characteristics. At best, Brantley will offer reduced evaporation and bank storage losses of approximately 8,000 acre-feet. Any comparison between Elephant Butte's conservation storage capacity of more than 2,000,000 acre-feet and Brantley's conservation pool of 42,000 is unwarranted.

The way water is managed on the Pecos River in New Mexico will change both as a result of Brantley's completion and last year's Supreme Court decree. I can only speculate as to what those impacts will be at this point, but I believe that Santa Rosa Lake will be the recipient of many negative impacts particularly if, or more accurately when, New Mexico experiences a shortfall in its water delivery obligations to Texas under the Pecos River Compact. The decree requires "action by New Mexico that will increase the amount of water at the state line prior to March 31 of the year following the accounting year by the amount of the shortfall."

Therefore, it is possible we may be seeing some decree-mandated Texas releases in March from Santa Rosa Lake. As a result, the CID may wish to schedule earlier irrigation water releases piggy-backed on a Texas delivery to the extent that it doesn't impact either the Fort Sumner Irrigation District or river pumping water rights. Naturally, Santa Rosa will continue to offer reduced evaporation and that may in large part offset any benefits associated with combining those releases, but it's certain to be a management option the CID will consider.

Avalon Reservoir, just below Brantley, is primarily used as the CID irrigation diversion. It's an old reservoir with a significant amount of sediment, which makes it rather shallow over most of its area. As a result, it will not support much of a fishery. Avalon will have a minimum pool of 600 acre-feet with an average depth of only 1.62 feet. Sailboard use may increase if this recreational user group finds either the wind or shoreline conditions at Brantley less desirable.

In summary, recreational issues just like all other water related issues on the Pecos are complicated by the river's rather bizarre hydrology, the Pecos River Compact, last year's Supreme Court decree, and the lack of any imported water that might offer the river's managers additional flexibility. The river has a large number of reservoirs with relatively little water. As the old joke goes: if you think your drowning, stand up.

Environmental conflicts on the Pecos, as with most other western rivers, focus on water storage and reservoir management. Relatively little interest to date has been given to instream flow issues as most recreational use occurs either on headwater river sections where existing diversions are not viewed as posing a threat to recreational use or on reservoirs. Both recreational users and irrigators would like to see those reservoirs full and to that extent they share a common goal, until the irrigators call for water. Unfortunately it's not a goal whose realization either group completely controls.

Charles T. DuMars is a professor of law at the University of New Mexico.. He recently served as chairman of the New Mexico Water Law Study Committee. He is the author of numerous articles on water law and water rights, the co-author of Economic Impact of Alternative Resolutions of New Mexico Pueblo Indian Water Rights, and principal author of Regional Water Plan Legislation in New Mexico. DuMars has litigated water issues at all levels of court systems in New Mexico and the federal system. DuMars is a member of the Western States Water Council, the Board of Trustees of the Rocky Mountain Mineral Law Institute, and the American Bar Association Natural Resources Committee. He received a bachelor's degree from the University of Oregon and a law degree from the University of Arizona.

TEXAS V. NEW MEXICO: IT'S TIME TO CORRECT SOME JUDICIAL MISTAKES

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My remarks are going to be pretty general and I am going to make a couple of predictions. I am free to do that because I am not counsel of record for the case, although I am quite familiar with it. The Texas v. New Mexico case, in my view, is a case that is wrongly decided for a couple of reasons that I will explain. I also think that the judicial decree regarding future deliveries is not workable now, through nobody's fault really.

The background, as probably most of you know, begins in 1923 when it became clear that there were great economic advantages to Texas and New Mexico to harness the erratic flows of the Pecos River. By 1948, after a lot of difficult negotiations, an Interstate Compact was developed. The main goal of most compacts is to try to clearly regulate the quantity of water that exchanges between states. According to Steve Reynolds, the international, historical methodology for resolving interstate water disputes has been war. War between states is not permitted by our constitution, so compacts are enacted. The Pecos River Compact was a good faith attempt to try to resolve the question of water allocation.

You can allocate water by percentage or you can do it by taking the total annual flow and divide that amount by a percentage as they do in the Upper Colorado River Compact. There is no numerical amount. You can also allocate water by specific amounts, as in the Colorado River Compact, where the upper basin is obligated to deliver 7.5 million acre-feet per year to the lower basin. That is it.

The Pecos River Compact drafters did not select any of these options. Rather, they used language aimed at promoting water conservation, but which is unfortunate in its effect. It said simply that New Mexico must deliver a certain amount of water, in fact, the amount under the conditions prevailing in 1947; that is, based on man's activities at that time. The activities of man in the future are not allowed to encroach upon that delivery obligation. Thus, New Mexico may not divert or take out of the

river by its own activities, by man's activities, an amount of water that takes it below the 1947 conditions.

The compact was doomed from the beginning for two reasons. One reason is that it has a built-in gridlock. The compact has a commissioner from Texas, a commissioner from New Mexico, and a federal commissioner who can not vote. Even with that unusual political setup, the compact worked pretty well and people worked to try to understand the vagaries of the river and what the 1947 condition meant. Indeed, there was an engineering water input/output or inflow/outflow model developed to try to define exactly what that meant, what the river did in terms of water deliveries. Unfortunately, that model was in error. Until 1970, there was a tremendous debate about how much water New Mexico was obligated to deliver and how the river responded. Indeed, the official engineering study on which the compact was based was itself in error. Since it was in error, they were deadlocked between New Mexico's obligation to deliver and Texas's right to receive.

In 1974, Texas filed a suit asserting that due to man's increased activities, New Mexico had underdelivered by well over a million acre-feet in the previous years. New Mexico took the contrary position and said the underdelivered amount was only approximately 52,000 acre-feet. New Mexico had a different theory for determining how much water was to be delivered and whether or not we might be held responsible.

A lot of history went on between then and now, but ultimately, Special Master Meyers, a fine man, former dean of the Law School at Stanford University, who was a personal friend of mine, made a ruling I think was fundamentally in error. I think the Supreme Court will some day rule that he was in error.

What was the error? The Pecos River Compact does not have a debit/credit provision. It does not say you get a water judgement if one state gets behind in its deliveries for a few years. It does not say credit has to be given if New Mexico gets ahead by man's activities somehow creating some water. It is simply silent on that point, as are the majority of compacts in the country as well as all equitable enforcement decrees. The latter is an example of when the Supreme Court equitably divides up the river.

If it is the case that the court can imply debit/credit, then in the future, all compacts and all equitable enforcement decrees entitle one state, the downstream state, to run to court to sue for retroactive relief. And if compacts are indeed like contracts, there will be a statute of limitations. Any lawyer who wants to avoid malpractice will be suing to get this decree from the Supreme Court water judgement. I do not think the Supreme Court will like that role at all. The original jurisdiction of the United States Supreme Court has traditionally been very narrow. I do not think there should have been retroactive relief. However, I think Hank Bohnhoff will talk about the details of the retroactive-undelivery relief that New Mexico was obligated to pay by what I think was the incorrect decision.

The other part of this decision deals with the calculation of man's activities. New Mexico only has to be responsible for those underdeliveries caused by man's activities. How do we know how much man causes? How much does man change the river? There are not a lot of ways to try to figure that out. Do we take some aerial photographs and look at how many different things men have done on the river? Can you develop an equation? One was developed and accepted by the special master that said we are going to figure out how much was done by excluding everything else. How much was lost to evaporation? How much was lost to phreatophytes? How much was lost to all other non-man activities? Subtract that from the amount of water that did not go down the river, and the balance had to be caused by man. The New Mexico men who were losing money not farming during that same period, because they didn't have any water or were doing other things, would be surprised to know they caused all that activity.

Simply put, the final decree from Special Master Meyers, which was confirmed by the Supreme Court twice, required a number of things. One, was the retroactive relief which has now been settled. The other is the prospective relief--how does New Mexico come into compliance with the compact? I have looked at the exhibits, and I am not saying I know that much hydrology, but if you look at how the Pecos River works, it is a very strange and difficult river. Because of its flood flows, because of the positions of the gaging stations, it goes in trends. The river will overdeliver for five or six years at a time and then it will underdeliver for five or six years at a time while man's activities have not basically changed. The decree as it is presently framed, requires almost immediate responsive annualized credits or debits for repayment of water. That would mean, if the decree actually were enforced, for five or six years at a time there would be overdeliveries. New Mexico would get credit for these overdeliveries even though man's activities did

not change. However, New Mexico would be charged for underdeliveries that were not in fact attributable to New Mexico when the river underdelivers.

My prediction is that, although New Mexico will do everything possible to comply with that decree in good faith, I believe the river master is going to have a very difficult time--and I have met him, he is a tremendous guy, bright and talented, and you are lucky to have him there--but he is going to have a very hard time figuring out how to make what happens by trends on the river comply with what the decree requires.

I predict the Supreme Court will reject this case as to its holding, regarding its debit/credit implications in compacts and other cases when everybody runs to the Supreme Court. For example, Kansas is suing Colorado for damages. Secondly, I think there is going to have to be some real good faith consideration as to how to figure out what to do with this river. Since it does not do what sometimes we say it does, the current decree will not work. Thank you.

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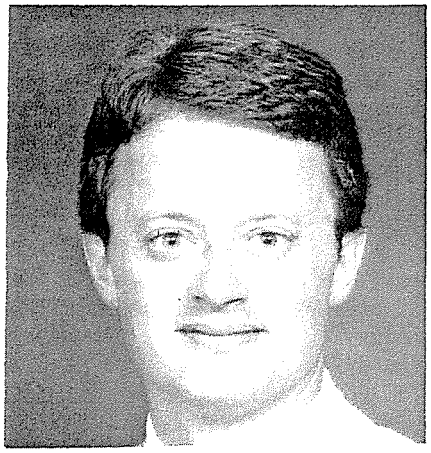

OVERVIEW OF THE TEXAS V. NEW MEXICO SETTLEMENT

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Earlier this year, I was asked to help out in the *Texas v. New Mexico* lawsuit. I was happy to do so, and I am quite proud of the results we achieved this past summer. We were not faced with the question of do you pay or don't you pay, but rather how much. When you compare the evidence both states put forth to the settlement ultimately reached, I think you are compelled to reach the conclusion that New Mexico must have put on the better case.

I would like to take a moment to thank publicly the legal team members with whom I had the good fortune to work. Peter White and Vickie Gabin are lawyers with the State Engineer Office. Peter, previous to my getting involved in the case, had put together an excellent group of experts--hydrologists, and economists. Our success in the case is due in large part to Peter's effort. The southeastern part of the state owes the State Engineer Office and the Attorney General's office a debt of gratitude for this last phase of the trial.

Let me summarize what happened in the trial. I will try to explain what the basic issues were, what happened, and give you a few thoughts on why we obtained the result that we did.

THE ISSUES

The overall question was: what should be the remedy for the 385,000 acre-foot debt the U.S. Supreme Court, in 1987, had determined New Mexico owed? There were three possible remedies. One is what lawyers call "specific performance"; a non-lawyer would simply call it having to repay with water rather than money. It would involve repayment over time, over and above the ongoing delivery obligations under the Pecos River Compact. For example, on average, New Mexico has to deliver about 80,000 or 90,000 acre-feet of water at the state line. If New Mexico had to repay the debt over ten years, it would have to send an additional 38,500 acre-feet down the river, over and above the 80,000 or 90,000 acre-feet it already had an obligation to deliver.

The second possible remedy was a monetary remedy, based on Texas' loss. Through hydrologic and economic evidence, a determination would be made as to how much profit Texas farmers could have made with the water, had New Mexico delivered it. The third alternative was also a monetary remedy, but one measured by the amount by which

New Mexico farmers profited by using the water that should have been delivered to Texas.

WHAT HAPPENED

Texas argued its case first. Texas claimed that what it really wanted was the water. But it put on no evidence of the relative benefits and burdens of such a remedy. Under the case law, Texas would have to establish that the benefits to Texas of a water remedy outweighed the burdens to New Mexico in order to get that kind of a remedy. Texas did not present any evidence on that critical issue. Instead, Texas focused its case on proving a right to a money remedy, which appears to me to have been its strategy all along.

On money damages, Texas' expert testified that, if New Mexico had delivered the water between 1950 and 1986, farmers in the Red Bluff project near Pecos, Texas, would have made approximately $51 million in profits. Texas' economist also claimed that farmers in Roswell who had been using the water that should have gone to Texas during that same period of time made $1 billion in profits with the water. Of course, Texas asked the special master to award damages based on New Mexico's gain, not Texas' loss. Its theory was that New Mexico had acted in bad faith in not complying with the compact during these years, and therefore, punishment in the form of requiring New Mexico to disgorge all of these profits was justified.

Then it was New Mexico's turn to put on its case. We first argued that a water remedy would be extremely wasteful. It would hurt New Mexico far more than it ever could have helped Texas. Our economists testified that the loss to New Mexico of having to deliver that extra water in the future would have been $85 million. The scenario again was 38,500 acre-feet per year for ten years. Texas over those ten years would have made about $2.5 million in profits from using that water. Thus, there was about a forty-fold difference between the loss to New Mexico and the benefits to Texas. Texas did not put on any contrary evidence.

On the money damages questions, we argued first of all that, as a legal matter, the question of how much profit New Mexico farmers made with that water was irrelevant. New Mexico had not acted in bad faith. In the absence of a showing of bad faith, the standard remedy for a breach of contract was appropriate here: the loss to the plaintiff caused by the breach, not the gain to the defendant of breaching the contract. Furthermore, our economists testified that if you really wanted to look into the question of how much New Mexico gained, it was far less than the $1 billion that Texas claimed.

Finally, our economists testified that, because of numerous problems Texas has in delivering water to its farmers and getting crops to grow with it, Texas actually could have made only about $8 million--and that figure includes compounding to a present value--in profits over thirty-five years.

In an unusual move, the special master gave us his tentative thoughts about the evidence at the end of the first two weeks of trial. He thought Texas had struck out! First, he indicated he was not willing to give Texas the water because it would be extremely wasteful to shut down numerous New Mexico farmers in order to gain only a very small benefit to Texas. Second, he told us that he was not inclined to grant damages based on New Mexico's gain because there had been no showing of bad faith. Texas had argued that New Mexico never did anything over this thirty-five year period to increase the flow of water down the Pecos River. The problem with that argument, which the special master saw, was that New Mexico during that entire period never thought or realized it was underdelivering and it had very good reasons for maintaining that belief. The U.S. Supreme Court ultimately rejected those reasons and found to the contrary, but the fact of the matter was that New Mexico was acting in good faith. On the third optional remedy, the special master did not give us a specific figure on Texas' loss that he had in mind, but he did tell us that the loss was "fairly significantly less" than the $51 million that Texas claimed.

We had a two-week break before we were scheduled to come back for another week of evidence. During that period there was some give and take in negotiating between the sides, but we ultimately struck a deal at $14 million. Again, it was not a question of whether or not we paid, it was only a question of how much. Our experts made solid, conservative, credible assumptions in coming up with their figures, and they concluded that New Mexico had damaged Texas by $8 million. That was probably the best result we could have obtained. Texas had their $1 billion claim. We struck the deal at $14 million. I think we won.

WHY THE STATES SETTLED FOR $14 MILLION

I am biased, of course, but I think we obtained this result because we put on a better case. The state engineer and the attorney general also had the foresight to invest the necessary resources, and I am

talking about tax dollars, to win this case. They had to spend some money on hiring good experts, and those experts had to spend an awful lot of time trying to reconstruct thirty-five years of records. I also had to spend a lot of time putting the case together. But your state government was willing to go ahead and spend, and I think the money paid off. We saved tens of millions of dollars on a possible judgment in exchange for tens or hundreds of thousands of dollars in expenses in getting prepared for the trial.

But in the final analysis, reality dictated the result in the trial. There are three fundamental problems with irrigation down in the Red Bluff District. Some people from Texas who are in the audience might not like what I have to say, but I am going to say it anyway. The first problem is carriage losses. If you start with 10,000 acre-feet at the state line, by the time you divert it into the Red Bluff irrigation canals you are left with about 6,000 acre-feet. By the time that water gets to the farmers' headgates, you are left with 3,000 acre-feet of water. Thus, you have a 70% carriage loss from the state line to the farms. In terms of absolute amounts, we were talking about 6 cubic-feet per second at the farmers' headgates. The special master, who himself was familiar with agriculture, realized that this amount of water, even under the best of circumstances, could not produce many crops.

The second fundamental problem that exists in the Red Bluff District is salinity. There is a place in the river south of Carlsbad called the Malaga Bend, where there is a lot of brine accretions. In other words, lots of salt is dumped into the river, naturally and continuously, every year. Mr. Davis, I think, mentioned earlier today that Carlsbad has a salinity problem at 3,500 parts per million (ppm). The average salinity of the water that Texas could have expected to receive, even had New Mexico delivered the extra water, would have been around 7,000 ppm. During some of the years between 1950 and 1986, Red Bluff would have received water with a salinity of twenty tons per acre-foot.

Finally, the third problem the Red Bluff District faces is the extreme variability in the flows of the Pecos River. New Mexicans have that problem, too, but it was exacerbated for Texas by the fact that the Red Bluff Dam, as far as we could figure out, has never been used to even out the flows of the river in Texas. The water comes down, and next year it is released to the maximum extent possible.

The bottom line was, faced with these natural problems, the Texas farmers never could make much of a profit from Pecos water, while New Mexico farmers can. For this reason, the special master refused to grant the water remedy, and the amount of money that Texas could obtain was far less than the amount requested.

Fred Hennighausen is in private law practice in Roswell, with his practice devoted mostly to water matters. He is the author of a number of papers on water rights administration, water use, and hydrology. He is a member of the Roswell City Council and the Roswell Advisory Committee. He is chairman of the Roswell Economic Forum's Water Committee. Hennighausen was employed by the State Engineer Office for 32 years. The last 24 of those years he was Roswell District Supervisor in charge of Water Resources Investigations and Water Right Administration in Southeastern New Mexico. He holds a B.S. in General Engineering and a B.S. in Mechanical Engineering, both from Duke University. Hennighausen received his J.D. from the University of Tulsa in 1983.

FUTURE OUTLOOK FOR WATER USE IN THE PECOS STREAM SYSTEM

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We have heard today from Peter White, attorney for the State Engineer Office, on adjudication procedures. We have also heard from representatives of the Fort Sumner Irrigation District, the Carlsbad Irrigation District, and the Pecos Valley Artesian Conservancy District. We have heard what they have done to improve their districts and serve their water users. There is no doubt they have done a lot. It is my opinion that it is not enough. Other things need to be done, and I think the main thing we need is for people to start working together as a group up and down the river system, whether it be an overall conservancy district, or just the individual water users. Many of these problems and shortages can be solved by methods other than a priority call.

One scenario, as outlined by the state engineer attorney, requires adjudication of individual water rights throughout the Pecos stream system, from headwaters to the state line and all tributaries. This may be completed in eight to ten years. Individual hearings would be held for contested issues. After that time period, inter se adjudication would take place, allowing challenges between and among parties.

This would take three to five additional years, including appeals. Upstream users would challenge downstream users as to earlier priorities, relationships of earlier priorities to upstream storage, equities of storage, quantities of water required, entitlement of flow rates, and other matters.

After that period, we would still have shortages of water persisting throughout the stream system and demands from downstream users for priority administration. Ill will and continuing divisions will persist among major water-using areas regarding priority administration, water supply requirements, and benefits of conservation measures. Additional demands would be placed upon the Pecos River stream system by developers and recreational users demanding water for instream flows for fish and wildlife habitat, for wetland areas, and other purposes. Legislation would likely be introduced and enacted to permit additional water for such uses.

And after that, in an effort to follow the prior appropriation dictates of the New Mexico Constitution and Statutes, the state engineer would initiate action to shut down junior water rights in the Ros-

well ground-water basin to satisfy senior rights of the Carlsbad Irrigation District and/or to meet the requirements of the Pecos River Compact deliveries to Texas.

In response to this action, the water users in the Roswell basin would file to enjoin such action by the state engineer on the basis that:

1. There are more junior rights upstream.
2. The shutting down of junior rights in the Roswell basin would not be responsive to immediate needs.
3. The equities do not warrant strict priority administration.
4. There are unauthorized uses of water for wetlands and other purposes that exacerbate shortages.
5. The assumptions as to quantities of water that would reach the downstream users require further review and adjustments.

Other water users in the entire stream system would join in with similar claims. This process would involve another three to four years of litigation and appeals.

Strict priority administration in my view would result in gross inequities. Also, due to the delayed effects of ground-water pumping on the river, there would be excess surface water in the stream system during some years in order to insure water availability for senior river appropriators in all years.

I think a lot of other steps could be taken. The second scenario I'll discuss represents the "best case." In this scenario, individual adjudications are completed within a period of six to eight years. Inter se portion of the adjudication proceedings are completed within two to three years including appeals. Persistent shortages of water throughout the basin could be alleviated by various means. Short-term shortages of water for existing water rights might be met by innovative methods.

Some of the demands for recreational instream uses would be met by reassignment of existing rights. In all cases, however, reassignments would be utilized in conjunction with existing water law. Animosities between different water-user groups would be replaced by consideration of the needs of all water users.

Under this scenario, strict priority administration would not be required as water shortages are met by other means. Greater latitude would be allowed in the transfer of water rights to meet specific needs within larger areas of the Pecos stream system. Such transfers could be justified under the public welfare and conservation of water criteria. Further, enhanced reserves of water and storage both underground and on the surface would be made available to meet contingencies.

To go from the first to the second scenario, cooperation and joint efforts involving all water users up and down the basin and with the relevant state and federal agencies would be needed. This might result in the creation of an overall conservancy district including the whole watershed, with an ad valorem taxing ability to implement necessary projects. Also needed would be the cooperation of all local entities for lobbying purposes and developing legislation. Federal agencies and congressmen would be needed to assist with plans and projects.

Some of the possible improvement measures that might be undertaken include the development of an overall plan to permit maximum utilization of the river system's water resources. The plan could include management of the resource with a financing base.

Surface water storage could be improved by investigating recent developments in evaporation suppression from surface reservoirs. Timing of releases between reservoirs to maximize depth and reduce surface area to minimize evaporation should be examined.

Maximizing underground storage would result in reduced surface evaporation. Now that all water rights in the Roswell basin are adjudicated and metered, it might be feasible to divert all flood flows on the Penasco, below the Hope diversion, to Antelope Sink, for natural seepage to underground storage. This would result in lower pumping lifts for well users and uniformally released surface flow for surface users.

A second option would divert excess flood flows on the Hondo into the old Hondo Reservoir for diversion to underground storage. The consequence would be lower pumping lifts for well users and uniformally released surface flow for downstream surface users on the Pecos and below.

A third diversion could involve excess flood flows on the Pecos into the Cocklebur Lakes area 15 miles north of Roswell for ground-water storage, if water quality and other considerations warrant. Again, lower pumping lifts for well users and uniformally released surface flows for downstream surface users would result.

The Rio Felix and other tributaries with similar sites for diversion to underground storage, without detriment to surface users, should be explored.

The regulation of water use should involve metering all individual surface diversions and wells throughout the basin. This would impose conservation measures by all users. Surface and ground-

water diversions could be limited to actual requirements. Reasonable limitations could be placed on diversion rates, quantities of use, and canal losses.

We need additional salt cedar eradication including the clearing of McMillan Delta, which will save an estimated 18,000 acre-feet. We also need to replace salt cedars in wildlife habitat areas with low water-consuming plants. The continuation of salt cedar control programs in various reaches of the river and tributaries is important.

A water rights clearinghouse should be maintained. The river and basinwide clearinghouse would keep a list of water rights which could be purchased, retired, or leased on a long or short-term basis for the express purpose of retiring such rights. The list would also help in exchanging leased or purchased water rights to prevent priority shut-down and mitigate effects on stream flow. A computer model to determine effects on stream flow and river carriage losses of all water rights should be maintained. The clearinghouse would also be utilized to permit individual water users, located upstream or at some distance from the river, to continue pumping by allowing them to retire, by lease, a smaller quantity of right close to, and with greater impact on the river.

The drainage of high water table areas would also improve the system. We should reactivate old drain lines at Fort Sumner, Roswell-E.G.P., Dexter, Hagerman, Lake Arthur, and Carlsbad in response to higher water tables adjacent to the river caused by ground-water storage and conservation measures. New drains should be installed in high water table areas such as the McMillan Delta, the Penasco Delta, east of the Pecos River near Roswell, and other areas. Legislation to prevent new uses from reclaimed drainage water should be encouraged. Additional legislation should be promoted that would require water rights to compensate for evaporation from maintained or dedicated wetland or swamp areas.

A combination of methods could be used to meet long and short-term shortages of surface water. For example, retrieval of bank storage on the perimeter of Brantley Reservoir and in McMillan Delta by pumping of shallow wells with relatively low pumping costs could be done. This would also create underground storage for surplus years. Pumping wells within the Carlsbad project through the canal system would help meet adjudicated entitlements.

There is also a possibility of pumping wells adjacent to the Pecos River with compensation to the well owners for costs incurred. The five-year accounting period could be used where the owner could pump water into the river as needed and retire the water use the following year.

The lease of existing water rights and diversion of water into the stream system is another option. Importation of water into the Pecos system through existing pipelines, and exchanges of water and existing water rights should be explored. The purchase of water rights for permanent retirement is yet another option.

And finally, conservation is vital. Low cost loans throughout the basin for conservation measures including canal lining, sprinklers, leveling, and planning assistance should be made. Water conservation education for all water users is a necessity.

These are the sorts of things at which we need to look. My personal view is that we need overall planning with a local core group to start the process and to work with the state engineer and others. The plan could then be implemented through cooperation of all water users and public agencies.

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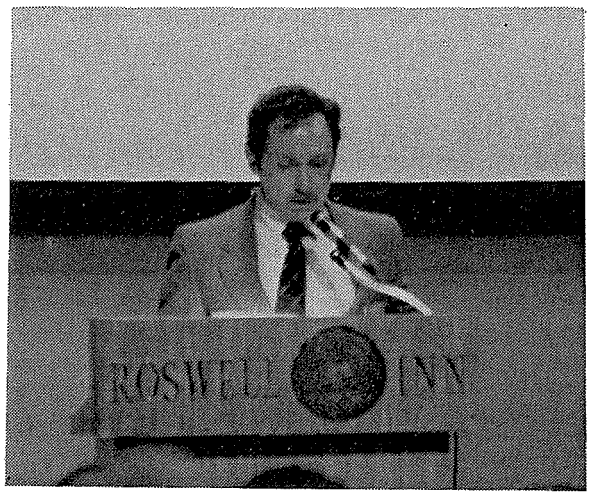

ENVIRONMENTAL ISSUES IN NEW MEXICO'S OIL AND GAS INDUSTRY: SUCCESSES AND CHALLENGES

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ABSTRACT

Of the major industries in the United States, the exploration and production sector of the oil and gas industry remains largely unencumbered by federal environmental regulations. While national environmental groups bemoan this fact, it has allowed progressive states like New Mexico to develop regulatory programs that respond to actual or potential environmental problems based on the unique geology and hydrology of the region. A well-known example is the prohibition of unlined produced water pits in Southeast New Mexico in 1969.

As the industry approaches the 1990s and the end of this century, the emphasis is shifting away from just water disposal to the entire range of industry wastes, both liquids and solids. Federal disposal rules and guidelines are just over the horizon and are likely to be instituted in some form or another within the next five years. At the same time, the 50-year old oil fields of Southeast New Mexico are reporting frequent instances of spills and leaks due to corrosion and failure of gathering lines and tanks. How the industry and state regulators respond to increasing national waste regulation and an aging infrastructure will determine, as much as the price of oil, the future direction of the industry in New Mexico.

INTRODUCTION

Historically, Oil Conservation Division (OCD) environmental programs were directed toward fresh water protection. The early programs were driven by actual instances of contamination. The "no-pit" order banning disposal of produced water in unlined pits in Southeast New Mexico beginning in 1969 resulted, in part, from the large amounts (50-150 acre-feet/square mile) of brine disposed in unlined pits south of the Monument and Oil Center areas. Inspection programs in the Hobbs area that require quarterly checks of production well surface casing

were instituted in 1957 because of casing leaks that caused oil to float on top of the water table in west Hobbs.

Within the past ten years, programs have become still more preventative in nature. An example is the defining of a "Vulnerable Area" in 1985 for the San Juan Basin to protect shallow ground water before large scale contamination occurs. Another is the testing of injection wells every five years (or more frequently when workovers occur) for mechanical integrity of the casing.

Now, as we approach the 1990s, new issues have arisen. They include disposal of so-called "solid wastes" (which can be physically solid, semi-solid or liquid) from production operations, and likely federal action to regulate these. Also, especially in Southeast New Mexico, aging oil field equipment is beginning to fail more frequently spilling oil and salt water on the surface and in some cases beneath the surface. This paper will touch on some of OCD's environmental successes and also present some of the challenges that lie ahead. This includes the need to address both the technical and regulatory issues resulting from aging industry equipment and increasing federal rules.

SUCCESSES

Underground Injection Control (UIC) Program

The sheer magnitude of water injected makes this OCD's biggest environmental program. Statewide, about 4 to 5 barrels of water are produced for every barrel of oil. In 1987, 345 million barrels (14.5 billion gallons) were produced. This water (commonly called "produced" or "salt water") is brackish to briny in nature and usually contains dissolved or emulsified hydrocarbons. That year, 88% of the water was reinjected into 5,200 wells for disposal or use in secondary recovery. The New Mexico UIC Program predates the 1980 federal rules under the Safe Drinking Water Act, but the federal program has helped OCD hire more inspectors and improve the testing of wells for mechanical integrity. A listing of fresh water protection rules and orders can be found in the Appendix.

Southeast "No-Pit" Order

In 1969, the OCD issued its historic order (R-3221) banning salt water disposal in unlined pits in Lea, Eddy, Chaves, and Roosevelt counties. It actually was the culmination of a process that began in 1958 with prohibition of disposal in and near the Hobbs, Monument, and other community areas in Lea County. Small volumes of one barrel per day per lease were, and continue to be, exempted and larger volumes can be allowed in areas where no protectable fresh water exists (water is protected by OCD up to 10,000 milligrams per liter of total dissolved solids).

The "no-pit" order received scathing industry criticism at public hearings when it was first considered, but its adoption forced a better method of disposal (underground injection) to be developed and put into use. Two key persons played a crucial role during this time. Pete Porter, OCD director, and Steve Reynolds, state engineer, provided important support and their offices provided technical expertise for the various hearings that were held over several years in the 1960s.

Well Plugging

New Mexico's abandoned well program has received high marks from other states not having an administrative method or a Reclamation Fund to plug abandoned wells, or those where the posted bond does not cover total costs. In existence since the mid-1970s, the Reclamation Fund is limited only to locating and plugging abandoned wells and has supported the plugging of over 50 wells with the majority to date being in the San Juan Basin. The fund is financed by a tax on production and fluctuates between $500,000 and $1,000,000 each year.

Environmental Bureau

The Environmental Bureau was formed in 1984 to provide a focus for OCD's non-production related ground-water protection efforts. This includes approving discharge plans for natural gas processing plants, oil refineries, service companies, geothermal sites, and discharges of natural gas and crude oil hydrostatic test waters under the State Water Quality Act. The bureau provides permit review for crude oil recovery/treating plants and off-site surface waste disposal facilities under the Oil and Gas Act; and investigates ground-water contamination related to production and refinement activities. An organizational chart showing the bureau's relationship to other OCD functions is provided in the Appendix.

In 1985, the bureau defined areas of vulnerable ground water in the San Juan Basin needing protection from discharges of oil and gas fluids. This work needs updating since additional shallow ground water at depths less than 50 feet has been located. Also, an 18-month study of the "vulnerable area" funded by the Environmental Protection Agency (EPA) found contamination at shallow ground-water sites from pits that receive low volumes of produced

water from oil water separators and possibly fluids from other on-site sources.

A comprehensive surface waste disposal rule (Rule 711) has been written and adopted that includes a financial assurance requirement. It also has a public notification section that requires (in addition to standard mailing list and newspaper legal notice) certified mail notification by the applicant to landowners and surface occupants within 1/2 mile of the proposed site. Landowners can protest the application and request a public hearing, but the permit can only be denied on technical grounds related to ground-water protection, safety, and public health, and not because of zoning or land-use considerations.

More recently, the bureau has been moving toward a comprehensive environmental permitting process that addresses nearly all aspects of waste disposal. This includes liquid and solid wastes, except "hazardous wastes," PCBs, asbestos, and air quality permitting. This authority comes from 1989 changes in the Oil and Gas Act giving OCD the authority to regulate liquid and solid wastes to protect public health and the environment. Issues arising from this new change are discussed in the next section.

Also in 1989, legislative memorials passed in both the New Mexico House and Senate requested return of brine production well jurisdiction to OCD where it existed prior to 1984. The Water Quality Control Commission (WQCC) made the change in June, 1989, and the Environmental Bureau now has a sizeable underground injection control responsibility since 21 facilities were transferred.

Reviews of WQCC discharge plans and OCD permit applications include all engineering and hydrologic aspects. All underground piping (product, process, or wastewater) at gas plants, refineries or other facilities over 25 years of age is required to be tested for integrity. All new underground sumps must have leak detection; existing sumps must have yearly integrity tests or be cleaned and visually inspected. Process areas that are subject to spills or equipment leaks (such as from valves or pump seals) must be paved and curbed, and tank and drum storage must be on lined pads that can contain leaks and spills. Major storage tanks for any nonfresh water fluids must be bermed to contain 1/3 more than their contents. In especially vulnerable groundwater areas, OCD has required integrity testing of above-ground product or crude oil storage tanks for detection of bottom leaks.

Recent Activities

Three recent OCD environmental efforts not initiated by the Environmental Bureau staff:

- Temporarily Abandoned Wells - The Hobbs district has proposed (and the legislature has funded) a program for temporarily abandoned (TA) wells. These are commonly low production wells that have been "shut-in" (that is, not in operation), usually to await a better price for oil produced. The OCD believes there may be up to 9,000 wells in this category. Though not producing, the casing can be corroded and oil, gas, or water can be leaking to other strata. The OCD plans to check these wells as follows:
    1. After 1 year, a shut-in well must be formally "temporarily abandoned."
    2. To be approved as a TA well, the well must have had a casing integrity test.
    3. If it fails, the operator has 90 days to repair or permanently plug the well.
    4. If the well passes, the approval is good for five years.
- Migratory Birds - As a result of documentation (with photographs and video tape) by U.S. Fish and Wildlife Service officers, OCD this past summer adopted a rule that all exposed lined or unlined pits, and large open tanks (exceeding 16 feet in diameter) must be netted or covered to protect birds. Written exceptions may be granted for pits with no oil, pits with 24-hour activity, pits used for emergencies only and emptied after use, or pits having adequate methods to prevent oil from reaching the pit. The Fish and Wildlife Service can fine violators having dead birds $10,000 per bird.
- Carbon Dioxide - CO_2 is a "natural" gas and subject to OCD conservation rules. A new OCD policy requires that gas plants extracting CO_2 from coalbed methane gas present and implement plans for capturing CO_2 so as not to add to the "greenhouse" effect. One plant is planning a short pipeline to connect with an existing pipeline transporting CO_2 to oil fields for use in secondary recovery.

CHALLENGES

In the next several years, there will be challenges to both industry and the OCD concerning the environment. The challenges involve technical and regulatory issues that require response from both.

Solid Waste

The issue of where to put waste will have to be addressed. Some wastes such as oily grit and

sand can only have so much oil extracted for recycling. The remainder and other solid wastes need disposal in a environmentally sound manner.

OCD rule 711 has so far provided adequate flexibility in permitting. However, in Northwest New Mexico, public opposition has arisen to disposal locations selected by operators. "LULUs" have led to "NIMBY" protests. "Locally unpopular land uses" lead to citizens' shouts of "not in my back yard." Operator flexibility in choosing sites is limited because much of the land away from the river valleys is under federal or Indian jurisdiction.

In Southeast New Mexico, operators are wary of future federal liability even though their sites may be adequate from the standpoint of fresh-water protection and isolation. They also are careful about accepting waste only from known trucking companies to prevent the receiving of "hazardous" or other unauthorized waste.

Last year, the New Mexico legislature gave OCD additional authority for waste disposal permitting to protect not only fresh water, but also public health and the environment. This authority, and the staffing needed for it to be effective, is required since other than the Occupational Safety and Health Administration, air quality, and hazardous waste inspections (at refineries), OCD staff provide the only environmental compliance at 49 natural gas plants, 7 oil refineries, 22 oil treating plants, 10 commercial surface waste disposal operations, 21 brine production facilities, 3 geothermal sites, and several hundred oil field service companies. Environmental Bureau staff are responsible for permitting at these facilities as well as inspecting gas plants, refineries, and geothermal sites. District staff share in inspections at the other locations along with full responsibility for inspections at drilling, production and UIC sites under state jurisdiction.

Aging Infrastructure

The first oil fields in Southeast New Mexico are now more than 60 years old. Most of the other major fields are over 25 years old. Age and the corrosive nature of the production and injection fluids have deteriorated equipment and piping. Company staffing has been cut back as they try to survive low oil prices; several major companies have closed offices in Hobbs. A combination of decreased maintenance and aging equipment leads to more spills and leaks from failures of lines, tanks, and valves.

In August 1989, 48 leaks and spills (excluding fire and theft) were reported in Southeast New Mexico, where most oil, and hence most water, is produced. An incident summary for that month can be found in Table 1. The largest spills reported were 123 barrels (5,170 gallons) of oil and 500 barrels (21,000 gallons) of salt water. Both of these were due to tank corrosion. Overall, corrosion was responsible for nearly one-half of the reported production line leaks, injection line leaks, and tank leaks during August 1989. Since the cause was not always listed on the spill report, the incidence of failure due to corrosion is likely higher.

In Northwest New Mexico, only two spills of oil and none of water were reported during August. This likely is due to the lower volumes of water produced and the absence of many injection lines connecting production and disposal systems. During winter months, failures reported from both areas of the state increase substantially due to broken water lines and valves resulting from freezing.

Most leaks are treated by vacuuming free fluids and covering the rest with dirt. OCD field staff visit spill sites, but very rarely is a ground-water investigation done. Expertise in hydrogeology is not always available in the districts and limited Santa Fe staff preclude follow-up assignment except for the most major spills. The usually thick unsaturated (vadose) zone has not protected fresh water in all past cases, but without follow-up at individual sites, there is no way to determine actual contamination.

Some possible solutions include:

1. For buried lines, integrity (pressure) tests for pipe older than 20-25 years. Such a test may have prevented the 1984 leak in the Monument area that contaminated a community water-supply well.
2. For surface facilities, berming requirements in all areas. Current rules only require berming near towns, roads, schools, churches, and inhabited structures.
3. For all spills, better investigation of the specifics of the leak's extent, the hydrogeology of the site, and the proposed cleanup. Some way to determine the potential threat to ground water (especially near communities and water wells) is needed. Companies should always be required to perform a ground-water contamination investigation where fresh water impacts are likely due to spill volume or location.

Federal Regulation

Additional federal regulation of oil and gas exploration and production wastes is a virtual certainty. In 1988, EPA decided to exempt exploration and production wastes from hazardous waste rules. Nationally, state rules were generally found ade-

TABLE 1. SUMMARY OF REPORTED OIL FIELD SPILLS AND LEAKS FOR AUGUST, 1989

SOUTHEAST NEW MEXICO

Type	Number	Volume Range (barrels) Oil	Volume Range (barrels) Water	Volume Average (barrels) Oil	Volume Average (barrels) Water
Production Line Leaks:					
Corrosion	5	5-20	10	10	10
Other	8	6-32	1-12	15	7
Injection Line Leaks:					
Corrosion	8	–	7-100	–	45
Other	9	–	10-160	–	53
Tanks Leaks:					
Corrosion	6	60-123	20-500	30	117
Other	3	5	150	5	150
Miscellaneous	7	6-116	5-30	41	17

NORTHWEST NEW MEXICO

Type	Number	Volume Range (barrels) Oil	Volume Range (barrels) Water	Volume Average (barrels) Oil	Volume Average (barrels) Water
Miscellaneous	2	1-10	–	5	–

quate, but EPA believes that a Resource Conservation and Recovery Act Subtitle D program (similar to municipal landfill rules) may be necessary. The program would likely include minimum national engineering and operating standards for waste management, and rules addressing gaps in state regulatory programs. EPA, with the Interstate Oil Compact Commission, is reviewing waste management issues with a goal of developing management and disposal guidelines for states to adopt.

EPA has stated its intention to work with Congress to develop necessary federal statutory authority to address treatment and transportation of oil and gas wastes. However, Congress will have the final say on the matter since RCRA is due for reauthorization.

A federal program should allow state flexibility since New Mexico has a wide variety of geology and hydrology, and an arid to semiarid climate. It should provide additional staff resources without an unreasonable increase in red tape. However, the current track record of the federal hazardous waste and UIC programs in generating regulatory and accounting paperwork does not lead to optimism.

Staffing

Currently, the OCD Environmental Bureau has three staff members including an environmental engineer and two geologists, one of whom is the bureau chief. An additional hydrogeologist requested to assist in regulation of the brine production wells transferred to OCD from the Environmental Improvement Division is awaiting legislative approval.

New solid-waste issues at the large number of OCD-regulated facilities and the need for expanded investigation of possible ground-water contamination demonstrate the necessity for more professional staff. Ideal staffing would include another environmental engineer in Santa Fe to handle solid waste management and oil field service company permitting; and an environmental geologist in Hobbs to cover southeastern New Mexico problems including spills and leaks, and facility inspections.

The Final Challenge - Environmental Education

Many major oil companies (already having environmental staffs) are leaving economically marginal and older oil fields. The independent producer, usually small, is taking over these wells and equipment. The 1969 no-pit order in southeastern New Mexico and the 1985 vulnerable areas designation in the San Juan Basin did not solve all waste disposal problems for New Mexico or the oil companies. Oil companies need to be aware of the changing environmental climate.

Next spring an environmental education program will be ready for operators. It will join OCD's current presentations on gas proration and marketing given every several months throughout the state. The program will bring operators up-to-date on current OCD programs and likely future requirements. It will provide information on good management practices (especially those related to on-site housekeeping and disposal), and document the cost of remediation if cleanup rules adopted in the future place liability on today's operator. However, even now, poor housekeeping or contamination problems can hinder or preclude sale of properties leaving operators no way to recoup the cost of their investment.

SUMMARY

It will be a combination of OCD's successful programs together with modifications tailored to meet the new environmental realities that will allow us to meet the challenges of the 1990s. New environmental realities require addressing solid-waste issues and an aging infrastructure, and providing for education on these issues. If flexibility in application of environmental rules is to remain a feature of the program, an adequate number of experienced professional staff must be maintained.

APPENDIX

MAJOR OCD FRESH WATER PROTECTION RULES

Major OCD Statewide Regulations

#	TITLE	PURPOSE
0.1	Fresh Water	Defines "Fresh Water" to be protected.
1.	Scope of Rules and Regulations	Rules 1, 2 and 3 state in general terms that fresh water is to be protected and OCD staff has the authority and duty to enforce such rules.
2.	Enforcement of Laws, Rules and Regulations	(See Rule 1)
3.	General Operations/Waste Prohibited	(See Rule 1)
8.	Lined Pits/Below Grade Tanks	Requires OCD approval of design and leak detection system.
105.	Pit for Clay, Shale, Drill Fluid, and Drill Cuttings	Requires on-site disposal in a manner to prevent fresh-water contamination.
106.	Sealing Off Strata	Requires wells to be drilled and abandoned in a manner to prevent water or contaminant migration.
107.	Casing and Tubing Requirements	Requires necessary surface and intermediate casing strings and cement to protect fresh water.
116.	Notification of Fire, Breaks, Spills, Blowouts	Notification and action requirements.
202.	Plugging and Abandonment	Requirements for plugging and abandonment of drill holes and wells.
308.	Salt of Sulphur Water	Monthly reporting of water volumes.
310.	Tanks, Oil Tanks, Fire Walls, and Tanks Identifications	Prohibits oil storage in earthen reservoirs and requires fire walls.
312.	Treating Plants	Specifies requirement for facilities performing oil recovery from production wastes.
313.	Emulsion, Basic Sediments, and Tank Bottoms	Prohibits pollution of fresh waters or surface damage from these wastes.

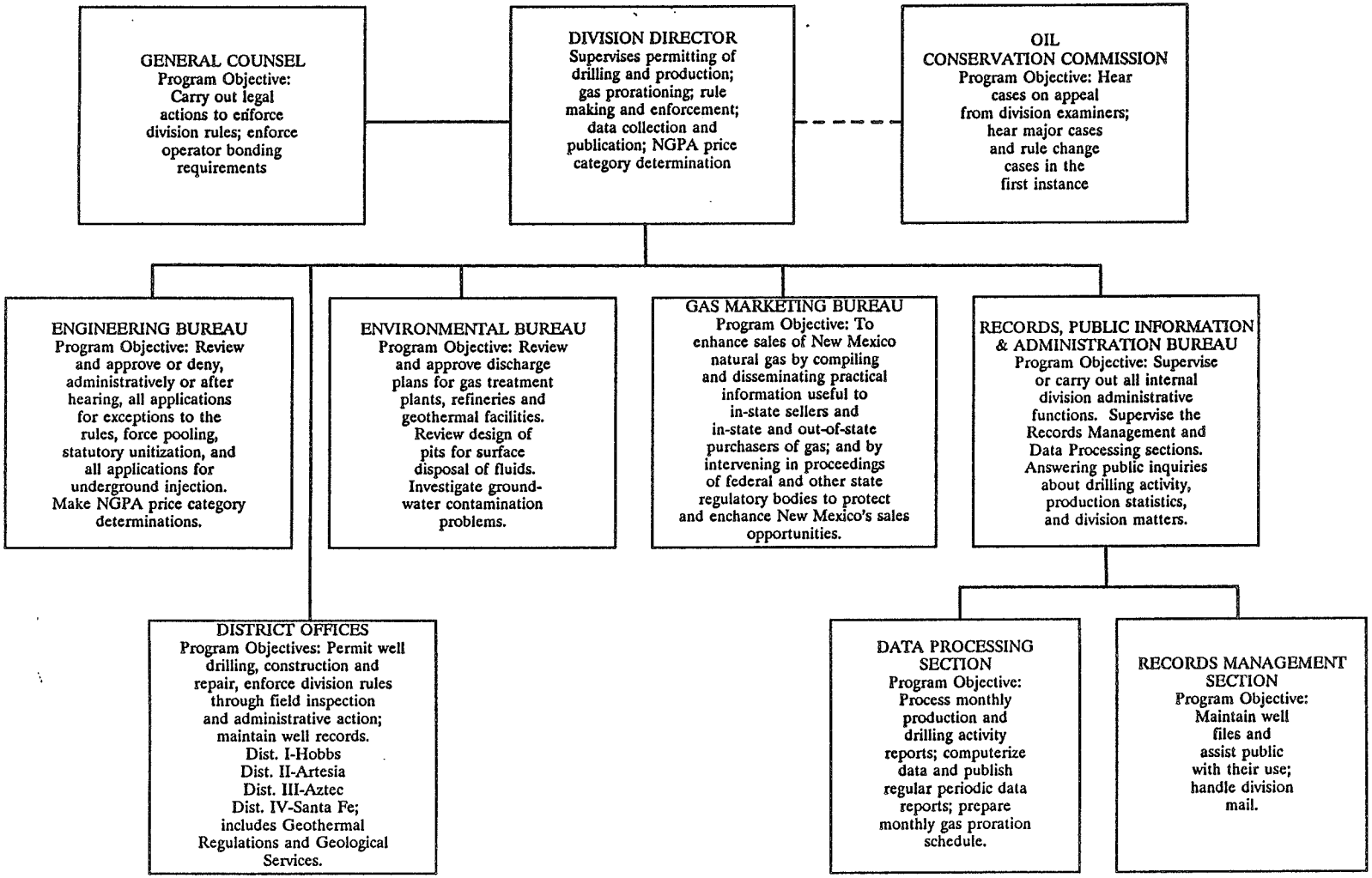
#	TITLE	PURPOSE
701-708.	Rules for Injection of Fluids	Underground Injection Control regulations for salt water disposal, waterfloods and pressure maintenance.
709.	Removal of Produced Water From Leases and Field Facilities	Requires transporter authorization to move fluids off-site.
710.	Disposition of Transported Produced Water	Prohibits disposal in water courses, pits, or in any other place or manner which will constitute a hazard to fresh-water supplies.
711.	Commercial Surface Waste Disposal Facilities	Requires a permit for commercial operations collecting, storing or disposing of produced water, drilling fluids or cuttings, or any other oil field waste in surface pits, ponds or below grade tanks.
R-8952	Migratory Waterfowl Protection	Requires screening, netting, covering or other protective measures to prevent migratory birds from contacting oily waste. Modifies rules 8, 105, 312, 313 and 711.

Major OCD Area-wide Orders

#	DATE	AREA	PURPOSE
R-1224-A	1958	Hobbs, Monument and other community areas within Lea County Underground Water Basin.	Prohibits disposal of produced water in unlined pits.
R-2526	1963	Oil pools of Pennsylvanian and Wolfcamp geologic age, Lea County.	Prohibits disposal of produced water in unlined pits.
R-2788	1964	An area 12 miles in length within 2 miles of the Pecos River in Chaves County.	Prohibits disposal of produced water in unlined pits.
R-3164	1966	Vacuum Oil Field (NW of Hobbs) Lea County.	Prohibits disposal of produced water in unlined pits.

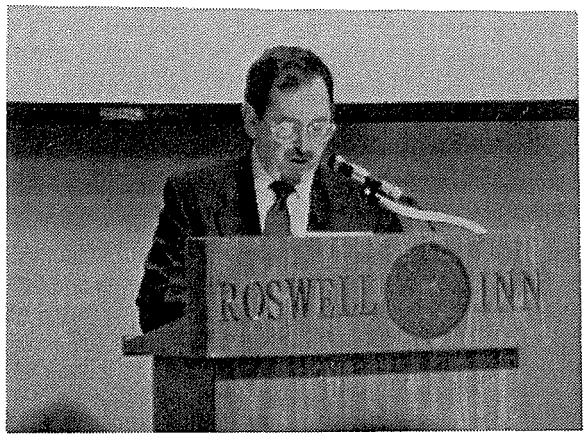
#	DATE	AREA	PURPOSE
R-3221 (as amended)	1967	All of Lea, Eddy, Chaves and Roosevelt counties (effective 1969).	Prohibits disposal of produced water in unlined pits. Areas have been and can be specifically excepted from the general order after demonstration through formal OCD hearing of no protectable fresh water.
R-7940	1985	Defined "vulnerable" ground-water areas in the San Juan Basin, mainly along the San Juan, Animas and La Plata River valleys.	Prohibits disposal of produced water in unlined pits, with small volume exceptions dependent on salt concentration and depth to ground water.
R-7940-A	1986	All of San Juan Basin (San Juan, McKinley, Sandoval and Rio Arriba counties).	Requires permits for commercial surface disposal facilities and registration and approval of centralized surface disposal operations.

OIL CONSERVATION DIVISION
Organizational Chart By Responsibility



David G. Boyer

Richard Mitzelfelt, director of the New Mexico Environmental Improvement Division has had 25 years of environmental health experience in the states of Georgia and New Mexico including 15 years of supervisory and managerial responsibilities. He is present chairman of the New Mexico Water Quality Control Commission, a member of the Coal Surface Mining Commission, and the Governor's Solid Waste Management Task Force. Mitzelfelt is past president of the New Mexico Environmental Health Association and past chairman of the Governor's Ground Water Quality Advisory Committee. He received a B.S. degree in biology from Southern College in Tennessee and an M.S. in environmental health from East Tennessee State University.



SOLID WASTE MANAGEMENT AND PROTECTING NEW MEXICO'S GROUND WATER

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Ground-water protection is an environmental priority for New Mexico. Most of the Environmental Improvement Division's (EID) programs directly protect ground water through programs such as the Ground Water Discharge Plan Program, Liquid Waste Disposal Program, Hazardous Waste Program, Drinking Water Supply Program, Surface Water Quality Program, Superfund Program, Underground Storage Tank Program, and the Solid Waste Program. The division's Air Quality Control Program indirectly protects ground water.

An integrated waste management program must include a number of aspects. First, a program must provide for worker, consumer and user safety, and protection of public and employee health. Programs must also protect the environment, including air, soils, surface, and ground water. There are also land-use elements to be considered. Although not an EID mandate, solid waste does play a role in land-use management. Conservation of resources is another aspect, and again, although not an EID mandate, it is an integral part of solid waste management programs. Funding mechanisms for local governments including loans, grants, and bonds are required to support this type of program. Waste reduction, reuse, and recycling should also be included. Public education and technical assistance to local governments as well as site remediation programs should be included in an integrated solid waste management program.

On May 14, 1989, new Solid Waste Management Regulations were put in effect. These regulations protect ground water in the following ways. A permit process is required for all new sites. This process can also be applied to existing sites. The process addresses ground-water protection issues and provides for detailed applications, reviews, and public involvement.

Stringent site conditions must be met under these regulations or, in lieu of that, control systems such as liners provided to protect ground water. Flood plains, faults, wetlands, and unstable areas must be avoided.

The disposal of bulk liquids in landfills is prohibited under these regulations. Sites must be secured and have controlled access. Operators must be on site whenever the landfill is open.

Ground-water monitoring is required for all facilities that can potentially impact ground water. Random inspection of loads is required to exclude

hazardous wastes. Record keeping, monitoring, and technical demonstrations also are required. In addition, the regulations require EID inspections to be frequent and comprehensive. Inspections should keep operators alert and honest. Finally, financial assurance, closure and post-closure care must all address long-term ground-water protection.

I will give you a briefing on where we are today. The Municipal League, the Association of Counties, and others have sued the Environmental Improvement Division and the Environmental Improvement Board. They have obtained a stay of the Solid Waste Management Regulations. However, there are a number of things going on in view of the stay. Sixty-three sites have been closed. Thirty to thirty-five have been replaced with collection stations.

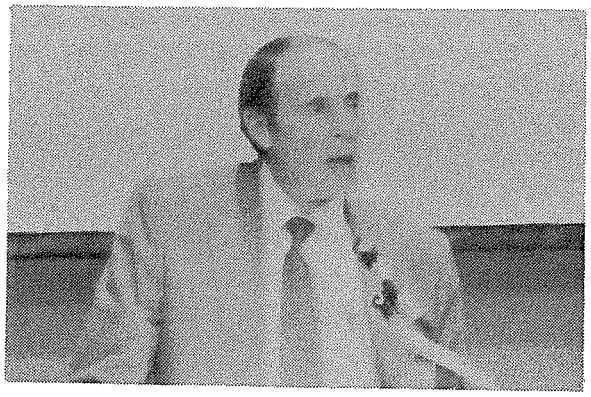
We have had some transition problems. Some sites, which had been closed, are continuing to be used illegally. Many bulk containers not large enough to contain the waste have overflowed. We have been warned to expect more illegal dumping in the arroyos.

A number of cities and counties including Albuquerque, Bernalillo County, Dona Ana County, Las Cruces, Santa Fe County, Santa Fe, and McKinley County have already made significant progress in establishing regional disposal sites. We think this is one of the real keys in any future solid waste management program. The new application process is much more comprehensive when compared to the old registration process. It requires the applicant to address all concerns related to health, safety, and ground-water protection. After the lawsuit is resolved, we expect to implement the regulations. At the moment, we are making progress through voluntary means.

The issue of recycling is being studied right now by the governor's task force on solid waste management and a legislative interim committee on the environment, land use, and solid waste management. We do expect to have a bill with recycling mandates during the next legislative session.

Although the court stay of the Solid Waste Management Regulations has delayed statewide implementation of these comprehensive regulations, progress is being made through voluntary efforts. Also, the governor and the legislature are committed to comprehensive solid waste legislation in 1990.

Bruce Elliott is the chief of the Water Quality Management Branch of the Environmental Protection Agency, Dallas Regional Office. He has been with the EPA since 1970. Elliott received a B.S. in Civil Engineering from Texas Tech.



EPA PROGRAMS AND PERSPECTIVES

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INTRODUCTION

It is my pleasure to be here today to discuss some of the ongoing water programs at the Environmental Protection Agency (EPA). Over the last two years, EPA has focused their water quality program as directed by Congress when the Clean Water Act (CWA) was amended in 1987. In addition, the Safe Drinking Water Act Amendments of 1986 are causing considerable, rapid changes in the Drinking Water Program. Congress not only gave EPA and the states a tremendous amount of work, they also set a very ambitious schedule for completion. I will briefly outline these directions and then discuss some of the implications to water quality in New Mexico.

Two of the 1987 directives deal specifically with water quality problem identification and the requirements to implement controls to restore and maintain the quality of our rivers, streams, and reservoirs. The first is Section 319, which addresses nonpoint source pollution control and the second is Section 314, which addresses restoration of impaired publicly owned lakes.

Nonpoint Sources

Section 319 of the 1987 amendments addressing nonpoint source pollution (NPS) required each state to prepare an Assessment Report and Management Program. Each state was required to complete their assessments no later than August 1988. Briefly, the NPS Assessment Report was to include the following:

1. A list of waters, which without additional action to control nonpoint source pollution, cannot be reasonably expected to attain or maintain the water quality standards or the goals of the act
2. The types (or categories) of nonpoint sources affecting the waters
3. The process the state will use to identify Best Management Practices (BMP) in each category
4. The existing state and local programs that assist in nonpoint source pollution control

The amendments required states to use available information from a variety of sources and to use an open assessment process that would allow participation from all those with an interest and expertise in water quality. Secondly, Section 319 required

states to develop a nonpoint pollution management program.

The management program was to include the following:

1. The Best Management Practices to be used to reduce nonpoint source pollution from each category of pollution
2. The state and federal programs that will be used to implement the Best Management Practices statewide and in targeted watersheds
3. A schedule of annual milestones for implementing Best Management Practices
4. A certification by the state's attorney general assuring that state law provides adequate authority to implement the management program or a schedule to seek such authority if it is lacking
5. State and federal funding sources to be used to implement this program
6. A list of federal projects that will be reviewed for conformance with the state program

An annual progress report to Congress by EPA is required with a final report on the progress made in reducing pollution due on 1 January 1990.

New Mexico submitted both an Assessment Report and a Management Program. Both have been approved. The New Mexico Assessment Report identified over 1,200 of the state's 3,500 river miles and 120,800 of 126,500 public lake acres as being affected by nonpoint source pollution. Also, over 50 percent of the 883 known ground-water contamination cases are identified as being caused by nonpoint sources. The state worked with a multi-agency task force and the public to develop the Management Program. The Management Program relies heavily on the cooperation of many agencies for its successful implementation. It contains more than 100 milestones to be met by thirteen different agencies at the state, federal, and local levels. It also contains four cooperative watershed treatment projects for nonpoint source control.

One major challenge facing states over the next year will be program implementation. It will require active support and participation by all thirteen agencies as well as private entities.

Clean Lakes

Section 314 of the CWA Amendments reauthorizes the National Clean Lakes Program that was begun in 1976. The program provides financial assistance to the states for the restoration and protection of publicly owned lakes. Reauthorization of the program added several important requirements including a Lake Water Quality Assessment Report including a revised lake classification report, a list of lakes known not to meet water quality standards or require controls to maintain standards, and a status and trend assessment of lake water quality. This list of threatened and impaired lakes was submitted as part of the state's biennial water quality report.

Over the past year, New Mexico has received two grants for their lake water quality program. One grant will assist the state in assessing and classifying lakes and another is the first phase of a study on the best restoration alternative for McGaffey Lake.

A common element of the two grant programs is the requirement to list and target those waters most severely impacted or at highest risk. As you can see, the states and EPA have had a full agenda over the last two years related to nonpoint sources and lakes. Given the number of agencies and parties involved, increased coordination and program integration of all federal and state programs are essential.

Indian Tribes

A few words about provisions of the 1987 Clean Water Act Amendments dealing with Indian tribes may be of interest. Indians were provided additional water quality management opportunities under Section 518 of the amended Clean Water Act. This topic is of particular interest to New Mexico with its 22 federally recognized tribes occupying land in the state. Section 518 provides the opportunity for Indian tribes to be treated as states for water quality management purposes.

In 1990, the priority for Indian tribes should be the development and adoption of water quality standards. Standards are the cornerstone of any water quality program.

When adopting water quality standards, Indian tribes would be subject to the same requirements as states. States are required to review their standards at least every three years and hold public hearings to provide the public with an opportunity to comment on proposed standards. Every three years, states must review any waterbody with standards not consistent with the fishable/swimmable goals. This is done to determine if new information has become available that warrants a revision of the standard.

In reviewing and adopting water quality standards, it is important to ensure consistency with both upstream and downstream standards. EPA will be establishing a process to resolve any conflicts or incompatibilities with adjacent stream standards. Tribes are to submit the new or revised water quality

standards and supporting documentation to EPA for review and approval.

Standards Criteria

While on the subject of standards, I would also like briefly to give you an idea of New Mexico's achievements in the standards program. The state of New Mexico's most recent triennial revisions to water quality standards were adopted by the New Mexico Water Quality Control Commission 8 March 1988 and approved by EPA Region 6 on 31 May 1988.

No numeric criteria for priority pollutants were adopted in the 1988 revisions. However, the state has been making progress in complying with the requirement in Section 303(c)(2)(B) of the Clean Water Act. This section requires states to adopt numeric criteria for all priority pollutants for which criteria have been published, if the discharge or presence in the affected waters could be reasonably expected to interfere with designated uses. Numeric criteria refer to both criteria protective of aquatic life and criteria protective of human health. New Mexico, while complying with one of the requirements of the Clean Water Act to identify and list segments with toxicity problems, has been identifying priority pollutants requiring adoption of numeric criteria. The state will submit a draft of the revised standards by June 1990.

Ground Water

In reviewing this conference's agenda, considerable time has been scheduled for discussion of ground water. I believe that is both timely and appropriate. Another top priority at EPA is groundwater protection. On a national scale, protecting ground water involves addressing about 1,500 hazardous waste land disposal facilities; 1,194 Superfund sites, ten of which are in New Mexico; thousands of nonhazardous waste disposal facilities; hundreds of thousands of injection wells; over a million underground tanks; about 23 million residential septic systems; and the use of millions of pounds of pesticides and millions of tons of fertilizers. The potentially regulated community encompasses not only a few large industries and businesses, but also small businesses, individual homeowners, and farmers.

We recognize that, in New Mexico, pollution of shallow ground water has the potential to contaminate private drinking water wells. The environmentally sensitive river valleys and floodplains, which often contain shallow aquifers, are also the most densely populated areas in New Mexico. Among the five states covered by our regional office, (Louisiana, Arkansas, Oklahoma, Texas, and New Mexico), New Mexico is of particular interest to us with regard to ground water because much of the area's geology renders the limited ground-water supplies vulnerable to contamination.

Approximately 87 percent of the population in New Mexico depends on ground water for drinking water and it is the only source of water in many parts of the state. Compare this to approximately 50 percent in Arkansas, 69 percent in Louisiana, 41 percent in Oklahoma, and 47 percent in Texas, and it is easy to understand the importance of ground water in New Mexico.

New Mexico took the initiative to protect ground-water resources a decade ago when the New Mexico Water Quality Control Commission adopted a comprehensive set of state ground-water protection regulations. New Mexico's regulatory program for the protection of ground-water quality is well established, workable, and effective. The ground-water laws of some sixteen states reflect New Mexico's influence. In general, I believe the state has done a good job to date on ground water, and deservedly serves as a model for other states.

Wellhead Protection Program

The 1986 Amendments to the Safe Drinking Water Act also established a new program to protect ground water supplying public drinking water wells and wellfields, called the Wellhead Protection Program.

Specifically, the safe Drinking Water Act required each state to develop and submit a wellhead protection program by 19 June 1989. The program was to be designed to protect wellhead areas from contaminants that may have adverse effects on human health.

New Mexico met the statutory deadline and submitted its Wellhead Protection Program to EPA for review and approval. The proposed New Mexico program established a 1000 foot radius around each public water supply well. Detailed contaminant inventories will be conducted in this area and contaminant sources identified will be subject to the applicable federal or state regulations.

Drinking Water

The last EPA water program I will mention today is our drinking water program. EPA is midway in the process of drafting regulations requiring drinking water to be more closely monitored and more thoroughly treated. The regulations will require that the public be notified sooner when

problems are discovered. The major requirements of Safe Drinking Water Act Amendments include:

1. The original list of 25 primary drinking water contaminants is to be expanded to 83. The final list of 83 contaminants will include organic and inorganic chemicals, microbiological contaminants, and radionuclides.
2. EPA was required to publish a priority list of drinking water contaminants by January 1988. We are further required to regulate 25 of these contaminants at three year intervals beginning in 1991.
3. The amendments also require EPA to develop regulations specifying criteria for filtration and disinfection of surface water and disinfection of ground water. The regulations for surface water were published in June 1989. However, the regulations for disinfection of ground water are probably several years away.
4. Monitoring for "unregulated contaminants" means that we are not proposing a maximum contaminant level for a given contaminant, but rather, we are establishing only a monitoring requirement. A decision will be made later, based on data gathered, as to whether each contaminant should be regulated. This monitoring is required or has been proposed for almost 200 contaminants to date.
5. Another new concept included in recent drinking water regulations is that of "vulnerability assessment." In several sets of regulations, the states are given discretion to require a system to monitor for a list of contaminants only if the system is judged "vulnerable" to those contaminants. Examples are pesticides, PCBs and asbestos. Criteria used to assess vulnerability can include previous monitoring results, use of a particular chemical/contaminant in the area, amount of protection of the source, and the mobility of the contaminant. We hope that through efficient use of the "vulnerability" concept, states will be able to target monitoring and save resources.
6. Monitoring for organic contaminants in ground water is a very important activity in New Mexico. The initial round of monitoring under the Volatile Organic Chemical (VOC) regulations, which included all water systems serving 10,000 or more people, found VOCs at a higher rate than was found in the other four states in Region 6. This may be reflective of larger systems being more dependent on ground water in New Mexico than in other states or it may actually indicate that more ground-water contamination is occurring here. We will get a better indication once sampling among the smaller systems is complete. Although more contaminated wells were found in New Mexico than other Region 6 states, the rate is still well below the national average.
7. The Drinking Water Section within the state's Environmental Improvement Division has done a good job of implementing the requirements passed by EPA. The section has received approval to implement a fee system to raise funds to supplement the federal grant funds dedicated to the drinking water program. If successfully implemented, this system should go a long way toward supporting the New Mexico Drinking Water Program through the coming expansion period.

I believe we have been busily striving to restore and maintain the physical, chemical, and biological integrity of our nation's waters as stated in the Clean Water Act. The programs I have discussed briefly today are just a few of EPA's water programs that are implementing the goals of the Clean Water Act and the Safe Drinking Act. I thank you for the opportunity to mention these programs and encourage you to call us if you have more specific questions.

Lonnie Mathews is the chief of the Bureau of Pesticide Management at the New Mexico Department of Agriculture. Mathews is a native New Mexican, raised on a ranch in Las Vegas and graduated from New Mexico State University with a B.S. in horticulture. He has worked for NMDA for 24 years.

NEW MEXICO DEPARTMENT OF AGRICULTURE'S PROGRAM FOR THE EPA'S PESTICIDE/GROUND WATER DIRECTIVE

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INTRODUCTION

At the beginning of the 1980s, many of us involved in pesticide regulation believed that pesticides in ground water would be the issue of the 1980s. While there has been much discussion and some movement on the part of the Environmental Protection Agency (EPA) and some states, pesticides in ground water is one of the big three pesticide issues for the 1990s.

EPA has mandated a timetable for development of plans by all states to address prevention of ground-water contamination by pesticides. However, other factors may hinder progress in this area. Before I describe to you what the New Mexico pesticide plan may entail, I want to say up front that I believe very strongly that New Mexico does not have and is not likely to have a serious problem with contamination of ground water by pesticides. I will describe why later.

Ground water, an issue in the 1980s, and still an issue in the 1990s, may receive less attention than deserved because of three other major pesticide concerns. The first, and from New Mexico's perspective the easiest with which to deal, is protection of endangered species from pesticides. The New Mexico Department of Agriculture (NMDA) has submitted its endangered species plan to EPA and we expect approval in 1990 with implementation in 1991. This will take some additional resources but not a significant amount.

The second pesticide issue concerns worker safety. This is a new area for most pesticide regulatory agencies and involves people's health and real or perceived risks to their health. It will require resources and a great deal of effort to develop and implement a regulatory program. This program alone has the potential to be as large as our entire current pesticide program. With our limited staff, worker safety has the potential to pull considerable resources from other programs such as ground-water protection.

The third issue is a non-problem as far as most of us in the business are concerned but it is a very real problem in the minds of many people. The issue is food safety. While due in part to the sorry state of science education in the United States, it is nonetheless the kind of topic which takes time and resources out of proportion to its real importance. Because of these and other competing pesticide issues, we may well be discussing pesticides and ground-water protection at the turn of the century.

EPA'S GROUND-WATER STRATEGY

In December of 1987, EPA published a document on a proposed strategy for Agricultural Chemicals in Ground Water and as far as we know, this is still the guidance document EPA is following for planning purposes. The proposed strategy made some points we believe are important to note and which we hope reflect EPA's attitude as these plans are developed.

1. Integration of pesticide registration activities with efforts to prevent ground-water contamination
2. Plans tailored by the states to meet specific local ground-water protection needs
3. Strategy focused on the prevention of unacceptable contamination of ground water by pesticides

The last two concepts are the most important as far as NMDA and the agricultural community are concerned.

The plans must be developed locally and reflect local conditions on a relatively fine scale. Otherwise, we will see what we saw with the original EPA endangered species maps where the boundaries for the species were drawn to county lines and bore little, if any, resemblance to the actual distribution of the species.

Also, "unacceptable contamination" is an important concept. While no one wants deliberately to contaminate ground water, increasingly sophisticated chemical analytical methods may in fact reveal some minute contamination at levels far below any shown to affect human health. Also, some agricultural areas with no community water supplies and with domestic well water pumped from a different aquifer, might well be willing to accept some low level of irrigation water contamination. An urban area of the state might not be willing to accept that same level of contamination. It is important that local citizens have some control over the use of their ground water.

NMDA'S THOUGHTS ON A PESTICIDE/ GROUND-WATER STRATEGY

We intend to begin work during 1990 on a state plan for the prevention of ground-water contamination by pesticides. The plan will not be finalized until at least 1992. Apparently, EPA hopes to have negotiated plans and cooperative agreements with all states by 1995.

NMDA envisions forming a task force for pesticides and ground water similar to the one developed for our endangered species plan. The task force will have members from interested state and federal agencies and universities. Public hearings will be held at various stages for citizen input. However, we see these task forces as forums for scientific input primarily and not for policy input.

NMDA believes our work in New Mexico will be much less than that necessary in many states. Because water has always been important in the West, our water laws and what we know about our water are more advanced than in many eastern states. Information on identifying aquifers, water quality, and other background data required by EPA for a ground-water plan is already available to us.

We see New Mexico's pesticide/ground-water plan as a relatively short supplement or appendix to the overall Water Quality and Water Pollution Control Plan developed by the New Mexico Environmental Improvement Division. At this time, we do not believe we will need additional statutory authority to implement a workable plan.

In general, we see the pesticide plan as consisting of the following parts:

1. Identification of cropping patterns and pesticide use patterns
2. Development of an extensive monitoring and well survey protocol
3. A three-tier approach to pesticide regulation to prevent or mitigate pesticide contamination of ground water

Monitoring is an essential part to any ground-water plan and requires a large commitment and coordination among a number of agencies. No one agency has the manpower to monitor all agricultural areas for pesticide contamination. Also, this is an area where existing programs can be used to piggy-back work for the pesticide/ground-water program.

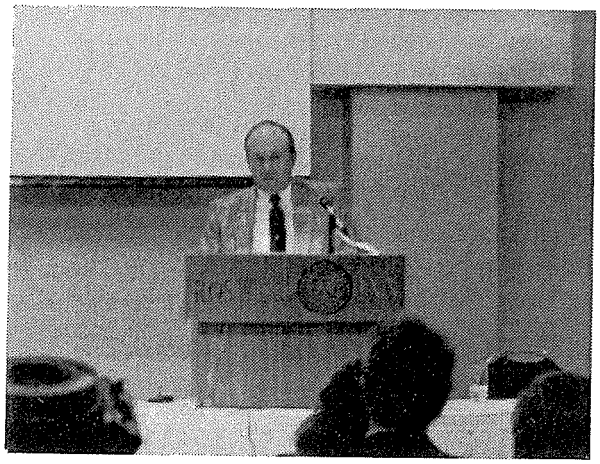
The tier approach to pesticides regulation to prevent or mitigate contamination of ground water would work something like this:

1. leachable pesticides would be identified
2. some level of maximum contamination would be set - probably the health advisory level for a particular pesticide
3. detection at any level and increased monitoring would occur
4. at some percentage of the maximum level, restrictions on the use of the pesticide would be imposed
5. at levels approaching say 60 to 75 percent of the maximum level, a total ban on the use of the pesticide would be imposed

This is essentially the concept the Governor's Ground Water Advisory Committee accepted in 1988.

Again, because of the relatively low volume and types of pesticides used in New Mexico, and the changing pattern of pesticide use away from soil-applied insecticides, I do not believe New Mexico has a pesticide/ground-water problem, nor do I expect one to develop. However, a state plan for monitoring on a broad scale will give us valuable knowledge we do not now have and should insure against developing a ground-water problem unknown to us.

Bob McQueen is the state resource conservationist with the U.S. Department of Agriculture Soil Conservation Service. McQueen has worked for the SCS since 1966 in Texas and Colorado before coming to New Mexico in 1984. His present responsibilities include managing the Resource Technology Staff for New Mexico SCS, which includes activities in range, agronomy, forestry, biology, plant materials, water resources, and watershed planning throughout the state. He is an officer in the Society for Range Management and an active member of the Soil and Water Conservation Society, National Association of Conservation Districts, and the New Mexico Association of Conservation Districts. McQueen is a new member of the Water Resource Research Institute's Water Conference Advisory Committee.



SOIL CONSERVATION SERVICE GROUND WATER QUALITY PROGRAMS

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President Bush's 1989 Water Quality Initiative made the U.S. Department of Agriculture (USDA) responsible for addressing agriculture-related water quality concerns in our ongoing and new programs. In response to the President's Initiative, USDA has developed an integrated water quality plan that includes three components:

- Education
- Technical Assistance
- Research and Data Bases

The Soil Conservation Service (SCS), Cooperative Extension Service, Agricultural Stabilization and Conservation Service, and a host of other agencies will be involved in implementing the water quality plan.

This plan sets the direction for USDA activities for the next five years. The plan primarily focuses on the effects of nonpoint source pollution on ground water. Under this water quality initiative, SCS will:

- Let state and local governments call the shots when it comes to defining water uses, establishing water quality standards, and setting priorities for action.
- Continue to emphasize voluntary action by landowners and land users. We will go out of our way to help people figure out how to prevent water pollution. We hope there will be no need for regulatory restrictions on the use of chemicals essential to agricultural production.
- Give water quality more attention in our technical assistance programs.
- Support research that helps us figure out where pollutants originate and what off-site effects they have.
- Make sure we are trained to identify and help solve water quality problems.

In helping the public improve and protect water resources, we are facing some new challenges. However, SCS in New Mexico is committed to improving water quality and quantity and is preparing to meet this challenge.

It appears the final 1990 USDA budget will include $13 million requested by the President for SCS water quality activities. The budget supports the following:

- regional demonstration projects

- treatment by hydrologic unit - a new concept for SCS
- regional technical assistance
- technology development
- data base development

Work plans for the regional demonstration projects, which are a cooperative effort of SCS and the Extension Service, have been received and are being reviewed.

Regarding the treatment by hydrologic unit, we submitted five projects for funding of nonpoint source treatment areas. As a result, a project located in Dona Ana and Sierra counties was one of 37 projects selected for funding nationwide. This hydrologic unit includes all the irrigated land below Caballo reservoir to the Texas state line.

Funds will be used to increase staffing to accelerate technical assistance to the farmers in the area. The farmers will be taught proper management of irrigation water, salinity, nutrients, and pesticides. The project is supported by the local Soil and Water Conservation Districts and by the Environmental Improvement Division of the New Mexico Health and Environment Department.

Another project is the Cooperative River Basin Study on the Pecos River. The SCS and Forest Service have received authorization for a study focusing on two questions. Have historic upland vegetation changes affected water quality and quantity in the Pecos River? Can improvement in upland vegetation, such as replacing invading brush with grass, increase water quantity or improve water quality in the river?

In January, representatives of the Forest Service and SCS will meet with the sponsors of the Pecos study. The representatives will become familiar with the sponsors' concerns and objectives. Anyone interested in sponsoring or providing input to the study should contact me or your local SCS office for details.

We are finishing the Hidalgo Y Luna Cooperative River Basin Study, which focused on irrigated cropland in Hidalgo and Luna counties. The primary objective was to evaluate the effect of irrigation practices on economics and conservation. Preliminary results show that the greatest opportunity for saving water, reducing production costs, and increasing yield is by monitoring soil moisture and scheduling irrigations based on crop needs and soil-water holding capacity. The Water Resources Research Institute and Black Range Resource, Conservation & Development Corporation joined forces to develop demonstration projects showing cost and savings associated with improving the efficiency of pumping plants.

Another SCS initiative, a Floodplain Management Study, started this past year. The project assists rural communities in identifying floodplains, wetlands and other important natural areas. The project also assists in developing management options the community can use to improve its quality of life and reduce environmental impacts from flooding. We currently have eight requests for this assistance and are starting on our first study with the city of Gallup. We expect to complete one study per year.

The Water Quality Act of 1987 requires states to assess their waters and prepare an assessment report for EPA. The act also mandates that states develop a management program for nonpoint source pollution control and that the program be implemented quickly. Both the assessment report and the management plan are prepared by the state's Environmental Improvement Division.

IMPROVE WATER QUALITY IN RURAL AMERICA

In New Mexico, our second priority is water quality, just behind our first nationwide priority, erosion control. In our state, erosion significantly affects water quality. Our agency's policy states that all USDA programs will be implemented in a manner that avoids harmful levels of contamination to ground and surface waters. This also means SCS field personnel need to be aware of how water quality may be affected by the conservation practices they recommend.

We are neither anti-chemical nor pro-chemical. We do support the prudent and wise use of chemicals. SCS is preparing a Water Quality Handbook, our initial effort at compiling the data needed by SCS personnel to incorporate the principles of water quality protection into conservation planning.

We will continually update this document as new information becomes available and as we make it specific to the field office level. Eventually, we will be incorporating the information into a Geographic Information System and our Field Office Resources Data Base. This new technology will improve our nonpoint source pollution control efforts.

We have been conducting training sessions throughout New Mexico for our field personnel. Our first round of training is complete, but due to interest from other federal and state agencies, we have been asked to conduct another session specifi-

cally for other agencies. The session will be held in Albuquerque on December 12-14, 1989. The Cooperative Extension Service and Environmental Improvement Division have been helping us present these workshops and we appreciate their involvement. The training is providing our field office planners with information that will enable them to identify water resources concerns and offer practical land-use alternatives to the landowner. For example, if a producer's land lies within an area that has water quality problems, this information will be available to the local SCS planner.

The SCS is serious about water quality and believes it is a very important issue to the nation and particularly to New Mexico. We recognize that agriculture is, or has the potential of being, a major contributor to the nonpoint source problem, if only because of the large areas involved and the amount of irrigated land.

Hopefully, agriculture is not as bad as some of the public perceives it to be. In my opinion, we must take action to correct any problems we do have--not only to prevent pollution, but also to try to change the public's perception of agriculture as being "all bad."

The SCS charge is to integrate water quality and quantity concerns into all our conservation planning and application activities. I do not foresee any drastic changes in our conservation planning process, but we certainly are going to place much more emphasis on water quality. We are not changing planning procedures but simply adding new tools to evaluate the impacts of our activities on water quality and quantity.

If a problem exists, we try to address it during the planning process in a logical and systematic way. This ensures an accurate diagnosis and that the right treatments or alternatives to correct the problem are prescribed.

By now, most of us have accepted the fact that water quality and quantity have become a permanent fixture in our planning process. Our responsibilities have changed in this respect but we plan to adapt and aggressively carry out our new role. As a final comment, I would like to emphasize that SCS is a strong supporter of voluntary action by landowners on water quality concerns.

Bob Porter is executive vice-president of the New Mexico Farm and Livestock Bureau, the state's largest agricultural organization. He has been working for the Bureau since 1954 when he began his career with the Dona Ana County Farm and Livestock Bureau. Porter is secretary-treasurer of Western Farm Bureau Mutual Insurance Company, Farm Bureau Marketing Corporation, and Western Farm Bureau Loan Company and editor of the New Mexico Farm and Ranch magazine. He serves on the board of directors of the Aggie Sports Association, the Governor's Economic Development Commission, and is a member of the Association of Commerce and Industry. The Las Cruces resident has been recognized as one of the 100 outstanding agricultural graduates at New Mexico State University and as a distinguished alumnus of the NMSU College of Agriculture.

CONCERNS OF THE AGRICULTURAL COMMUNITY

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On behalf of the New Mexico Farm & Livestock Bureau, I am pleased to appear here today to address the very important topic of water quality and ground-water protection. We believe there is a need for research, education, and technical assistance to agricultural producers in the area of water quality. From Farm Bureau's perspective, we think the Farm Bill is an appropriate vehicle to do some of these things and we will be working toward that goal.

The protection of our water resources, from both a quality and quantity standpoint, is essential to the future of agriculture. As has been noted many times in recent years, over 90 percent of our rural population relies on ground water as a source of drinking water. No one has more at stake over the protection of water resources than farmers and ranchers. They live on the land they work, and their own wells or irrigation water are often the first indication of possible problems. Water quality has been a concern of agriculture long before it became a "public" issue. Farm Bureau has had a water quality program and has conducted training and educational workshops for our members for more than a dozen years. These programs have focused on both ground water and surface water protection, and have promoted practices designed to prevent contamination and soil erosion. I offer this only as evidence that contrary to public perception, farmers are vitally concerned about the issue and have been active in resolving the problem for some time.

As we have all learned in recent years, water quality is a very complex issue. A tremendous need exists for research into the causes of ground-water contamination, how to prevent it, and what effects trace amounts of contaminants will have on health and the environment. Indeed, the more we learn, the more we realize the need for additional information. Contrary to early thinking, the evidence from an Iowa study is now showing that the general application of pesticides and fertilizers may not be the primary cause of contamination. Rather than this being a nonpoint source problem, it now appears much of the contamination can be traced to point sources, such as sink-holes, cracked well casings, drainage wells, applicator mixing and loading sites, and commercial facilities. Such information is

extremely important in determining what the appropriate response should be. It also suggests that we should proceed cautiously or we risk spending time and money responding to the wrong perception.

Furthermore, it underscores the fact that this is ultimately a problem where the solutions are local in nature and generally site and soil specific. We believe public policy should recognize the need for states and local governments to have primary responsibility for addressing this issue. However, an essential role exists for the federal government to play if we are to have a consistent and coordinated response. Specifically, we believe the federal government must take the lead in developing standards, establishing broad policy guidelines, undertaking research, and providing technological and financial assistance.

From agriculture's standpoint, we believe the U.S. Department of Agriculture is particularly well suited to address those aspects dealing with research technical assistance and cost sharing. The Soil Conservation Service (SCS), the Agricultural Stabilization and Conservation Service (ASCS), the Agricultural Research Service (ARS), the Cooperative State Research Service (CSRS), and the Cooperative Extension Service all have extensive technical, scientific, data collection, and outreach capabilities that should be utilized.

Let us now turn to research and information needs we believe are desired and would benefit the farm and ranch community. Sound information is absolutely essential to good decision making at the farm level. Opportunities should be created for cost and technical assistance to farmers and ranchers. Many of the Best Management Practices will cost money to implement, such as purchasing new application and tillage equipment, installing concrete pads around mixing and loading sites, digging new wells, establishing filter strips, etc. Short-term economic considerations should not serve as barriers to long-term environmental quality.

The establishment of a cost-sharing program for well testing should be considered. We believe a well-testing program should be voluntary and confidential, and should not be linked to threatened denial of farm program benefits. Such a linkage presupposes an unwillingness on the part of agriculture that does not exist and contributes to an atmosphere of suspicion and finger pointing. The basic assumption should be that any water quality problem found is the result of longstanding, generally accepted farming practices and lawful use, not misuse. Therefore, the focus should be on incentives rather than penalties.

Regarding specific research needs, we suggest the following areas for consideration:

Predictive Modeling: How can we better understand what happens to chemicals after application, and what can be done to predict their fate prior to application? How can this information be used routinely on the farm?

Plant Nutrition: Additional research is needed to determine the optimum level of nutrients necessary for crop production. More efficient nutrient management will reduce both input costs and the potential for contamination.

Environmental Fate: We need to learn more about the movement and behavior of farm chemicals after they are applied. What can be done to encourage breakdown? What role does soil and water management play?

Chronic Effects: What are the long-term health effects of consuming drinking water with trace amounts of pesticides? Additional research should be done to determine whether the human immune system and nervous system are affected.

Integrated Pest Management (IPM): What needs to be done to increase the use of IPM on a broad scale? How do EPA's regulatory decisions affect the adoption of IPM technologies? What are the research and data needs necessary to foster widespread use of IPM programs? What is the most effective means of communicating this information to farmers? The widespread adoption of IPM is a priority for Farm Bureau.

Biotechnology: We need to strengthen research on alternatives to chemical pest controls as a way to increase options available to farmers and ranchers. The development of microbial agents for weeds, diseases, insects, the introduction of resistance into crop plants, and even the degradation of chemical waste offer great promise to agriculture. We need to examine the regulatory impediments that may inhibit research and marketing of those products.

Crop Rotation: Examination of crop rotation practices to find the optimum soil/crop rotation should help reduce the need for herbicide, insecticide, and fungicide controls by keeping pest populations in check.

Integrated Farm Management Practices: This is what we believe the concept of low-input sustainable agriculture means at the farm level. An integrated farm management systems approach incorporates tillage, nutrient, chemical and pest management within the context of conservation practices, soils, and crop production plans. The systems approach may help reduce energy costs, input costs, soil erosion and contaminant leaching. It offers agricul-

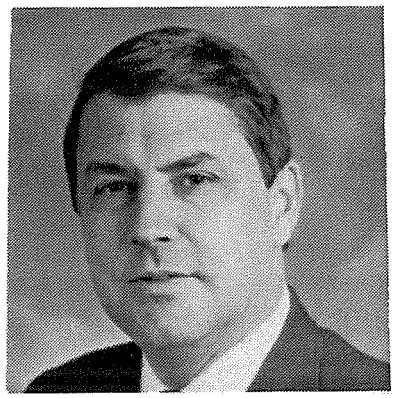
ture some exciting long-term possibilities from the perspective of improving net farm income and environmental protection.

Undoubtedly, there are many more areas where research would be appropriate. The American Farm Bureau and many state Farm Bureaus have had a great deal of interest in ground-water protection for many years. In the absence of federal and state regulation, a concerted private sector effort has been aimed at educating and informing farmers and ranchers about ways to protect ground water. Farm Bureaus' commitment to assist farmers in protecting their ground water extends throughout the organization. Hundreds of county and state Farm Bureau workshops and training programs have been conducted focusing on conservation practices, awareness, prevention, and well testing.

In February, 1986, The American Farm Bureau Federation conducted an educational water testing program at its annual Program Kickoff Meeting. Samples were received and analyzed from 44 states including New Mexico. The Farm Bureau has also prepared a Self-Help Checklist designed to help farmers and ranchers analyze their own water supply and farming operations. This publication instills an awareness of good operating practices and also serves as a record-keeping system for annual tests of pH levels, nitrates, bacteria, and dissolved solids. In addition to the checklist, Farm Bureau has joined with the National Agricultural Chemicals Association, the U.S. Extension Service, and the National Agricultural Aviation Association in the preparation of another publication entitled, *Protecting Our Groundwater--A Grower's Guide*. This publication was designed to assist growers by promoting safe pesticide handling practices. Literally tens of thousands of these booklets have been distributed to farmers and ranchers across the country in the last year.

The American Farm Bureau Federation's board of directors recently authorized development of a water-testing program similar to one in Ohio that would be offered to state Farm Bureaus nationwide. In conclusion, farmers and ranchers have made a strong commitment to protecting their water resources from agricultural chemicals even though a specific federal policy is absent. That commitment and concern will continue to grow because of the unique dilemma the issue poses for farmers and ranchers.

John D. Kemp is the director of the Plant Genetic Engineering Laboratory and a professor of plant pathology at New Mexico State University. As director of PGEL, he oversees about 50 faculty members, technicians and students. In 1983, the first successful recombinant DNA transfer was performed under Kemp's direction at the University of Wisconsin and Agrigenetics Corporation. This experiment proved for the first time that a plant gene could be transferred into and expressed in a distantly related species. Kemp received a B.S. in chemistry and a doctorate from UCLA. He is a member of the Water Resources Research Institute's Program Development and Review Board.



NEW PLANTS FOR THE 21ST CENTURY

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The Plant Genetic Engineering Laboratory (PGEL) is one of five original Centers of Technical Excellence established in 1983 in New Mexico. The state legislature was quite farsighted in identifying plant genetics, plant genetic engineering, and biotechnology as the future of agricultural technology. Since that, time virtually every state in the union has created some type of biotechnology program, many of which are based on what was initiated here in New Mexico. The mission of PGEL is fairly simple: develop basic and applied research programs in plant biotechnology emphasizing agriculture for semiarid lands and New Mexico.

Plant genetic engineering can be defined as using the new tools of biotechnology to improve plants; the tools may be new, but man has been improving plants for probably 10,000 years. We have been improving plants ever since we stopped our nomadic wanderings across the face of the earth and settled into communities. We could stop being nomads because we made a fundamental scientific discovery 10,000 years ago. Although the discovery seems quite simple today, it was very profound then. Man was wandering across the face of the earth gathering seeds and using those seeds as a source of food. What man discovered so long ago was that he could place some of those gathered seeds in the ground and a plant would emerge. That plant would provide more seed of the same kind. Suddenly, man did not have to wander on the face of the earth gathering seed for food. Instead man could grow crop plants in one location and settle into communities. We then carried the concept one step further and began selecting those plants best suited for our needs. Hence, we became true genetic engineers. A photograph of a tomb in Thebes, Egypt, around 4000 B.C. shows a man standing next to wheat of a uniform height about shoulder high so it could be sickled by hand. Other paintings from that era reveal that flax and hybrid fig trees were also being cultivated and selected for desirable characteristics.

An example a little closer to home can be found near the Organ Mountains outside of Las Cruces. Some of the oldest hybrid corn in the world has been discovered in 4000-year-old archeological sites at the base of the Organ mountains. Over the last 3000 to 4000 years, man has made tremendous improvements in corn beginning with teosinte and ending today with the famous high yield midwestern Dent corn.

Though man has been a genetic engineer for perhaps 10,000 years, the early technology that man

used was rather simple. It involved making a genetic cross by taking the pollen from one plant and placing it in female parts of another plant. Then the ripe seeds of the cross were gathered and the plants that emerged from those seeds were selected for desirable characteristics.

George Mendal was a scholar who revolutionized our understanding of these processes by teaching us that genes are little packets of information that can be transferred in a predictable manner every time a cross is made. This knowledge break through allowed us to continue on to the sophisticated breeding programs that we have today.

The next breakthrough in the technology of genetic engineering came perhaps 40 years ago when we discovered genes are made up of a chemical - DNA (deoxyribonucleic acid). With that discovery, we suddenly had available to us a way of isolating genes as pieces of DNA. The difference between genetic engineering using traditional breeding versus using DNA techniques is that in a traditional breeding experiment you are limited to making a cross within a species. In other words, only males and females of the same species can breed. Therefore, if a particular trait is not within the species of interest, we do not have access to that trait using traditional breeding programs. However, if you can isolate that trait as a piece of DNA, you have the potential of moving that DNA into any species. That is the power of this technology, for it expands our gene pool from the species to virtually the living world. Two examples of this type of work is being conducted at PGEL. The first project deals with improving cotton by genetically engineering pest tolerance into this crop. A serious pest problem in cotton is the boll worm. This worm feeds on the cotton boll and destroys it. Our normal procedure for controlling the worm is to apply chemical pesticides. This is a very costly procedure and environmentally unsound. Soon we may have an alternate strategy. Recently, we were successful in isolating a gene from a bacterium that produces a biologically controlled agent that kills the boll worms. We also have been successful in transferring that gene as a piece of DNA from the bacterium into tomato plants. The gene in the new plant species is stable and perfectly functional. The plant is now protecting itself against those pesky insects. In the near future, cotton farmers will also realize an economic savings by having this protection gene in cotton. Furthermore, the environment will benefit as well with less reliance on chemical pesticides. Recently, we have identified a second gene we think will protect cotton against the boll weevil, an organism that has plagued cotton farmers for a 100 years. Currently, the boll weevil has not arrived in New Mexico but it will not be long before it does. We just hope it does not occur before the 21st century because it will take us that long to fully develop the new technology.

Another problem I see on the horizon is nematodes. These microscopic worms are potentially an enormous economic catastrophe on plants. Billions of dollars in crop loss occur each year because of nematodes. They may soon become a significant problem in this state especially in chiles and potatoes. We can apply pesticides to control them, but nematocidal chemicals today are among the most environmentally persistent and the most toxic of all the pesticidal chemicals. As a result, the federal government has removed from use all but a very few, and if it is necessary to remove the remaining one or two left on the market, many of our crop plants are going to be vulnerable to devastation by this worm. The alternative is to use a naturally occurring enemy of nematodes. At PGEL, we are investigating the potential of using a biological compound that kills nematodes by dissolving its skin. We are in the process of isolating the gene and transferring it to plants to see if indeed that gene will allow plants to protect themselves by killing any invading nematodes. This is another example of biological control making our plants resistant to many of the pests that we can only control today using chemical pesticides.

The economic impact that this technology will have on New Mexico agriculture can best be illustrated with the two projects I have just discussed (insect resistance and nematode resistance) plus our liquid wax project which I did not have time to cover. Together, these three projects will have a $237 million per year impact on the state's $1 billion agriculture business, an increase of over 23 percent. Gross cash receipts will increase nearly $76 million per year from the current $300 million. However, the biggest impact will occur in net farm income which will increase by $63 million per year from its current level of about $50 million. This is an incredible 129 per cent increase! We believe that the future for engineering our crop plants is very bright and exciting. The new tools of biotechnology will expand our abilities beyond our wildest dreams. It will not come in the next year or so and it will not be cheap, but maybe with your support and the continued success of programs like PGEL, we will see practical results by the turn of the century.

Dennis W. Darnall is chairman of the board of Bio-recovery Systems, Inc., a rapidly growing company engaged in recovery of heavy metals from industrial wastes and mining process waters. Prior to founding Bio-recovery Systems in 1986, Darnall was a professor of chemistry, associate dean of the College of Arts and Sciences, and director of the Arts and Sciences Research Center at New Mexico State University. In 1978, Darnall received the Westhafer Award for Research, the highest academic award given by NMSU to its faculty. He also received the National Institutes of Health Career Development Award. He received a B.S. from the New Mexico Institute of Mining and Technology, his Ph.D. from Texas Tech, and was an NIH postdoctoral fellow at Northwestern University.

USING ALGAE TO CLEAN UP WATER

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INTRODUCTION

The use of microorganisms in the treatment of hazardous wastes containing both inorganic and organic pollutants is becoming more and more common. There have been two approaches to the use of microorganisms in waste treatment. One involves the use of living organisms and the other involves the use of nonviable biomass derived from microorganisms. While the use of living organisms is often successful in the treatment of toxic organic contaminants, living organisms have not been found to be useful in the treatment of solutions containing heavy metal ions. This is because once the metal ion concentration becomes too high or sufficient metal ions are adsorbed by the microorganism, metabolism is disrupted causing the organism to die. This disadvantage is not encountered if nonliving organisms or biological materials derived from microorganisms are used to adsorb metal ions from solution. Instead, the biomass is treated as another reagent, a surrogate ion exchange resin. The binding, or biosorption, of metal ions by the biomass results from coordination of the metal ions to various functional groups in or on the cell. These chelating groups, contributed by the cell biopolymers, include carboxyl, imidazole, sulfhydryl, amino, phosphate, sulfate, thioether, phenol, carbonyl, amide and hydroxyl moieties.[1]

Various algal species and cell preparations have quite different affinities for different metal ions.[2,3] The different and unusual metal binding properties exhibited by different algae species are explained by the fact that various genera of algae have different cell wall compositions. Thus, certain algal species may be much more effective and selective than others for removing particular metal ions from aqueous solution.[4]

The reaction of metal ions with a nonliving algal cell is depicted in Figure 1. This reaction shows the interaction of divalent or trivalent metal ions with either a living or nonliving algal cell to form a complex composed of the algal cell and the metal ions. The result of this reaction, that is, the formation of the alga-metal ion complex is basically why metal ions are toxic to living organisms and shows how the toxic effect of metal ions is amplified in the food chain. The metal ions are adsorbed to the cell even when their concentrations are in the mg/L range. The bound metal ions, when accumu-

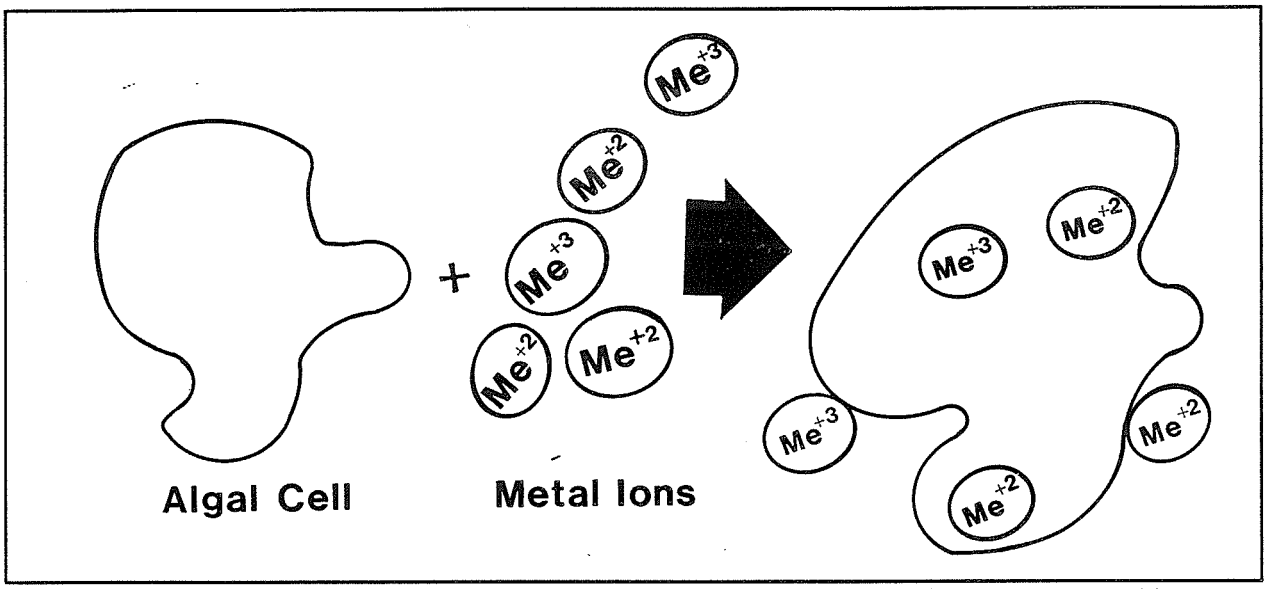

Figure 1. The Reaction of Metal Ions With an Algal Cell. Both divalent and trivalent heavy metal ions react with chemical groups on an algal cell wall to form an alga-metal ion complex.

lated over time, eventually interfere with metabolism by disrupting enzyme reactions and killing the organism. If microorganisms on which metal ions have been sorbed are used as a food source by larger organisms, the metal ions find their way into the food chain. This can eventually result in toxic effects for humans.

While the reaction shown in Figure 1 has been known for many years, it is only recently that advantage has been taken of the high affinity of microorganism cell walls to remove and recover metal ions from industrial waste water or contaminated ground waters. Methods to reverse the reaction shown in Figure 1 have been developed so that when metal ions are recovered from dilute solutions, they can be stripped off the cell walls in a highly concentrated form. The cells can then be reused to capture more metal ions from dilute solutions. Conditions can also be adjusted so that only one or two types of metal ions can be sorbed from solution and then they can be selectively stripped from the algal cell one metal at a time.[1,5]

AlgaSORB®: A NEW BIOSORBENT FOR WASTEWATER TREATMENT

Bio-recovery Systems, Inc. has developed a proprietary, algal based material, AlgaSORB®, which can be used on a commercial basis to remove and recover heavy metal ions from point-source industrial waste water, contaminated ground waters or mining process streams. AlgaSORB® functions very much like a commercial ion exchange resin. It can be packed into columns through which waters containing heavy metal ions are flushed. The heavy metal ions are adsorbed to AlgaSORB® and metal-free water exits the column for reuse or discharge. Once the AlgaSORB® is saturated with metal ions, the metals can be stripped from the AlgaSORB®, which is then ready for reuse. In comparison to ion exchange resins, however, AlgaSORB® has some distinct advantages making it superior to ion exchange resins for certain applications. In other instances, ion exchange resins perform better than AlgaSORB®. AlgaSORB® has a remarkable affinity for heavy metal ions; in some cases the metal-binding capacity is as much as 10 percent of the dry weight of the cells. The algae matrix is capable of concentrating heavy metal ions by a factor of many thousandfold.

When unadulterated algal cells are packed into columns, the cells tend to aggregate and form cohesive clumps through which it is difficult to force water even under high pressures. However, when the cells are immobilized into a polymeric matrix, this difficulty is alleviated.

The algae are killed in the immobilization process indicating that sorption does not require a living organism, and hence the algal matrix can be exposed, with little or no ill effects, to solution

conditions that would normally kill living cells. The pores of the polymer are large enough to allow free diffusion of ions to the algal cells, since similar quantities of metal ions are bound by free and immobilized cells. The immobilization process serves two purposes: (1) It protects the alga cells from decomposition by other microorganisms. AlgaSORB® immersed in aqueous solution for over two years has shown no decrease in metal binding efficiency. (2) It produces a hard material that can be nicely packed into chromatographic columns that can be pressurized and that have excellent flow characteristics.

Not only does the immobilized algal matrix appear to be useful for the removal of the "traditional" heavy metals from solution, but it also seems to be particularly useful for near quantitative removal and recovery of very low concentrations (in the parts per billion range) of precious metals such as gold, silver, platinum and palladium.[6] In addition, conditions have been developed for removing metallic oxoanions such as chromate from aqueous solutions using immobilized algae.

AlgaSORB® functions as a "biological" ion exchange resin and like ion-exchange resins, can be recycled. Metal ions have sorbed and stripped over many cycles with no noticeable loss in efficiency. In contrast to current ion exchange technology, however, a real advantage of the algal matrix is that the components of hard water (Ca^{+2} and Mg^{+2}) or monovalent cations (Na^{+} and K^{+}) do not significantly interfere with the binding of toxic, heavy metal ions. In fact, calcium or magnesium ion concentrations as high as 10,000 mg/L have little or no effect on AlgaSORB® sorption of copper at concentrations as low as 6.5 mg/L. The binding of Ca^{+2} and MG^{+2} to ion-exchange resins (even chelating ion exchange resins that are relatively selective for transition metal ions) often limits ion exchange usefulness since calcium and magnesium ions are frequently present in high concentrations and compete for heavy metal ion binding. This means that frequent regeneration of ion-exchange resins is necessary to remove effectively heavy metal ions from solutions. It also means most of the ion exchange capacity is spent in removing calcium and magnesium from the waters. Thus, AlgaSORB® has the potential to be particularly useful for removing metal ions from "hard" waters.

AlgaSORB® is also particularly effective for heavy metal removal from waters containing organic residues. Organics often foul synthetic ion exchange resins that limits their utility in many waste-water treatment applications, including ground-water treatments. AlgaSORB®, on the other hand, functions well in waters containing organic molecules.

WASTE STREAMS FOR WHICH THE AlgaSORB® TECHNOLOGY IS APPLICABLE

A. Industrial Point Sources

A major source of heavy metal wastes from industrial sources comes from the electroplating, metal finishing and printed circuit board manufacturing industries. Waste waters from these industries primarily come from rinsing operations. The rinse waters will typically contain rather low concentrations (on the order of 100 parts per million) of heavy metal ions. Certain of these waste streams are particularly amenable to treatment with AlgaSORB®. The metal can be recovered and then either recycled back into the process or recovered for use by other industries.

B. Ground Waters and Surface Leachates

Contaminated ground waters and surface leachates often contain heavy metals in the low parts per million or even parts per billion range. The AlgaSORB® technology is particularly well suited for removing and recovering heavy metal ions from these waters, which will often contain high concentrations of nontoxic dissolved materials. Often these types of waters will contain high concentrations of sodium, potassium, magnesium, chloride or sulfate that are innocuous and for which no treatment is needed. The AlgaSORB® is capable of preferentially removing heavy metals found in these streams. Toxic heavy metal ions recoverable with the algal biomass include copper, nickel, uranium, lead, mercury, cadmium, zinc, arsenic, and silver among others.

C. Drinking Water

In locales with older plumbing, heavy metals such as lead are often found in tap waters. Because AlgaSORB® has such a high affinity for heavy metal ions, ions such as lead can be removed with AlgaSORB® to levels well below those allowed in drinking water.

D. Precious Metal Recovery

AlgaSORB® has a higher affinity for precious metal ions than other heavy metal ions tested.[5,6] Thus, another area in which the AlgaSORB® technology is useful is in the recovery of gold, silver, or platinum group metals from mining process streams, waste waters resulting from mining operations, and industrial point source waste water.

ADVANTAGES OVER CONVENTIONAL WASTE TREATMENT

A. Disadvantages of Conventional Treatment

1. Sludge Disposal Costs

The conventional method for treating waste waters in electroplating or printed circuit board manufacturing plants has been to commingle all metal-containing waste waters and send them to a central location for treatment. Treatment methods vary depending upon what metals are present in the stream, but the most common treatment is precipitation of the metals as hydroxides. If metal cyanide complexes are present, cyanide is usually oxidized prior to metal precipitation. Likewise, if hexavalent chromium is present, it is usually reduced to trivalent chromium prior to precipitation. The metals hydroxide precipitates are then dewatered and most commonly sent to a hazardous waste landfill. As of 8 August 1988, these metal-containing sludges could no longer be sent to a hazardous waste landfill unless they are stabilized so that the toxic metal ions cannot be leached from the sludge. A variety of agents such as Portland cement fly ash or other pozzolanic materials can be used to stabilize the sludge. However, whatever the stabilization method, the disposal costs have increased dramatically since August 1988. In addition, both state and federal regulatory agencies are moving toward the future complete ban of land disposal of metal hydroxide sludges in any form.

2. Difficulty of Cost-Effective Treatment

In addition to high sludge disposal costs, another disadvantage of the conventional treatment system is the difficulty in many instances of reaching effluent metal conditions low enough to meet discharge standards. This is because hard-to-treat waters are often commingled with easy-to-treat waters thereby making all the waste water hard-to-treat. For example, in printed circuit board manufacturing operations, there are typically three different types of copper-bearing waste waters that must be treated: copper sulfate from acid copper baths, ammoniacal copper from alkaline etchers and chelated (usually EDTA quadrol or tartrate) copper from electroless copper baths. Copper sulfate responds very well to hydroxide precipitation, but the ammonia complex of copper and the EDTA chelate of copper are very difficult to treat with conventional hydroxide precipitation. Thus, expensive chemicals such as sodium borohydride or dithiocarbamates are added to the entire waste-water stream in order to treat the ammoniacal and chelated copper, which usually make up only a small proportion of the total waste streams.

3. High Water Consumption

When the conventional hydroxide precipitation of metals is used, usually sodium hydroxide or lime along with other reducing agents or flocculating agents are added to produce the metal hydroxide sludge. Once the sludge is removed from the waste water, the water is generally discharged to a sewer. No opportunity exists for reuse or even partial reuse of the water because of the effluent water has too many dissolved salts to be effective as a rinse water. The cost of deionizing this water is generally much higher than the cost of deionizing fresh tap water and hence water reuse is generally not a viable economic option.

4. Liability for Sludge Disposal

Generators of toxic metal sludges are held liable, without proof of fault, for cleaning costs and natural resource damage at hazardous waste disposal sites at which the generator's waste is disposed. Therefore, if the owners of a hazardous waste dump happen to mismanage the site so that toxics are allowed into the environment, it is the generator who is ultimately responsible for the cleanup. Thus, any process by which sludge can be minimized or eliminated will reduce liability for the generator.

B. Advantages of a Recovery-Recycle Approach to Waste Treatment

The AlgaSORB® technology has been incorporated into a highly effective recovery-recycle approach to waste-water treatment for the electroplating, metal finishing, and electronics industries. The concept is illustrated in Figure 2 for a treatment system that allows for recovery of metals and recycling of process waters. In this scheme, rinse waters derived from each individual plating bath are segregated and passed through columns containing AlgaSORB® or specialty ion exchange resins. Metal ions are removed from the rinse waters, which can then be discharged directly or returned to the rinse tanks for partial water reuse. Because salts tend to build up in the rinse waters, deionization of the treatment effluent may be needed if it is to be reused in crucial rinses. Otherwise, a bleed-off of water to the sewer is adequate to keep salt-build up at acceptable levels. Such an approach can often decrease water usage by 50 to 90 percent.

Once the columns of AlgaSORB® are saturated with metals, the metal ions can be stripped from the columns. The concentration of the stripped metals is approximately 10 g/L. In certain instances, these stripped metal ions can be added back to

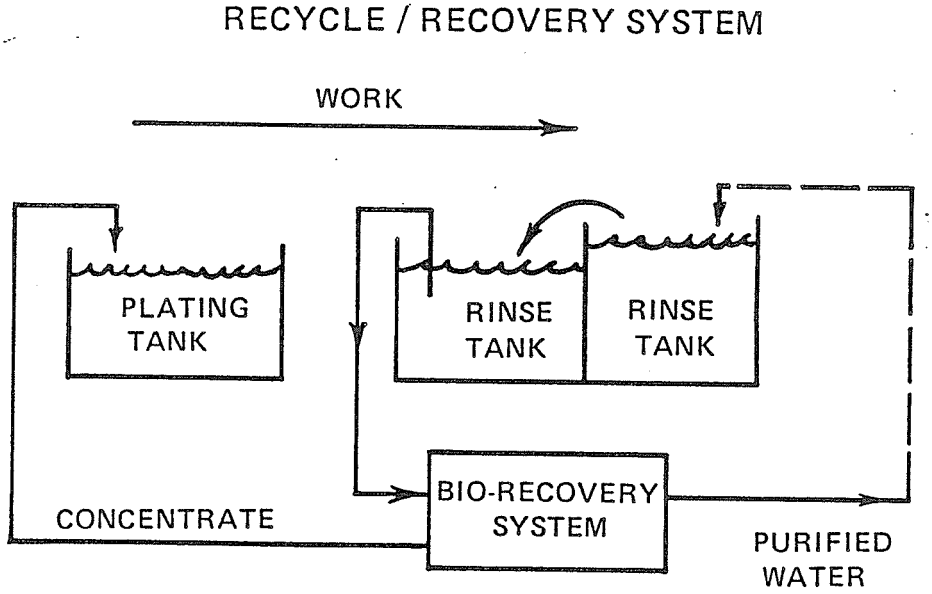

Figure 2. Recycle-Recovery System. Segregated rinse waters from a plating process are directed through a recovery system where metal ions are recovered, and the rinse waters are directed back to the rinse tanks.

the plating bath. In instances where this is not acceptable, the metal can be recovered through electrowinning or metalwinning. Alternatively, the metal ions can be further concentrated by evaporation and sent to one of a number of companies now established to recycle such materials. Whichever approach is taken, however, the elimination of sludge production results in lower operational costs due to decrease in chemical costs, decrease in water usage, elimination of sludge disposal costs, and minimization of future liability.

STATE OF DEVELOPMENT

Bio-recovery Systems is currently manufacturing and installing waste-water treatment systems for use in recovering heavy metals from industrial point sources in the electroplating and printed circuit board manufacturing industries. Figure 3 shows a system designed for a printed circuit board manufacturer. The heart of the system is comprised of columns (B), which contain the metal-adsorbing materials. Rinse waters containing only a single type of plating or etching chemistry are segregated and plumbed to individual columns. When the columns become saturated with metal ions, a specific metal ion sensor signals the controller (A) to begin a regeneration cycle to strip the metals from the materials in the column and to send the stripped metal ions to one of the holding tanks (D). Once regeneration is complete, the controller automatically returns the regenerated column back into service. The stripped metals are then recovered as the metallic elements in the metalwinning unit (E).

The system shown in Figure 3 is capable of treating 30 L/min (8 gal/min). However, larger flow rates (up to hundreds of gallons per minute) can be accommodated by simply adding either more metal-adsorbing columns or by using larger diameter columns.

The system shown in Figure 3 was designed for a printed circuit board manufacturer, but the same type of system is also employed for metal finishing and electroplating facilities. Different chemistries are encountered in metal finishing rinse waters, but the approach to treatment of these waters is basically the same as that encountered in a printed circuit board manufacturer's facility, that is, waste waters are segregated for treatment so that maximum reuse of metals and water can occur.

AlgaSORB® PERFORMANCE EVALUATIONS

In 1986 and 1987, Bio-recovery Systems, Inc. was awarded Small Business Innovative Research (SBIR) contracts from the United States Environmental Protection Agency to research and develop the AlgaSORB® technology for commercial applications. In 1988, Bio-recovery Systems was awarded another EPA contract as part of the Emerging Technologies program under the auspices of the Superfund Innovative Technologies Evaluation

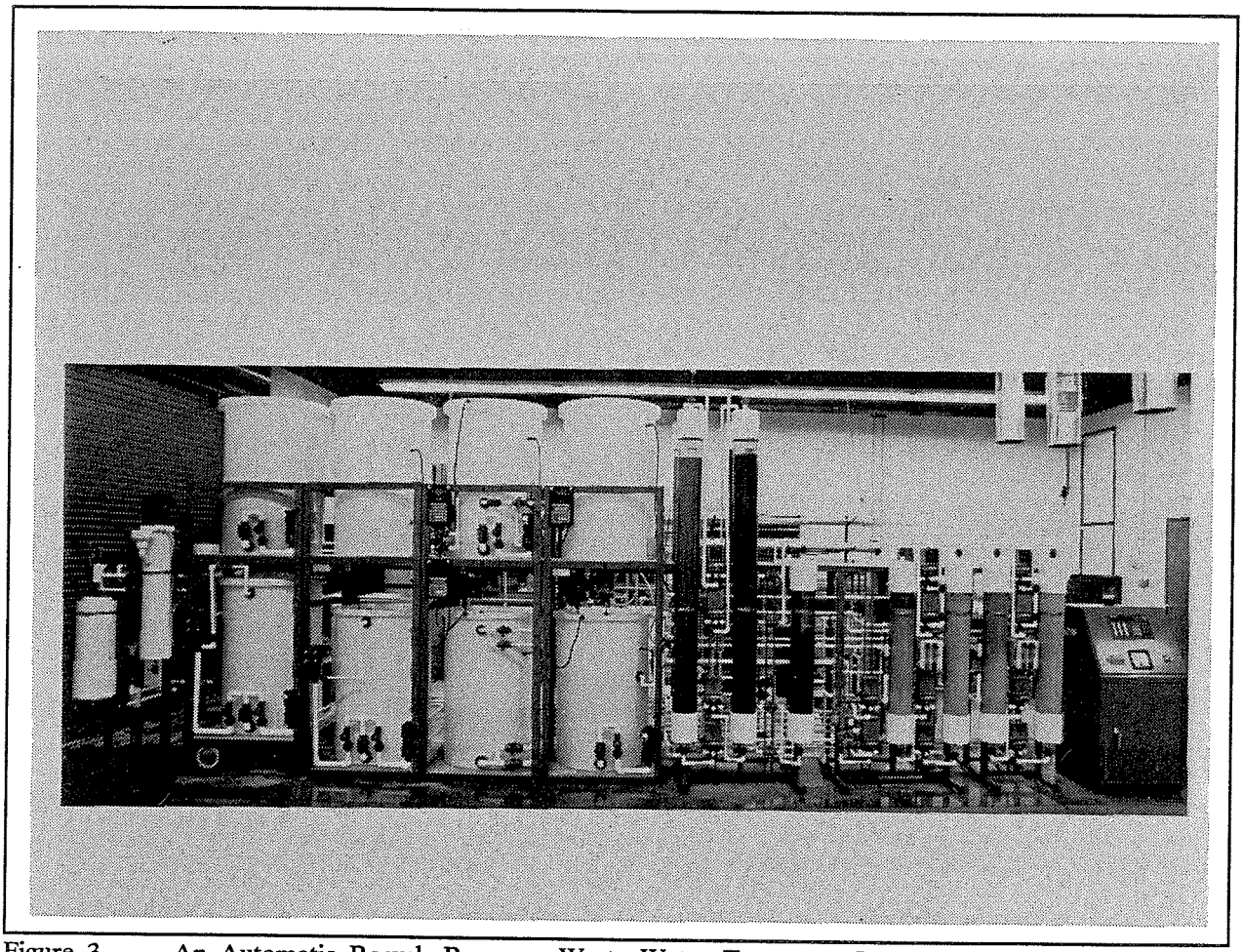

Figure 3. An Automatic Recycle-Recovery Waste Water Treatment System. A: controller; B: metal adsorbing modules; C: deionized water system; D: holding tanks for pH adjustment, regenerant chemicals; E: metalwinning module.

(SITE) program. Results from these contracts, some of which are summarized below, clearly show the efficiency of AlgaSORB® for heavy metal removal from a variety of sources. These successful laboratory and pilot scale tests made full scale commercialization of the technology a foregone conclusion.

A. Removal of Cadmium from Waters at a Superfund Site

Officials from EPA Region II arranged to supply samples from a well at a Superfund site in New Jersey, the Waldick Aerospace Devices site. These waters contained, among other things, cadmium at a level of 0.13 mg/L. The waters at a pH of 6.0-7.1 also contained, among other organics, 0.66 mg/L of a halogenated hydrocarbon, tetrachloroethylene. Organics, of course, are well known to interfere with the function of traditional ion exchange resins.

A column containing AlgaSORB® (0.7 cm i.d. x 13 cm high) was prepared and the Waldick Aerospace waters were passed through the column. Five ml fractions of water exiting the column were collected until 500 mL (100-bed volumes) of Waldick waters were passed through the column at a flow rate of one-sixth of a bed volume per minute (total bed volume was 5.0 ml). Each fraction of effluent was analyzed for cadmium using graphite furnace atomic absorption spectrometry. All effluent fractions showed that cadmium concentration was near or below 0.001 mg/L through the passage of the 100-bed volumes of the cadmium-containing solution. Because the experiment was stopped after the pas-

sage of 100-bed volumes through the column, it is not possible to state explicitly what volume of solution could be treated before cadmium breakthrough would occur. However, experience has shown that if a test material is capable of treating at least 100-bed volumes of metal-bearing water, use of that material is economically feasible. The essential point is that AlgaSORB® removed cadmium well below those levels allowed in drinking water. The current drinking water levels for cadmium stand at 0.005 mg/L.

After 100-bed volumes of the cadmium-containing solution had passed through the AlgaSORB®-containing column, cadmium was stripped from the column by passing 0.15M H_2SO_4 through the column. Analysis of the column effluents showed that nearly 90 percent of the cadmium was stripped from the column with the passage of two-bed volumes of sulfuric acid through the column. Most of the remainder of the cadmium appeared in the next two-bed volumes. Mass balance calculations showed that, within experimental error, all of the bound-cadmium was stripped from the column.

B. Removal of Copper from Contaminated Ground Waters Containing Halogenated Hydrocarbons

Bio-recovery Systems obtained ground waters contaminated with copper, tetrachloroethylene, and dichloroethylene by a printed circuit board manufacturer. These waters contained a total dissolved solid content (TDS) of nearly 2000 ppm and had a total calcium and magnesium content of approximately 300 ppm. Past experience had shown that ion exchange resins were not effective in treating these waters for copper removal because of (1) the high mineral content and (2) the propensity of the resins to become clogged with the organics in these waters. However, experiments showed that 400-bed volumes of the copper-containing waters could be passed through a column (0.7 cm i.d. x 13 cm high) containing AlgaSORB® without effluents from the column containing more than 0.01 ppm of copper. The experiments were stopped at 400-bed volumes, so undoubtedly, larger volumes of waters could have been treated before unacceptable levels of copper appeared in the effluents.

After 400-bed volumes had been passed through the AlgaSORB® column, the bound copper was, within experimental error, completely stripped from the column by passing 0.5M H_2SO_4 through the column. Again, as with the previously described cadmium stripping, the copper was almost completely stripped within the first few bed volumes of effluent.

C. Removal of Mercury from Contaminated Ground Waters

Bio-recovery Systems was provided with water samples from a mercury-contaminated ground-water site. The site had been contaminated with mercury years ago as a result of a process used to manufacture chlorine from seawater. The ground waters contained 2-3 ppm of mercury (both inorganic and organic mercury), had a total dissolved solid content of 7,200 mg/L, and contained over 900 mg/L of calcium and magnesium. Passage of these mercury-containing waters through an AlgaSORB® column (0.7 cm i.d. x 13 cm high) resulted in effluents containing mercury at levels below 0.006 mg/L as determined by analysis using cold vapor generation and atomic absorption spectrometry. The customer requires effluents of below 0.01 mg/L for discharge.

These experiments show, as had earlier experiments, that AlgaSORB® is effective in removing both inorganic and organic mercury from aqueous solutions even in the presence of very high concentrations of calcium, magnesium, and other dissolved salt.

D. Removal of Nickel and Chromium from a Contaminated Ground Water

A sample of ground water contaminated with nickel and chromium was obtained directly from the electroplating business responsible for the contamination. Currently, the electroplater is pumping and treating these ground waters with his conventional (precipitation) waste-water treatment system. The initial pH of the ground waters was near pH 7. The chromium content (essentially all hexavalent chromium) was near 0.9 mg/L and nickel content was at 2.7 mg/L. The customer's discharge levels are 0.5 mg/L and 0.25 mg/L for nickel and chromium, respectively.

Passage of these waters through a column (6 mL total volume) containing AlgaSORB® resulted in effluents that were below 0.5 ppm in nickel after elution of 175-bed volumes. The nickel could be easily stripped by passage of acid through the column. However, chromium appeared in the column effluents after the passage of only five-bed volumes of the metal-contaminated ground water through the column. This was actually what had been anticipated since other work has shown that chromium(VI) is most strongly bound to AlgaSORB® at pH 3.5 and is not bound at pH values near 7. Thus, after adjustment of the pH of another portion of these

waters to pH 3.0 and passage through another AlgaSORB® column, results showed that after elution of 225-bed volumes of chromium-containing waters through the column, chromium content in the effluent was near or below 0.3 mg/L. Thus, these waters are successfully treated using two AlgaSORB® columns, if the pH of the effluent from the first column is adjusted to pH 3 before passage through the second column.

E. Removal of Ammoniacal Copper from Industrial Waste Waters

Many printed circuit board manufacturers use an ammonium hydroxide/ammonium chloride etch solution to remove copper from printed circuit boards. The resulting ammoniacal copper solution is particularly difficult to treat with conventional precipitation technology because the copper-ammonia complex is stable in even very alkaline solutions. Figure 4 shows results of AlgaSORB® removal and recovery of copper from an ammoniacal copper waste water from a printed circuit board manufacturer. The influent concentration of copper was 286 mg/L. This solution was passed through a column of AlgaSORB® which contained 0.25 g of algae. Breakthrough of copper began to occur after approximately 75 mL of solution had been flushed through the column. The amount of copper (21.5 mg) bound to the AlgaSORB® at breakthrough corresponds to an 8.6 percent loading (on a dry weight basis) of the algal material with copper. Figure 4 shows that once the column was saturated with copper, the copper was quantitatively stripped with 0.5M sulfuric acid.

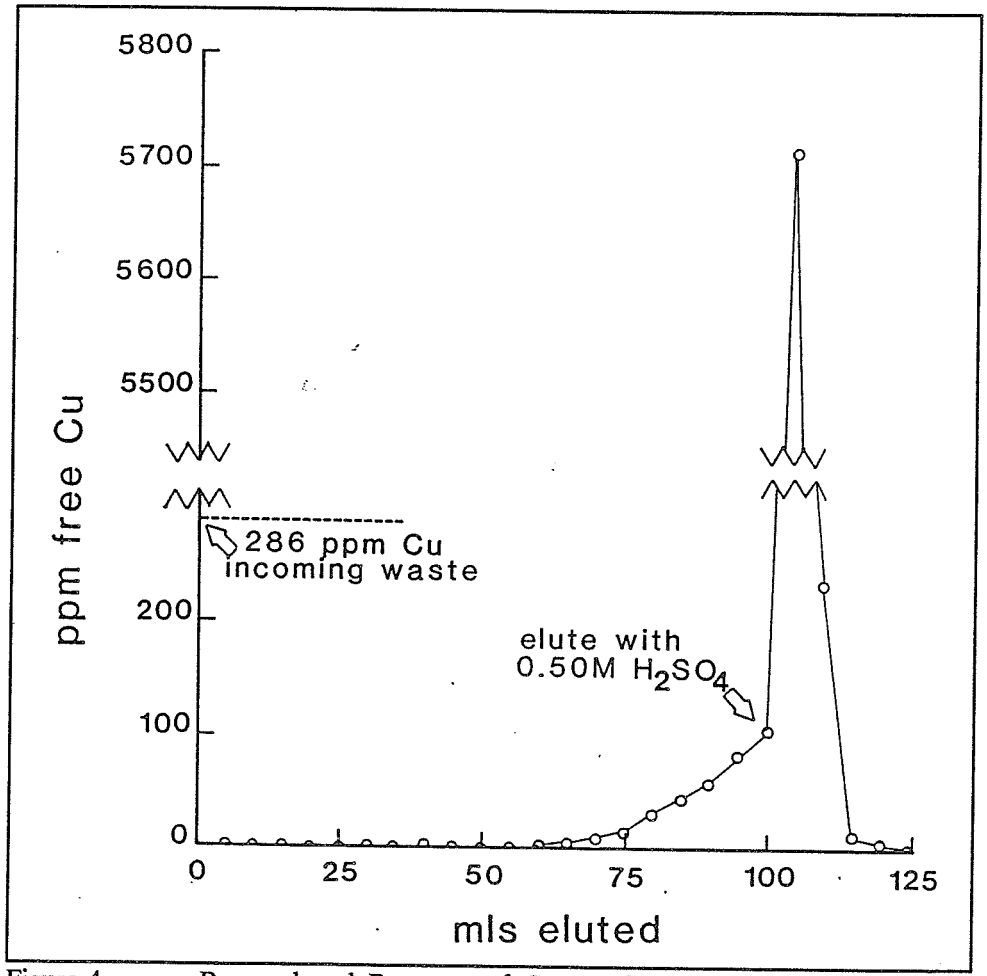

Figure 4. Removal and Recovery of Copper from an Ammoniacal Copper Solution. A waste solution containing copper as the ammonia complex was passed through a column containing AlgaSORB®.

F. Removal of Lead from Printed Circuit Board Manufacturing Waste Waters

The printed circuit board industry frequently plates a tin-lead alloy onto printed circuit boards as a base for solder connections. The tin-lead alloy is plated from a solder bath, which often contains tin and lead fluoborates. Since tin discharge is notcurrently federally regulated, the major problem in treating rinse waters derived from tin-lead solder baths is lead removal. One particular AlgaSORB® preparation is especially amendable for this application since it strongly binds lead and allows the majority of the tin to pass through.

A sample of a tin-lead plating bath was obtained from a printed circuit board manufacturer. The bath rinse waters commonly contain 10-60 mg/L of lead and about twice as much tin.

A column containing AlgaSORB® (3.3 mL total bed volume) was prepared and the tin-lead containing waters (27.4 mg/L of lead; 49 mg/L of tin) which had first been adjusted to pH 5.0 were passed through the column at a flow rate of one-third of a bed volume per minute. Two-bed volume fractions of the effluent were collected, and each of these fractions was analyzed for tin and lead by atomic absorption techniques. All effluent fractions showed lead concentrations at or below the detection limit of 0.1 mg/L for the first 300-bed volumes, after which lead began to appear in the effluents. Influent tin-lead passage was stopped after passage of 325-bed volumes through the column after which the column was stripped of lead by elution with 0.5M nitric acid (Figure 5).

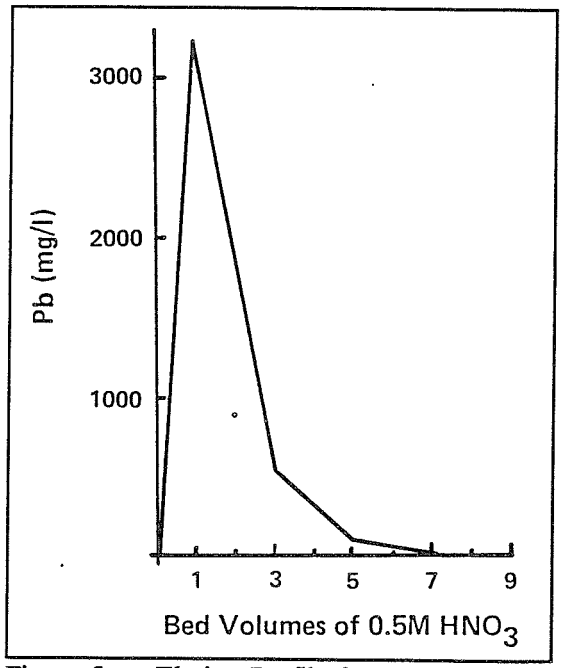

Figure 5. Elution Profile for Lead Stripping from AlgaSORB®.

All fractions eluted through the AlgaSORB® column were also analyzed for tin. Because tin is more weakly bound than lead, tin began to exit the column after passage of only 33-bed volumes of influent. Thus, the AlgaSORB® column showed marked preference for lead over tin. When the column was stripped of lead (after 325-bed volumes) the small amount of tin bound on the column was also fully recovered in the nitric acid stripping solution.

SUMMARY

The currently commercialized AlgaSORB® technology has been found to be particularly useful for treatment of various types of waste waters. Not only can waters be effectively treated, but the metals can be recovered and recycled. AlgaSORB® is a biological ion exchange material that has advantages over commercial ion exchange resins for particular applications.

In the past, the majority of waste waters containing heavy metals have been treated to produce sludges, which are then disposed in a landfill. It is becoming apparent that this approach is becoming less economical and that the federal regulations are aimed toward the complete elimination of landfill disposal of heavy metals in the future. Thus, the recycle-recovery approach for waste-water treatment will expand rapidly in the future.

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WESTERN REGIONAL OVERVIEW

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INTRODUCTION

Nearly 25 years ago, the Western States Water Council was created by resolution of the Western Governors' Conference (now the Western Governors' Association). Western governors recognized that the future growth and prosperity of western states depended upon the availability of adequate water supplies of good quality. The express purpose of the council is to promote effective cooperation among western states in matters relating to the planning, conservation, development, management, and protection of their water resources. Council members are appointed by their respective governor. New Mexico is represented by Steve Reynolds, Charles DuMars, Frank DuBois, and Wayne Cunningham (alternate). The governors themselves are ex officio members.

When the council was organized in 1965, western states found themselves in an era of rapid federal water resources development, and regional or basin-wide planning, without a direct unified voice in the use of their own water resources. Water availability to meet ever increasing needs and potential interbasin transfers of water were important issues. Since its organization, the Western States Water Council has provided a united voice on behalf of western governors on water policy issues. The emphasis and focus of the council has changed over the years as different water policy problems have evolved. However, there has been a continuing commitment to working toward a regional consensus on issues of mutual concern.

The council strives to protect western states' water resources interests, while at the same time serving to coordinate and facilitate efforts to improve western water planning and management. At present, there are fifteen member states and two associate member states. The latter includes the recent inclusion of the State of Minnesota. The council has proven it is a dynamic, flexible institution providing a forum for the free discussion and consideration of many western water policies and problems that are vital to our future welfare. As originally envisioned by the Western Governors' Conference, it has succeeded as a continuing body, serving the governors in an expert advisory capacity.

Nevada Governor Grant Sawyer addressed the first meeting of the council in 1965. He observed water availability in the West was a major obstacle to an expanding economy. In addressing future water problems, the governor suggested the role of the Western States Water Council should be to provide guidance on behalf of western states in the

development of needed water resources. Governor Sawyer praised western governors for recognizing the necessity for cooperative state action to "resolve our own problems rather than looking elsewhere for their solutions."[1] The governor added: "We must act as fast as we can, for I guarantee, if we cannot get this moving among the states, it is going to be done, and it may be done at a level which may not take into account the public interest as we see it. If we cannot work together as combined states, we certainly cannot complain if someone else, specifically the federal government, resolves our problems for us. We cannot complain about federal control when it is invited by our own inaction."[2]

Two years later, California's new governor, Ronald Reagan added: "I am impressed with the need for the states of the West to look beyond sectional interests and to approach water resources development on a regional basis.... I am convinced that the best approach to westwide regional planning is through cooperative state action. I see no need, certainly at this time, for the states to look to Washington to act as a broker in this endeavor." In 1985, President Reagan renewed this conviction stating that "...cooperation among the states was the best way to achieve optimum use of water resources in the West. States are primarily responsible for the management, regulation and development of water resources. A federal interest in western water resources remains, but here too, cooperation is the key."[3]

Hopefully, the following discussion will provide a regional perspective on various water resources issues, focusing on appropriate state and federal roles in national water resources management.

National Water Policy and the West

In 1965, the same year the governors created the Western States Water Council, the U.S. Congress enacted the Water Resources Planning Act establishing the national Water Resources Council to encourage the conservation and development of our water resources on a comprehensive and coordinated basis. The intent was to encourage the cooperation of all federal agencies, state, and local governments, and other public and private concerns. Most concede the Water Resources Council failed to fully achieve its major objectives. However, the need for cooperative action remains.

The Western States Water Council worked closely with the Water Resources Council as well as through subsequent federal administrative forums. We have reviewed recent calls for a new national water commission, a President's water council, White House conference on water resources, and other national water policy forum proposals. The Western States Water Council has not taken a position on any of these proposals, but generally, western states support greater cooperation and coordination.

North Dakota Governor George Sinner, chairman of the Western Governors' Association, is particularly concerned with improving coordination between federal and state water policies and programs. Based on his experiences in dealing with the recent drought, Governor Sinner has concluded that the present system (or lack thereof) promotes divisiveness, decisional gridlock, and an increasing incapability of dealing effectively with growing water resources concerns. Governor Sinner has further referred to the pending Environmental Protection Agency (EPA) veto of a 404 permit under the Clean Water Act by the Army Corps of Engineers for the nonfederal Two Forks Project as exemplifying the failure of the current system to address effectively water supply and management problems. The project would provide a future water supply for the metropolitan Denver area in Colorado.

While supporting greater cooperation, many western state water resources managers are concerned that any federal water policy and program coordination mechanism might become merely another "bureaucratic paper machine." To be effective, any new federal agency must have sufficient authority to implement its decisions and it must have visible, high-level support in the Administration and from the Congress. Further, states must have an active and strong role.

Any successful effort at establishing a truly effective national water policy must focus on defining roles and improving the process - recognizing no static policy statement will survive for long. Over the years, a great many committees, task groups, and commissions have produced a very long list of suggestions with respect to national water policy. A few far-sighted recommendations have been, or are being implemented, while others await a more favorable social, political, or economic climate. However, none of our past efforts have resulted in a truly comprehensive national water policy. Nor, if history is any guide, would it appear any such document is possible or even desirable. While we are not totally without vision, the field of water policy and management is truly an area requiring that we muddle through muddy waters, braving the sometimes treacherous currents. Our challenge is to improve the present process for developing national water policy and build bridges across our national water problems.

We are constantly defining and redefining appropriate intergovernmental roles with respect to national water resources management. In the past, federal attitudes have relegated states to the status of a "junior partner" in determining and implementing national water policy. Too often, discussions of national water policy have focused almost exclusively on federal policy and program changes. New roles are evolving as a result of changing water needs and uses, changing public values, federal fiscal problems, and other trends. Recently, federal actions appear to be shifting the weight of responsibility for water policy, planning and management to the states.

Western states believe a fundamental principle for establishing any effective national water policy is that states have the primary authority and responsibility for water resources planning and management. Generally, the states are in the best position to weigh competing interests and appropriately allocate and protect our water resources to maximize our social, environmental, and economic health and welfare. However, while states generally welcome the opportunity to reassert their role as the "managing partner," too often recent federal fiscal and regulatory reforms have resulted not only in the delegation, but sometimes the abdication of responsibility for implementing "national water policy."

Cooperation - Not Pulling Up Fence Posts

While the West is often viewed as the home of rugged independent individuals, cooperation was the key to its successful settlement and development. In July of 1847, looking over the Great Salt Lake Valley from the mouth of Emigration Canyon, the Mormon Prophet Brigham Young declared, "This is the right place, drive on." Compared to the rich lands of their homes in Illinois, Missouri, Ohio, Pennsylvania, and New York, many of the emigrants probably did not see the Great Salt Lake Valley, largely sagebrush, as a Promised Land flowing with milk and honey. However, the next day, these Mormon pioneers began plowing fields, planting crops, and diverting the local streams for irrigation. With vision and hard work, the desert did blossom. Their cooperative endeavors and other similar examples, such as the Spanish missions in the Southwest and New Mexico's acequia, or community ditch systems, were key to the successful settlement of the West. Western water resources were and are scarce, but careful planning and management and cooperative development helped meet past needs and set a pattern directing future growth and now allowing for new uses.

My great great grandfather, William Lee, was called by Brigham Young to lead a mission among the Indians of the Great Basin. He had a special gift with the Indian language and baptisms followed his efforts. However, his journal talks more about irrigation than conversion. The church mission included a farm to help the Indians improve their lifestyle. My grandfather records arising early and working long hours irrigating fields and supervising the work of the missionaries and Indian workers. He also records spending time mending fences, often because the Indians tended to pull up the posts for firewood. With regard to water policy, too often we find that given different needs and values (or misunderstandings), we spend too little time working together and too much time pulling up fence posts.

CONTEMPORARY PUBLIC VALUES AND ISSUES

My great great grandfather's journal largely speaks of farming and hard work. He sometimes mentions gentle evening rains in the summer, but otherwise very little refers to aesthetics. There is no mention of recreation. He said nothing about fish and wildlife or wetlands. Nothing is said about non-point source pollution, selenium, fertilizer, pesticides, and herbicides. There is no mention of lawsuits, water right adjudications, federal reserved rights, or the Indians claiming any right to the stream used to irrigate the fields. There is nothing about water policy and planning, or any intergovernmental or interagency jurisdictional disputes. Occasionally there were quarrels among the workers. There is no mention of many other contemporary water policy concerns. He does not mention ground water, drought, wilderness, hydropower, global warming, or interbasin transfers. All of these and other contemporary issues are now before the Western States Water Council, and I want to discuss a few.

Ground Water

In recent years, ground water has become a prominent national concern. Ground water has always been an important resource in the West, and generally states have sufficient authority to effectively manage and protect the resource. However, faced with the potential threat of comprehensive federal legislation regulating the management and use of ground water, the Western States Water Council has developed an "alternative" bill which delineates appropriate state and federal roles. The purpose is primarily as a defense against any federal intrusion

in what has been primarily a state responsibility. In our play, the states star and the federal government is cast in a supporting role. We go so far as to suggest federal actions should be consistent with state policies and programs. However, our writers have yet to reach a consensus in refining the script. Congress' interests in federal ground-water legislation appears to have waned. Therefore, the council's bill may never play. We have recently testified on federal ground-water legislation at congressional hearings based on general principles. We have also participated in the development of a unified state position with several interstate agencies.

Ground Water Recharge

The Western States Water Council is a nonprofit organization, an interstate agency which is funded almost exclusively by state dues. We have not sought grants or contract work. However, this past spring, the Bureau of Reclamation and the council signed a cooperative agreement to perform a study of legal, institutional, economic, and cost sharing considerations related to ground-water recharge. The bureau was required to contract with the states for this study by federal statute. We are currently gathering information from our member states and other Reclamation states, which will be summarized in a draft report. The first rough draft is scheduled to be released for comment in January 1990, with the final report completed before August 1990.

Interbasin Transfers

I know ground-water and interbasin transfers are issues important to this part of New Mexico. The Western States Water Council was organized during an era of grandiose proposals to move water from the water rich areas of Canada and the Northwest United States, to the arid Southwest. Of the original eleven member states, it has been said five states joined the council seeking additional water supplies, five joined to protect their water resources from export, and one joined to protect its interests in both directions. The state of Texas requested membership in 1966 citing the complicated problem of providing a dependable water supply for the high plains of West Texas, and their deep interest in the possibility of solving this problem on a regional basis by the interstate importation of water. Texas' request was deferred, though the state was granted observer status. In 1978, Texas became a full member.

In 1969, the council published *A Review of Inter-Regional and International Water Transfer Proposals*. Considerable controversy had arisen among member states over water transfer proposals, many of which were merely "lines on maps." At least one member observed that none of the schemes justified study in depth. It was suggested major inter-regional surface water transfers were perhaps 50 years away. They are probably not yet any closer to becoming reality. Still, as you are well aware, the U.S. Supreme Court's *Sporhase* decision and the *El Paso* suit have changed how we look at water and water transfers. The council has previously reviewed state statutes restricting water exports and monitored water transfer issues.

This past year, the Nevada state legislature adopted a joint resolution asking that the council study the "orderly and optimum development of inter-regional transfer of water resources in the western states to meet the needs of the wildlife and the people who live in the arid Southwest." In response to this request, the council intends to prepare a report on the current status of state and federal statutes regarding the interstate transfer and use of water, analyze related case law, describe any current major transfer proposals, and evaluate the pros and cons of interbasin transfers. We intend to approach this delicate topic carefully.

State Water Planning

While I have previously mentioned our interests and effort with regard to national water policy proposals, the council is also striving to improve state water planning and management. Last month, the council sponsored a symposium on state water plans. Twenty state representatives presented papers and the meeting drew participants from as far away as Alabama, Alaska, Hawaii, and Minnesota. Many western states are revising their state water plans, as well as reviewing existing state water institutions and organizations. The diversity of state water needs necessarily requires that the planning process and state institutions vary from state to state. State programs, policies, and plans address differing water problems. The council sponsored the symposium in response to interest for information regarding western state planning and management processes and programs. We intend to review the papers presented and very briefly summarize any special approaches or unique examples of resolving water resources planning and management problems.

Drought

The council has also specifically focused on drought response planning in recent years. The Western States Water Council was very active in state and federal response efforts during the 1976-77 drought. In 1986, the council prepared a report on *Western State Drought Management*, and in 1987, *A Model for Western State Drought Response Planning*. This work has been well received and used by the states in responding to the current continuing drought. The drought is not over, though the extent and intensity of its impacts are continually shifting. In some instances, it has been more serious than in 1976-77, but westwide the impacts have been less serious. This past summer, the council has periodically prepared a summary of current drought conditions and various western state response activities. The council has and will continue to work with the Western Governors' Association toward improving coordination of state and federal response activities and highlighting successful state drought response measures. A work group is being formed to develop policy recommendations.

Clean Water Act and Safe Drinking Water Act

More and more water quality issues require western water managers attention. States are continually faced with growing regulatory and management responsibilities under federal statutes providing little, if any, increased financial support (in proportion to the increasing responsibilities). Water quality regulation perhaps best illustrates the previous administration's religion of "fiscal federalism." It might also be termed "fiscal flight," given the political panic associated with the present federal budget deficit problem. There appears to be no reasoned approach to dividing intergovernmental responsibility based on principles of economic efficiency and social equity.

The states' experience has been that they are left to implement and fund programs to meet national goals (such as fishable, swimmable, and drinkable waters) created by federal statutes. Where the federal government has established such rights, a financial obligation remains, which it should not abdicate. Further, in many instances, while abandoning programs by withdrawing financial support, the federal government nevertheless expects that the states, as the adoptive parents, comply with its every wish and command in raising the orphans. The Western States Water Council continues to raise these concerns with EPA and the Congress. Further, the council is completing a report on state alternative/innovative funding programs related to water quality.

Treatment of Indian Tribes as States

One rather innocuous, and at the time, noncontroversial provision of the Clean Water Act amendments of 1986, was Section 518. It directed that Indian tribes be treated as states for many purposes. The council has been active in evaluating proposed regulations implementing the amendment and insisting that EPA adequately consult with the states as specifically directed by the statute. To date, few tribes have applied to exercise such authority, and EPA must first find that they have the capacity to administer federal water quality programs. However, the potential for serious conflicts within basins checkered by various reservations as well as state and federal lands is obvious.

Moreover, EPA has yet to clarify the status of past state water quality standards and other regulatory authorities on reservation lands given the new provisions. The best EPA has been able to do is state that it assumes without determining that state standards are still applicable pending acceptance of jurisdiction by the tribes. The present confusion reminds me of a previous speech by Governor Carruthers, then Assistant Secretary of Interior for Land and Water Resources, about the first rule of wing walking. That is, "Don't leave hold of what you have ahold of until you have ahold of something else."

Nonpoint Source Pollution

Also regarding water quality, this past year, the council sponsored a very successful workshop on technical issues related to non-point source pollution control in western states. The workshop followed a survey conducted by the council in 1986 on related problems. The workshop proceedings have been published as a resource book to aid states in the preparation of nonpoint source pollution management programs under Section 319 of the Clean Water Act. It highlights successful state strategies and nonregulatory methods of dealing with nonpoint source pollution control. The council is also interested in water quality problems related to irrigation and has invited the National Research Council's Water, Science and Technology Board's Committee on Irrigation-Induced Water Quality Problems to present a workshop for council members next January.

Federal Reserved Water Rights and State General Adjudication Procedures

Earlier this month, the council sponsored a workshop for state representatives to exchange ideas regarding the efficient and effective adjudication of appropriative water rights and federal reserved water rights. Among the issues discussed and under continuing discussion include the negotiation and litigation of Indian reserved water rights claims and water for wilderness areas. Also of note, the council participates in an ad hoc group on Indian reserved water rights which includes representatives of the Western Governors' Association, tribal organizations, and industry interests.

Conflicts Between Federal Statutes and Western State Water Law

The council strongly supports the appropriation doctrine as a flexible and dynamic institutional mechanism for allocating and regulating water use. Conflicts continue to arise between state water law and the implementation of federal statutes, primarily environmental laws. The council has prepared a draft report summarizing examples of conflicts in various areas and describing methods to reduce difficulties. Rather than pulling up fence posts, we believe in mending fences. Legitimate state and federal water needs can be accommodated.

Federal Hydropower Licensing

Last, but not least, the council has been directly and heavily involved in a continuing conflict with the Federal Energy Regulatory Commission (FERC) over federal hydropower licensing and state water rights in water resources management. Until 1940, FERC's predecessors deferred water-use decisions related to hydropower development to the states in compliance with Section 27 of the Federal Power Act. In 1940, the U.S. Supreme Court issued its *First Iowa* decision, which clouded the state's claim to exclusive jurisdiction regarding the appropriation of water for all purposes, including hydropower.

The issue has recently come to a head in California in the *Rock Creek* case. While this small project would produce an insignificant amount of power, given national energy needs, FERC claimed exclusive jurisdiction to regulate water release requirements for instream flow purposes. FERC disregarded the state of California's jurisdiction and water right requirements under state law. The Ninth Circuit Court of Appeals recently upheld FERC's claims stating the Supreme Court had already decided the question. The decision was not unexpected, and California has petitioned the Supreme Court for a writ of certiorari. The Western States Water Council prepared an amicus brief before the Ninth Circuit that was revised and circulated by the state of Idaho. Fifteen states signed. Idaho has now prepared an amicus brief before the Supreme Court, which some 43 states have agreed to sign.

Hopefully, the Supreme Court will put FERC in its place, but if not, federal legislation may be possible to restore the states' previous authority. As it now stands, FERC claims comprehensive jurisdiction over any waterway with federal hydropower development, including authority to grant or deny any upstream diversion for any use so as to protect flows for hydropower. FERC has refused to subordinate federal hydropower use to future upstream diversions under state permits (even domestic use). FERC also refuses to require preliminary permit applicants to acquire or demonstrate the ability to acquire state water rights for a project, which can be condemned under the federal statute.

FERC has also run afoul of the states with respect to state water quality certification requirements for federal projects under Section 401 of the Clean Water Act. FERC unilaterally waived state authority to make certification decisions on some 227 projects in 32 states, claiming states were unduly delaying required certification action. FERC has refused to reconsider its order, despite numerous state petitions and federal legislation which passed both the House and Senate last year, but died before the differing versions could be reconciled. However, the Fourth Circuit Court of Appeals in Virginia recently revoked the license for a project issued improperly by FERC after waiving the state's certification authority in the *Fredericksburg* decision.

CONCLUSION

I have touched on many issues before the council only briefly. I want to emphasize again the growing importance of the state role in water resources management and the necessity of working together with federal agencies, Indian tribes, and other public and private interests toward resolving western water resources problems.

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[1] Minutes of the 1st Western State Water Council meeting held at Harvey's Resort Hotel in Stateline, Nevada on Lake Tahoe, on August 3, 1965.

[2] Ibid.

[3] Letter to the Western States Water Council dated April 5, 1985, in marking its 20th anniversary.

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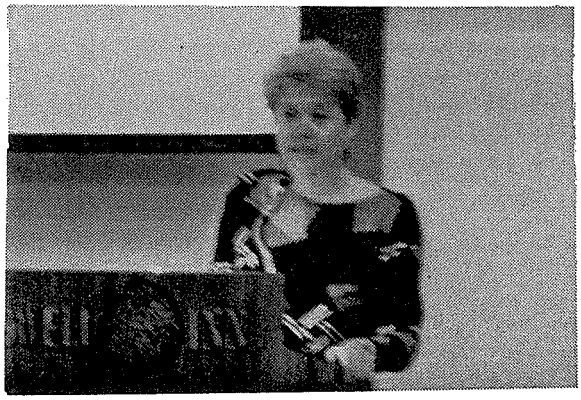

TRANSFERS OF NEW MEXICO WATER
A SURVEY OF CHANGES IN PLACE AND/OR PURPOSE OF USE, 1975-1987

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INTRODUCTION

In a region like our own, where most available water is appropriated and in use, a successful water policy must confront the need to provide new users with water. New Mexico's water administration has relied on privately arranged transfers of water (water marketing) to fill this need. Water markets are a decentralized approach to resource-use decisions, and ideally can give a water-allocation system flexibility, security, and resilience.

However, water is difficult to define as a private transferrable asset. It flows from user to user and the hydrologic system is not amenable to being chopped into discrete physical units of property. Private transfers of water, therefore, require a water administration system that can account for the relationships between water users who jointly depend on a common resource, translating the unified hydrologic reality into discrete legal claims in changing places and circumstances of use. In New Mexico, this is the responsibility of the State Engineer Office (SEO).

Water users who wish to change the place and/or purpose for which their water is used must show the State Engineer that the proposed change does not impair existing rights. The change must also be consistent with the public welfare and the conservation of New Mexico waters. For markets to be a flexible and inexpensive means of providing water to new uses, the process of reviewing these applications must be expeditious and simple; for private water rights to be secure, the process must be thorough and careful.

The ongoing research reported later is aimed at assessing the speed and expense of the application

process and exploring criteria that might increase the speed and reduce the expense with minimal loss in thoroughness and care. The project began with a comprehensive census of applications to change place and/or purpose of use (ACPPU) and a survey of a small sample of applicants to gather information about prices, transactions costs, and time delays.

The census and survey show that while some ACPPU are slow and costly to process, most are processed quickly and cheaply. More than half of the applications recorded in the census were processed in less than three months; an additional 25% took between three and six months; only 10% took more than a year (Figure 1). The survey collected estimates of attorney fees, court costs, hydrological expenses, and filing and publication fees for 87 ACPPUs. In 76% of these, applicants spent less than \$50/AFCU[1]; 5% had transactions costs greater than \$1000/AFCU (Figure 2). In terms of volumes of water in ACPPUs, 95% of the water was processed at costs below \$10/AFCU (1988\$); transactions costs were above \$100/AFCU for less than 2%.

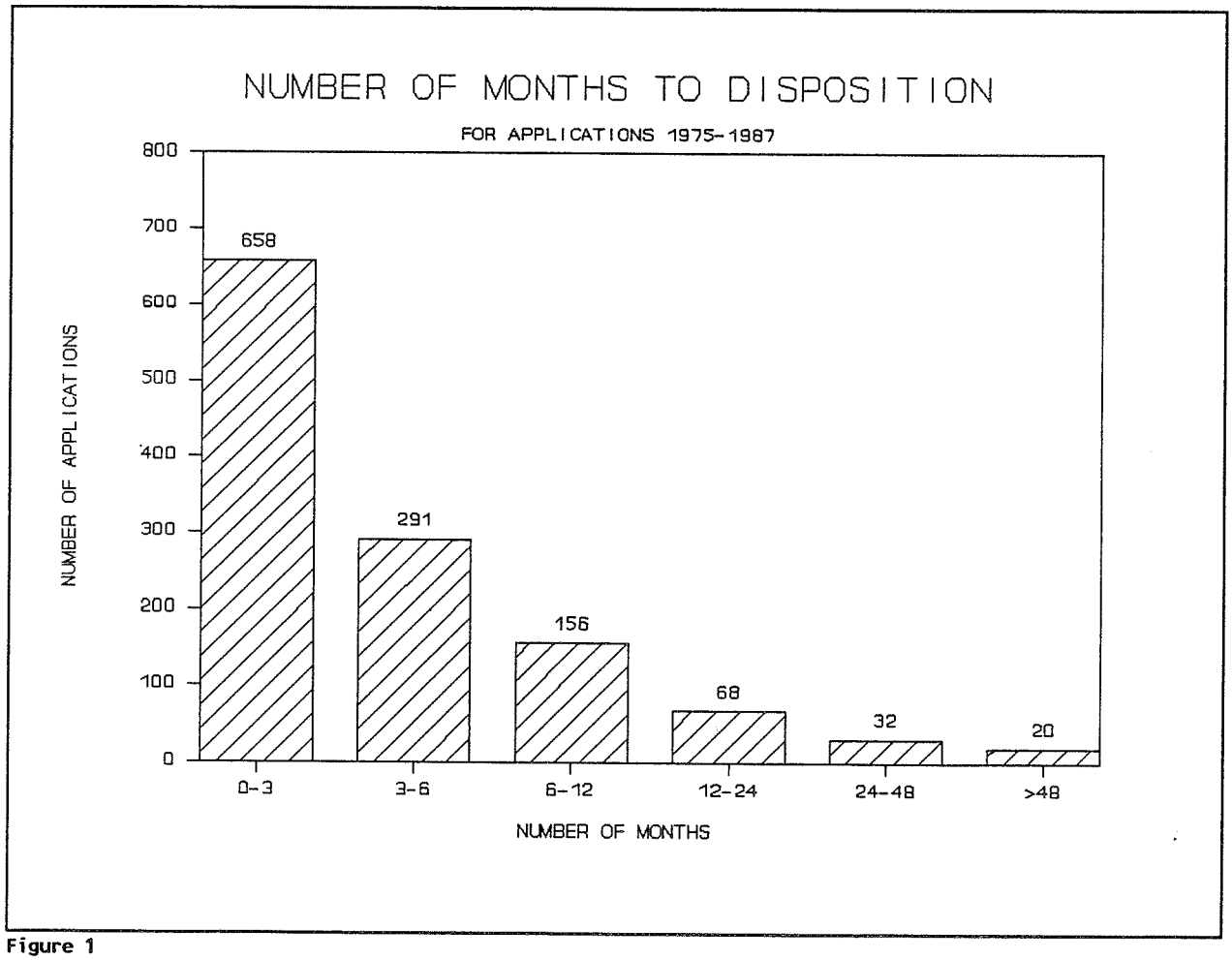


Figure 1

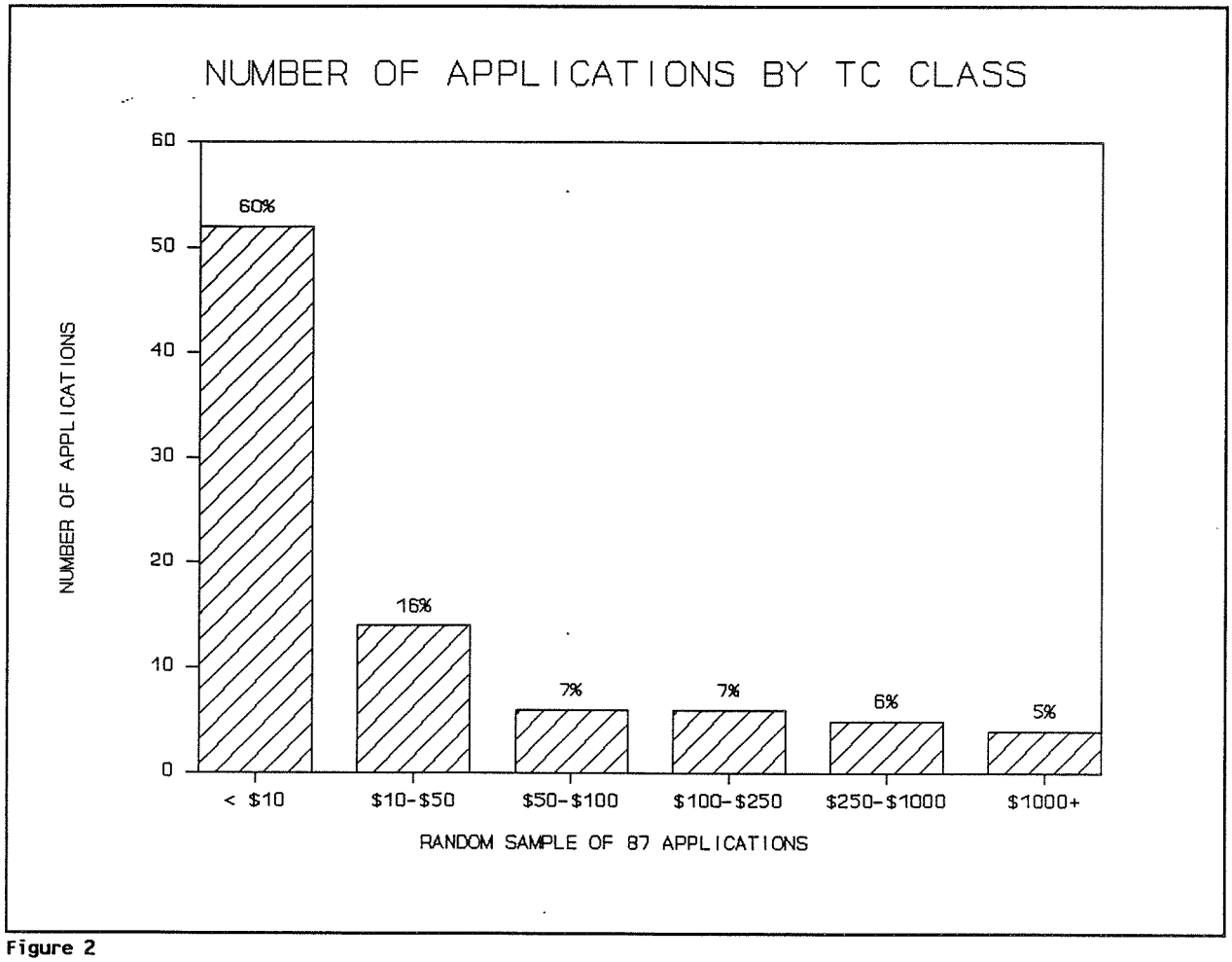


Figure 2

The second step in our research is to identify what causes the occasional long delays or high costs, and explore ways of addressing these situations. It has proved difficult to define these circumstances through statistical analysis. What I can report now is a summary of some of the data we have assembled. I am open to suggestions as to explanations of these data and productive avenues to explore.

For the purposes of the survey, the state was divided into twelve water regions. The objective of the division was twofold. For surface and surface-related water rights, we wished to collect all water rights that were related to one another. Therefore, we considered, for example, the Pecos River, its tributaries, the Rio Hondo, Rio Peñasco, Rio Ruidoso, and Hagerman Canal, and the related ground-water basins, the Roswell artesian and shallow water aquifers, Carlsbad, Capitan, Fort Sumner, and Upper Pecos as a single group. Surface rights in the Gila and San Francisco Rivers and ground-water rights in the Gila-San Francisco Basins were likewise considered as a group. The Rio Grande was divided into three segments, the Upper, Middle, and Lower Rio Grande. While the river is hydrologically connected, considerations arising from the terms of the compact with Texas have resulted in a policy not to permit water uses to move from Rio Grande associated waters above the Otowi Bridge gauge to points below Otowi, or from points above Elephant Butte to below the Butte. Surface rights in the San Juan and ground-water rights in the Animas shallow water aquifer are considered together, as are surface and ground-water rights in the Bluewater and Canadian drainage.

We collected the enclosed ground-water basins in the same region in a group. The groups thus defined are: Central Ground-water basins, Estancia and Sandia; Southeast Ground-water basins, Lea

County and Portales; Southwest Ground-water basins, Mimbres, Playas Valley, Lordsburg Valley, Nutt-Hockett, and Animas; and the South Central Ground-water basin, the Tularosa. While these basins are hydrologically separate, they are probably affected by similar economic and climatic forces. The twelve water regions are shown in Figure 3.

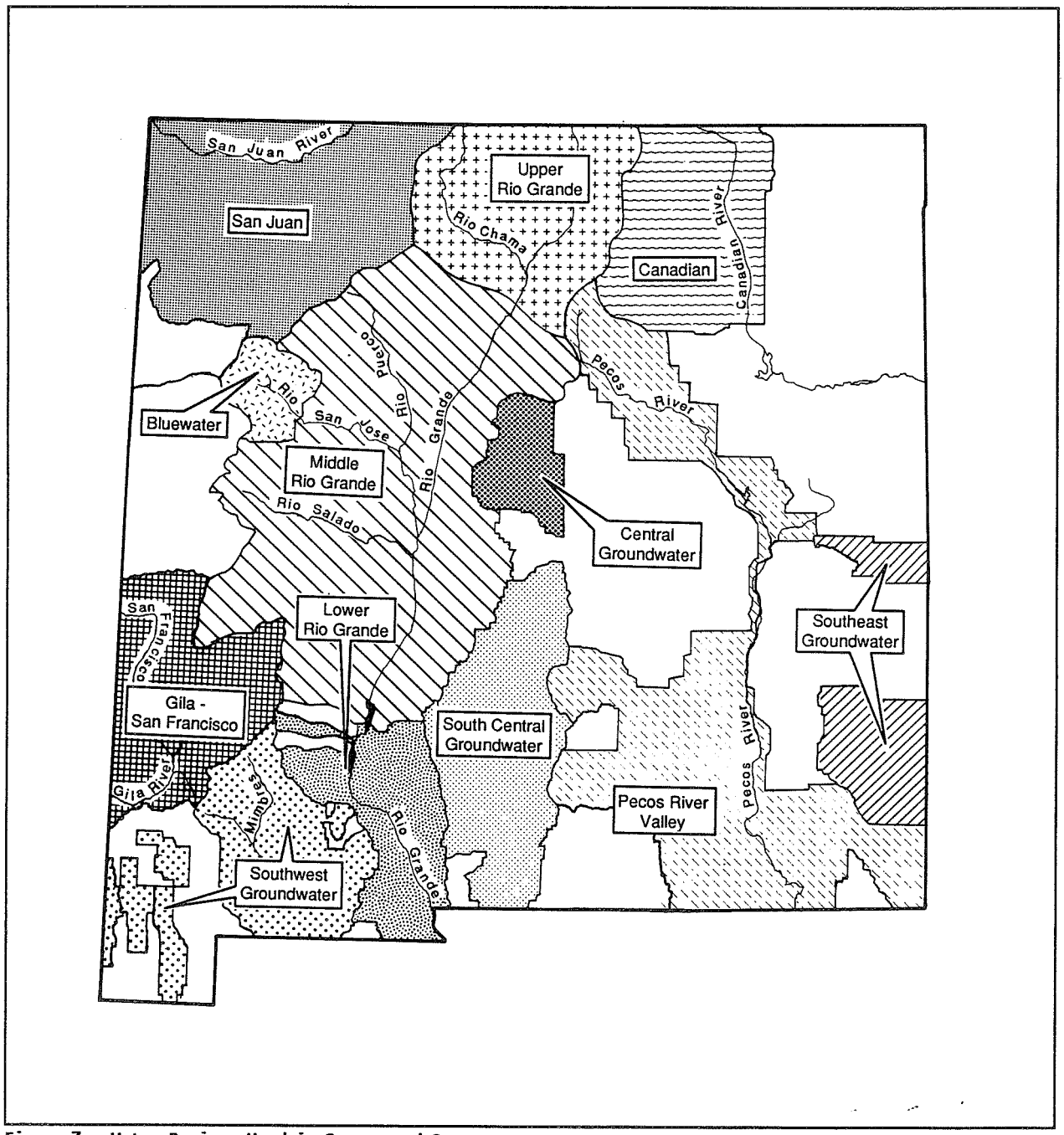


Figure 3: Water Regions Used in Census and Survey

TECHNICAL CONSIDERATIONS IN REVIEWING ACPPU

Before reporting the data, it is useful to review the considerations in evaluating an ACPPU for different types of water resources: streams, tributary aquifers, and nonstream related ground-water basins.

A. Surface Water Rights: In New Mexico, both surface and ground-water rights are held under the doctrine of prior appropriation. This means that during times of shortage, the most recently established water uses will be shut down to protect the earliest established rights. When water is short or, as in the Pecos Valley, when rights are asserted that exceed the capacity of the stream, priority dates become important.

On a fully appropriated stream, the only way to establish a new use is to acquire an existing right and file an ACPPU with the State Engineer Office (SEO) to change the place and purpose of use. The SEO will permit the change if it does not impair existing rights and it is consistent with the public welfare and conservation of the waters of New Mexico. The major cause of impairment in a transfer of a surface right is the resulting change in the pattern of return flows to the stream. Figure 4 provides an illustration.

The hypothetical stream in the Figure 4 has annual streamflow of 500 af in a normal year. Recognized rights exist to divert 750 af/yr; it is possible to divert more water than there is in the stream because the first three users consume less than they divert, and their return flows are available to downstream users.

Suppose the user at position (1) has the highest priority in the stream, and wishes to move the place of use from (1) to position (5). If this move is approved, the stream will be unbalanced. Only 100 af of water will exist at position (5), not enough to satisfy the 250 af diversion right now held by position (1).

Requiring a lower-priority user (say position (4)) to shut down 150 af/yr of its established use in order to allow the user at position (1) to change the place of use would impair the low-priority right. To avoid this impairment, the user at position (1) might only be allowed to move the 100 af/yr that was *consumptively* used in the original use, in order to maintain the other water users in their original position.

Technical questions addressed in transfers of surface rights: In considering an ACPPU of a surface water right, the SEO evaluates the effect of the changes in return flow patterns on existing rights. To do this, the SEO must determine consumptive use and return flows at the original use and at the new use. For many uses, particularly irrigation, area averages are used for this purpose; occasionally, however, consumptive use is evaluated on a site-specific basis. Such evaluations are costly and time-consuming.

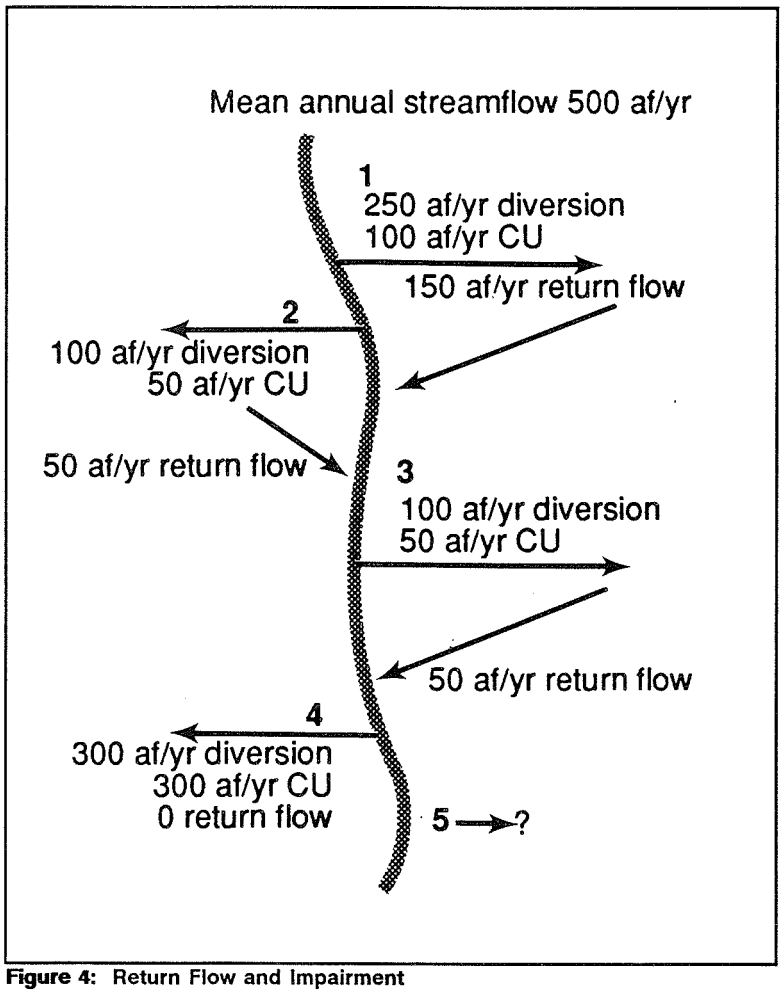


Figure 4: Return Flow and Impairment

B. Rights on a Tributary Aquifer: Many important ground-water rights in New Mexico are in stream-related aquifers. An appropriation of water on a stream-related aquifer will eventually have an impact on streamflows.

As shown in Figure 5, pumping dewaters a portion of the aquifer, creating what is called a "cone of depression." If the ground-water flow is toward the stream, a part of the water withdrawn from the well is at the expense of stream flow.

To protect prior rights in the stream, the State Engineer requires, as a condition of granting an application to appropriate or change a tributary ground-water use, that the applicant acquire rights in the stream in the amount of the impact on the stream and dedicate those to the State Engineer.

In the Pecos Valley, ground-water pumping was already impairing rights on the stream by the time the ground-water basins were first administered. The New Mexico Supreme Court, in Templeton v. Pecos Valley Artesian Conservancy District, 65 N.M. 59, 332 p.2d 465 (1958), ruled that when appropriations from a stream-related aquifer depleted streamflows, surface right holders could "follow the source of their original appropriation." The court ordered that such surface right holders should be allowed to appropriate water from the tributary aquifer, even though no appropriable water existed in the aquifer.

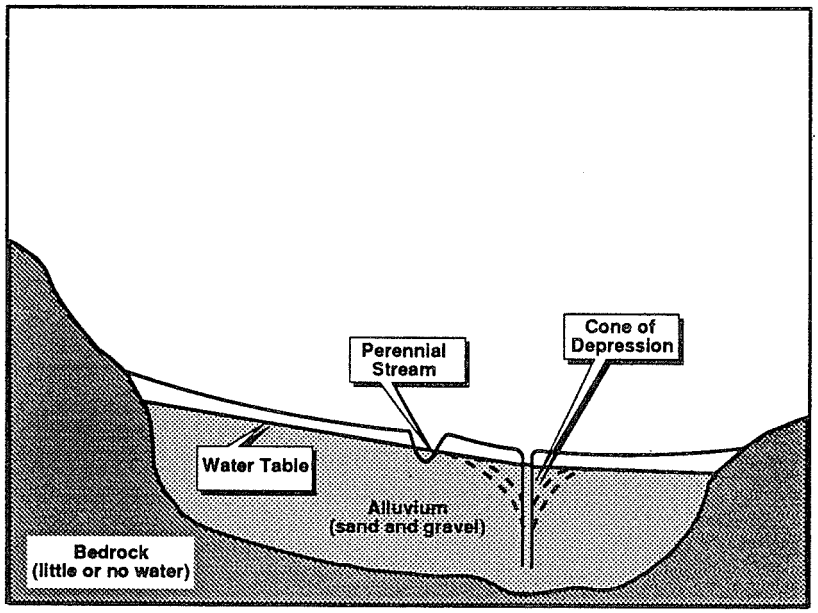


Figure 5. Effect of a Well on Streamflows in a Tributary Aquifer

Technical questions addressed in transfers of tributary ground-water rights: In considering an ACPPU of a ground-water right on a tributary aquifer, the SEO must evaluate the impact of the new well on the stream. In most of the state's basins, standard models with given assumptions on aquifer parameters are used to calculate stream impact. When these models change or are challenged, the hydrological work required to show site-specific effects of a well on a stream can be demanding and costly.

C. Rights in an Enclosed Ground-Water Basin: New Mexico was the first state in the West to apply prior appropriations to ground water. Priorities in a mined ground-water basin have different implications from priorities in surface water. For a surface right, priority tells water users how likely they are to get their water in a particular year under a particular streamflow condition. In contrast, a ground-water right is not subject to annual variability in precipitation and runoff; a well in an enclosed basin will yield in wet years and dry. However, in a mined basin, the more water pumped per year, the shorter the future of the basin as a water resource.

Administration of rights in an enclosed basin involves a tradeoff: on one hand, it is desirable to make water available for as many beneficial uses as possible; on the other, water users typically make long-term investments related to their water use, and they need to be secure in their expectations of future water availability. The more water users on an enclosed basin, the shorter the future expectations for each. This tradeoff has been made by administering the basin so as to secure to water users an expectation of a "reasonable" economic lifetime after declaration of the basin, usually 40 years. Very roughly speaking, rights are granted so long as they are not expected to bring water levels below an economic pumping lift for the marginal water user (usually irrigation) during the 40-year period. This allows exploitation (mining) of the basin, while providing security for water users.

This guideline is interpreted in the context of hydrologic conditions on the basin to develop criteria for granting permits to appropriate water from the basin. The criteria may be expressed as limitations in the number of feet the water table may be lowered in a 40-year period (Mimbres) or in terms of the amount of water available for appropriation (Portales).

Each enclosed ground-water basin is administered under the same set of criteria. However, all points in the basin are not equivalent. Lateral movement of ground water is slow. Depending on the aquifer's transmissivity, the major impact of a well on water levels over a 10, 20 or even a 100-year period may be confined to the well's immediate vicinity. To account for this localized impact, the SEO divides the basin into administrative units, each viewed as a sort of subbasin. To determine whether there is appropriable water in an administrative unit, the SEO applies the basin-wide criteria to the unit.

Figure 6 shows a map section of the Mimbres Basin used for making administrative decisions about water applications. In each 4-square mile administrative block, the upper number shows the calculated nonpumping water level at the end of 1994 for existing rights; the lower number shows the average calculated annual water level decline. The Mimbres criteria provide that rights may not be granted that bring the projected 1994 non-pumping water levels above 128 ft, or that increase the rate of annual drawdown to more than 2.5 ft/yr. In the block indicated, the criterion for nonpumping water level has already been exceeded, and no water would be available for appropriation. Similar (but not identical) criteria are used in other enclosed basins.

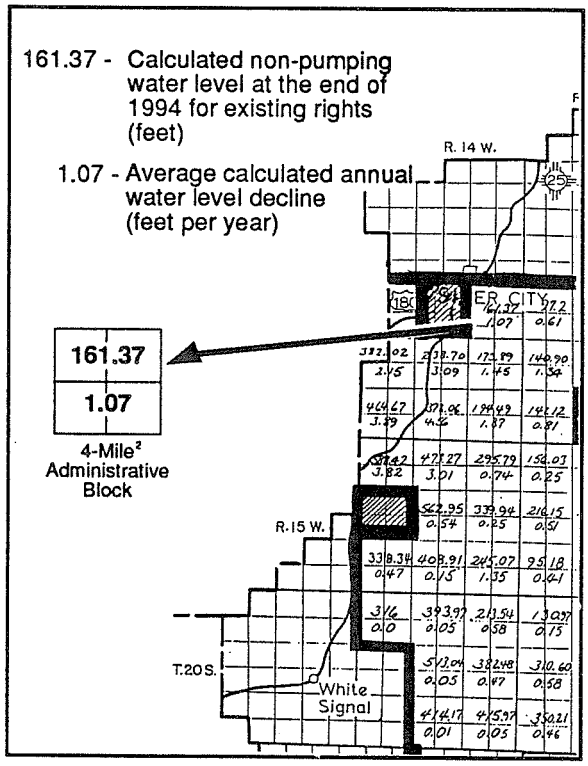


Figure 6. Section of the Mimbres Basin administrative map

Technical questions addressed in considering transfers of rights in an enclosed basin: ACPPU for water in an enclosed basin are very much like applications for new appropriations. Unless the new use is in the same administrative block as the old one, the water freed up by suspending the original use is not likely to count as water available for the new use. In considering these applications, the SEO needs to estimate the impact of the well on water levels within the pertinent time frame, and perhaps to calculate the new well's contribution to annual rate of drawdown.

D. Other Considerations: For any type of application, the SEO also considers local effects on nearby wells or diversions, and the impact on water quality. While an increase in pumping lift for a nearby well, even such an increase as would require drilling a new well, is not automatically considered a local impairment, there is some threshold that will cause such an impact to be considered impairment. Similarly, if it appears an application will have a negative effect on water quality, the SEO may consider this effect to be an impairment.

LEVEL OF ACTIVITY: CHANGES IN PLACE/ PURPOSE OF USE OF WATER RIGHTS

The census reviewed 2313 applications. On about 835 of these, no census form was taken because they were judged to involve irrigators moving their water rights around their own acreage. Of the remaining 1478, 25 were for dates outside the 1975-1987 period, and others were missing data; 1309 contained the basic data on quantity of water and date of application and disposition used for census records. Comparing this figure with the annual reports of the SEO, it appears that census takers

reviewed about 80% of the applications made over these twelve years. The state engineer and others familiar with water administration during this period were of the opinion that the census is reasonably representative of the applications during this time.

There are two alternative ways to measure the level of activity represented by the ACPPUs reviewed - the number of applications and the volume of water represented by applications. These measures tell different stories.

The number of census applications per year rose to 147 in 1979, remained high until 1983, since then it has declined (Figure 7). It may be worth noting that the compound annual rate of growth in population in New Mexico during the seventies was 2.51%, falling to 1.83% in the eighties, while employment growth rates also fell from 4.2% to 2.3% in the same periods.

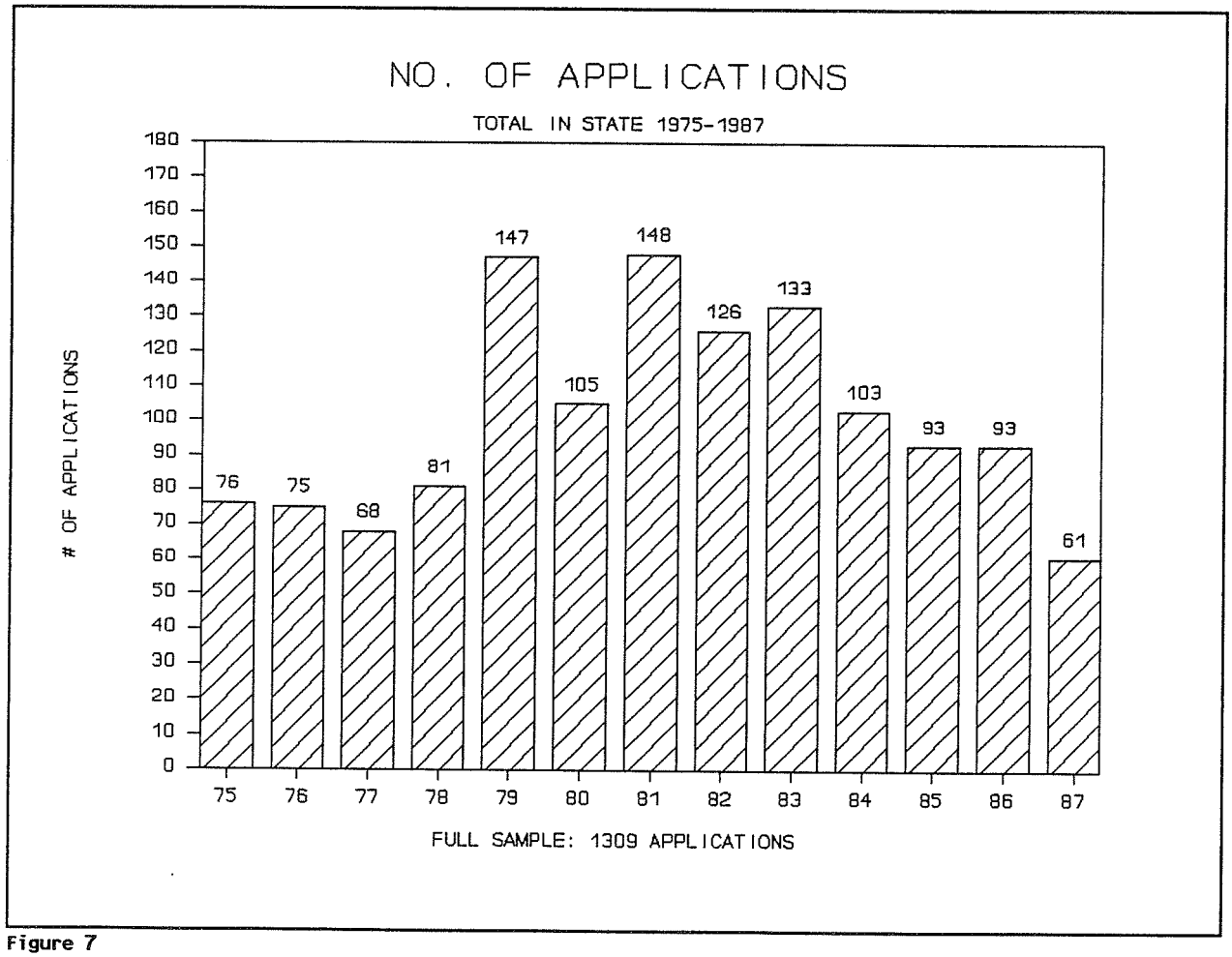
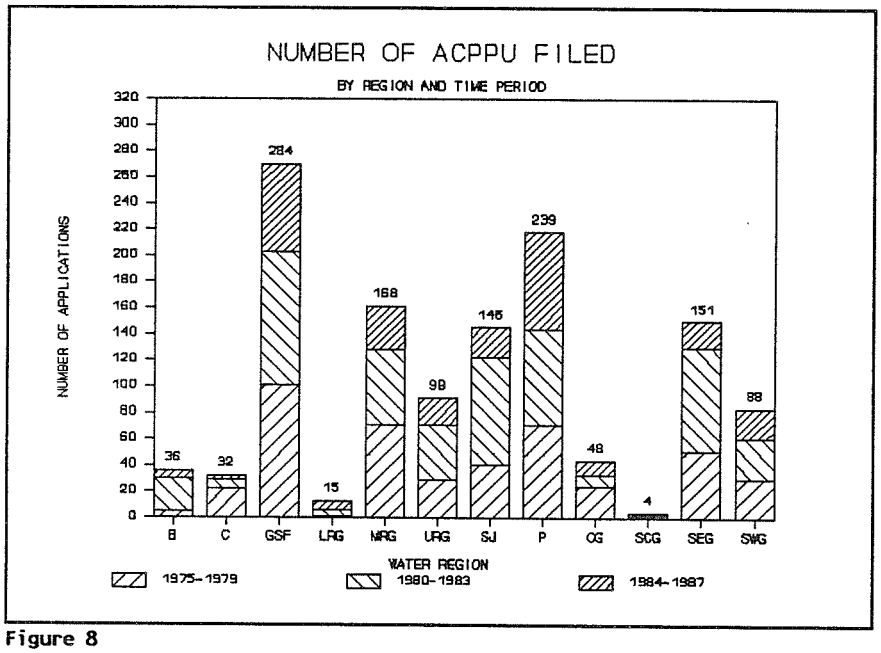


Figure 7

The number of applications in a water region will be affected by water-related regional economic activity, the regional water supply, population and physical extent of the region, and region-specific administration, quite a hodgepodge of determinants. Figure 8 shows the Gila-San Francisco Basin leading the state in number of applications, followed by the Pecos, the Middle Rio Grande, the Southeast Ground-water region and the San Juan Basin. The Gila-San Francisco has a large number of applications because the basin is administered under the Supreme Court decree in Arizona v. California, 373 U.S. 546 (1963). As administered, basin homeowners must acquire water rights even for domestic use and home irrigation, while in other parts of the state, up to 3 acre-feet/year may be pumped without a right for domestic purposes. Second place is taken by the Middle Rio Grande, the most populous and economically active of the water regions; third and fourth places by the Southeast Ground-water and San Juan basins, where energy-related water use is significant.



WATER REGIONS
(refer to Figure 3)

B	Bluewater
C	Canadian
GSF	Gila San Francisco
LRG	Lower Rio Grande
MRG	Middle Rio Grande
URG	Upper Rio Grande
SJ	San Juan
P	Pecos River Valley
CG	Central Ground Water
SWG	Southwest Ground Water
SCG	Southcentral Ground Water
SEG	Southeast Ground Water

Figure 8

Measurement of the volume of water in these applications required the development of a common metric. Some applications give the quantity of water to be moved in terms of diversion rights, others in consumptive use rights, and others give both. Consumptive use at the destination, or "move to" use (AFCU) was chosen as the index of quantity; wherever consumptive use was not stipulated, it was estimated by applying the average ratio of consumptive use/diversion to the diversion right. The ratio used is specific to the type of use in the original location. For transfers from agricultural uses, the average ratio in ACPPUs in the census is .534; from municipal uses, .459; from industrial uses, .663. These ratios were applied to all applications that lacked a consumptive use measure in the destination use. This procedure is an approximation which has been judged to involve fewer errors than the alternatives.

Thus defined, the volume of water in applications for change over time (in AFCU) does not follow the same pattern as the number of applications. AFCU in applications for change has declined since 1975-1976, except for 1986 (Figure 9).

What we see in this time series is the dominance of specific projects in determining the volume of water in ACPPUs. In 1975, for example, Carlsbad acquired nearly 3,000 AFCU of ground-water rights in Lea County, with the intent of eventually piping that water to Carlsbad. In 1976, the Public Service Company applied to change the place and purpose of use of nearly 12,000 AFCU of San Juan Chama Diversion water. In 1986, applications to move almost 5,000 AFCU were made to fill Brantley

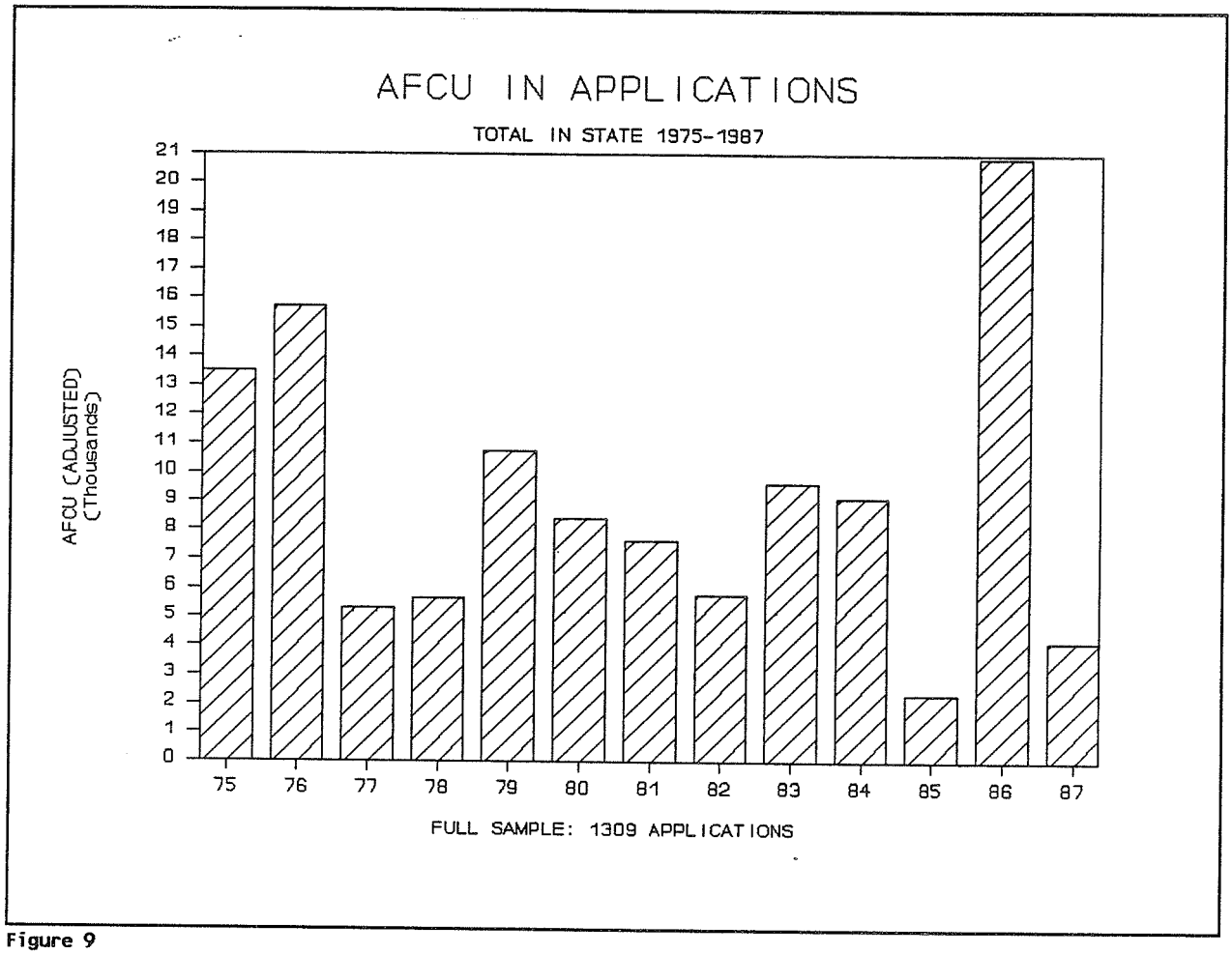


Figure 9

Dam Reservoir. In addition, 1986 figures are pushed up by a single application by a wine grower's association to move nearly 9,000 AFCU of San Juan Chama Diversion water.

Shifting our perspective from looking across time to one of looking across the water regions, the difference between number of applications and consumptive use in applications persists. The Middle Rio Grande has the greatest volume over the entire period (recall that the Gila-San Francisco had the greatest number of applications). Pecos River Valley (where ACPPU's involved a greater volume than the Middle Rio Grande during the 1980-1987 period) is second. A substantial amount of water was also moved in Southeast Ground-water basins (Figure 10).

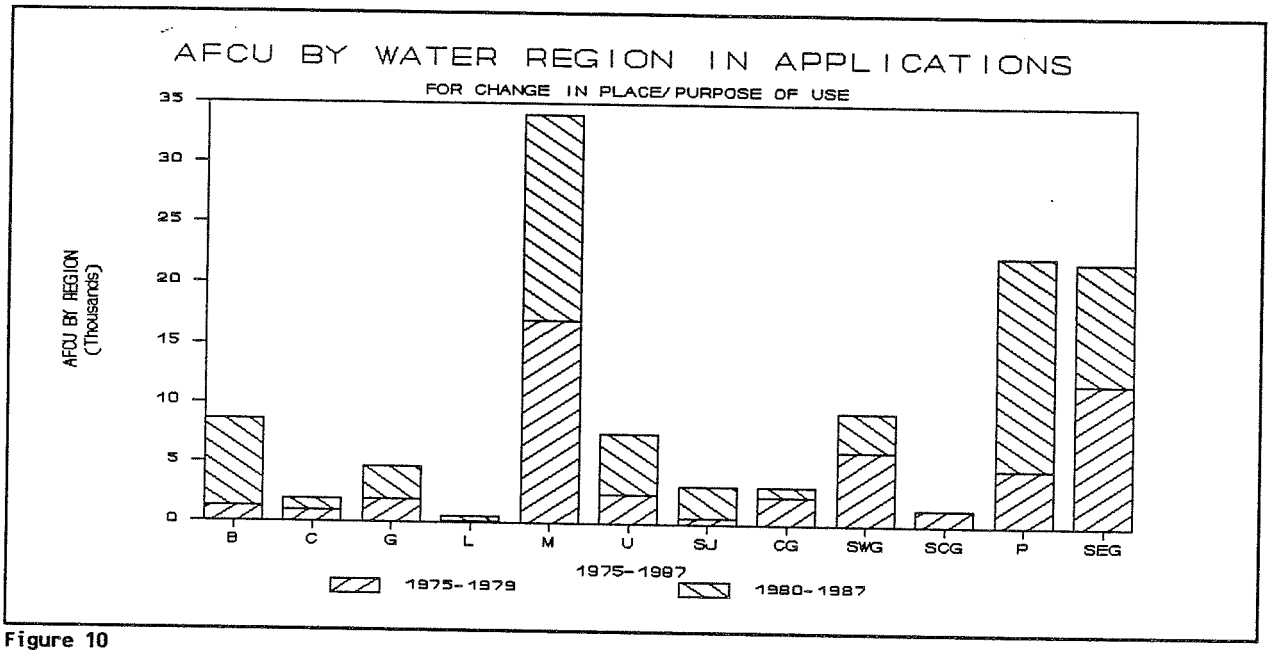


Figure 10

The difference between the patterns of consumptive use and number of users in applications has to be in the average size of application. As mentioned above, the Gila-San Francisco Basin has many small applications to move water rights because of a court order. Applications in most water regions involved, on average, less than 250 AFCU; average size of application tends to be smaller from 1980-1987 than from 1975-1979. One large application in the Southcentral Ground-water region (Tularosa basin) pushes its average off the chart, to 1328 AFCU (Figure 11).

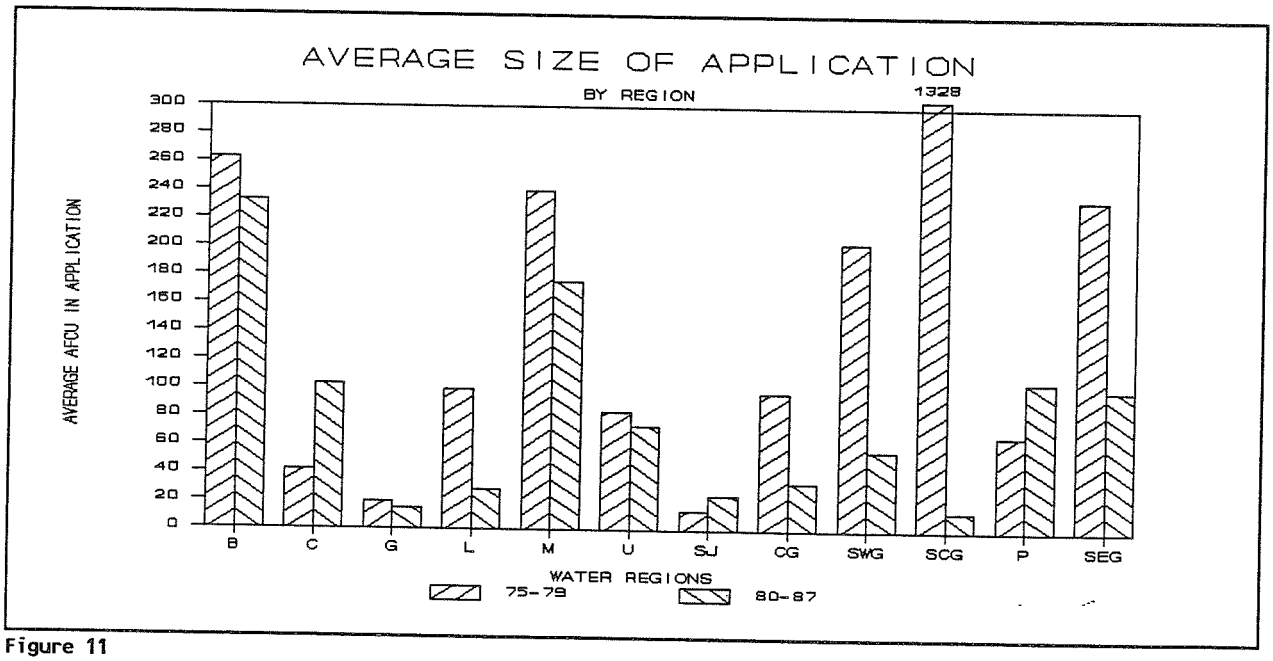


Figure 11

To summarize, we see a system in which movements in *volumes* of water over time are dominated by single events. These large transfers are usually special cases reflecting one-time needs or opportunities (such as the filling of Brantley Dam, or the availability of San Juan Chama water) rather than a continuous adjustment to changing economic conditions. The *number of applications* may be a better measure of the ongoing adjustment process; it seems to correlate roughly with population growth and growth in employment.

It is difficult to interpret the differences in ACPPU activity among regions, because the regions differ in size, population, level of economic activity, and quantity of appropriable water. We could compare the intensity of activity in changes in water use among regions by looking at the percentage of total water rights in the region that is involved in ACPPU's. Unfortunately, the total water rights data is not available. Lee Brown, of the University of New Mexico's Natural Resources Center, in a related study of transactions costs, used the SEO's five-year estimate of annual consumptive use of water as a rough proxy for volume of water rights. These estimates are made by river basin and by county, so there is no figure to compare with our enclosed ground-water regions, and even the surface-water basins are not all comparable to the regions defined in this study. However, the Rio Grande (Upper, Middle, and Lower as a group), the San Juan, the Gila-San Francisco, and the Pecos appear to be roughly comparable.

Table 1 shows the total volume in ACPPUs in the census as a percent of depletions in these four basins. Almost 10% of Gila-San Francisco estimated depletions were involved in ACPPUs during the 13-year period, a high intensity consistent with the Gila-San Francisco's more rigorous requirements on accounting for domestic uses. ACPPUs contained 5.4% of the estimated depletions in the Pecos River Valley, 2.5%, or almost half, of these were related to the filling of Brantley Dam Reservoir. In the Rio Grande as a whole, ACPPUs in the census involved 4.8% of estimated annual depletions in the whole stream. In the San Juan Basin, which had a high number of applications but relatively low volume of water, ACPPUs involved only 1.1% of estimated depletions.

COMPARISON OF VOLUMES IN ACPPUs
WITH REGIONAL DEPLETIONS
(IN AFCU)

WATER REGION	VOLUME IN ACPPUs	DEPLETIONS	ACPPU AS % OF DEPLETIONS
Rio Grande	42,069	883,300	4.8%
San Juan	3,157	299,500	1.1%
Pecos	22,510	414,300	5.4%
Gila-San Francisco	4,665	48,400	9.6%

From Summary Statistics section of F. Lee Brown, draft report to U.S.G.S., November, 1989; estimated depletions taken from Water Use in New Mexico in 1985, Brian Wilson, New Mexico State Engineer Office Technical Report 46, November, 1986.

Table 1

PRICES AND COSTS OF TRANSFERRING WATER RIGHTS

Price and cost data on water sales is notoriously hard to come by. Only a subset of the ACPPUs represented in the census involve sales; others are permanent or temporary changes by a water rights owner of the place and/or purpose of use of that right without change in ownership. The SEO records on ACPPUs do not indicate whether an application represents a sale, a lease, or an owner seeking to change its water use. A field test of the survey instrument revealed that many of the changes within agriculture and from agriculture to domestic use did not involve sales. These applications were removed from the census, and a random sample of the remaining applications was surveyed. Of the 368 applications drawn, 110 responses have been collected to date. Sixty-three represented sales, 15 leases, and 32 changes in use by the owner. We asked applicants from this small sample what they paid or received for the water right, how much money and time they spent on the application process itself, and how strongly the application was protested. Of the respondents involved in sales and leases, 62% provided price information and 79% of all respondents provided information on transactions costs.

Prices: Of the 34 applications for which we have data on sales price, the average sales price was $2316, with quantities converted to consumptive use units and price expressed in constant 1988 dollars (Figure 12). This average covers a substantial variability: the standard deviation is $2043/AFCU (that is, if the population is normally distributed, 68% of the prices lie between $273 and $4359, a wide range). There is also considerable variation among and within regions. In the Southeast Ground-water basins, for example, the average price was $174/AFCU; in the Pecos River Valley, $2609/AFCU, with individual prices ranging from $347/-AFCU to $11,134/AFCU.

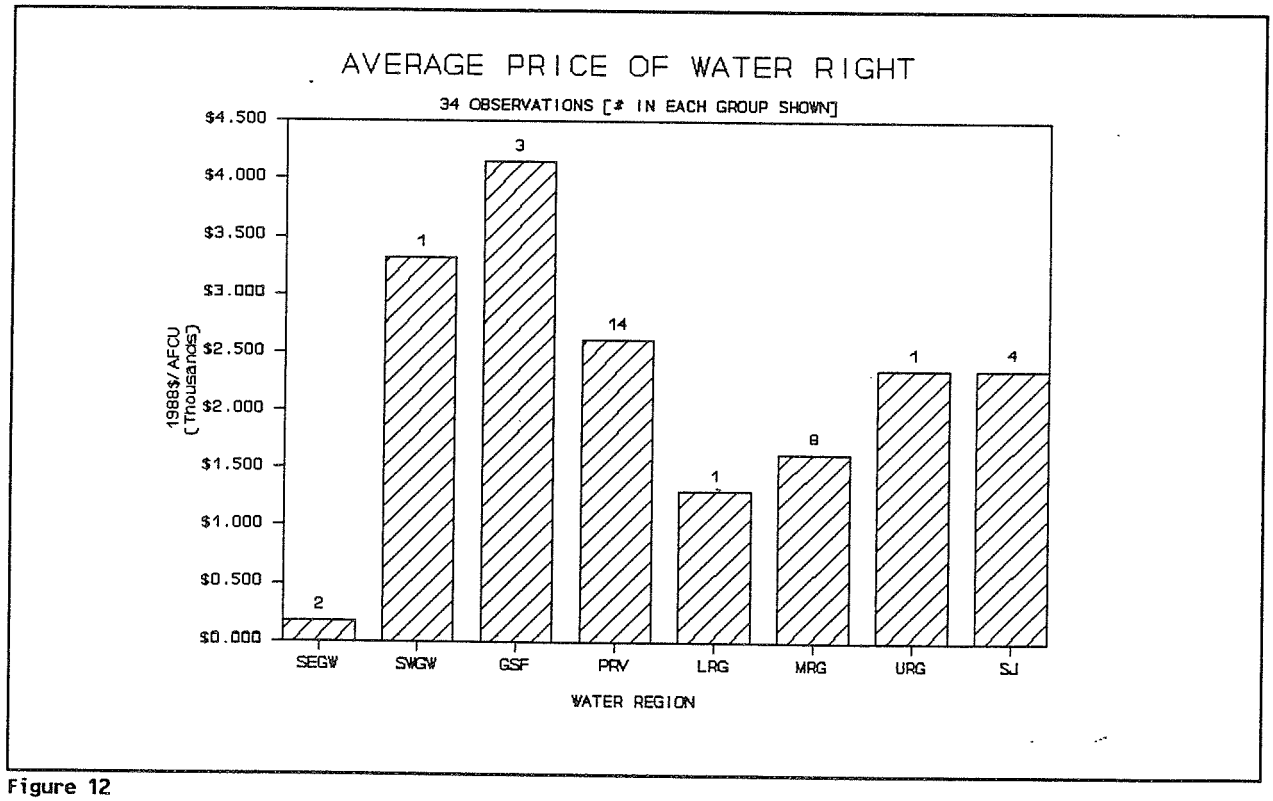


Figure 12

Over the state as a whole, prices appear to be rising somewhat over time. The average of the six prices reported in the 1975-1979 period is $1379/AFCU; of the 13 prices reported in the 1980-1983 period, $2121/AFCU; of the 15 prices reported in the 1984-1987 period, $2860/AFCU. These prices have been adjusted using the Consumer Price Index (CPI), and are expressed in 1988$, so this represents a rise in real relative price as compared with the goods indexed in the CPI.

Purchases of less than 5 AFCU tend to be higher priced than larger transactions (averaging $4051), but this tendency does not continue as the size of transaction increases above 5 AFCU (Figure 13).

Lease rates: Annual charges for the 14 leases of water rights ranged from $148/AFCU to $1843/AFCU, with an average of $364/AFCU, and a standard deviation of $448/AFCU. Eight of the leases drawn in the sample were from the Gila-San Francisco region during 1979 and 1980; this leased water was moved to municipal, industrial, and domestic uses, with lease rates all close to $150/-AFCU. The other six in the sample were leases for pipeline pressure testing, highway construction, commercial uses, mining and metallurgical uses, gas and oil drilling, and construction. If this very small sample is representative, lease rates differ from prices in that they do not appear to be higher for leases of less than 5 AFCU (Figure 14).

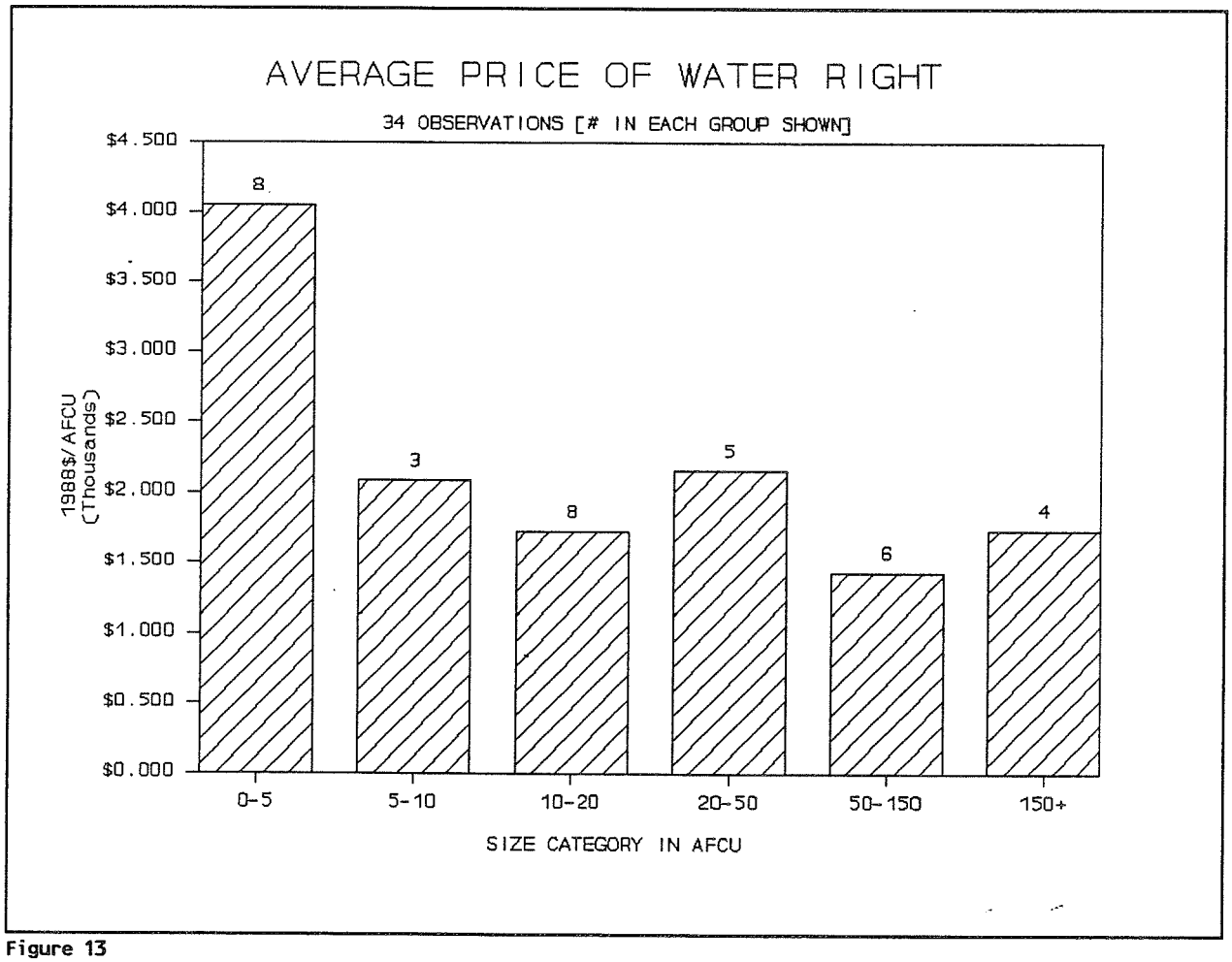


Figure 13

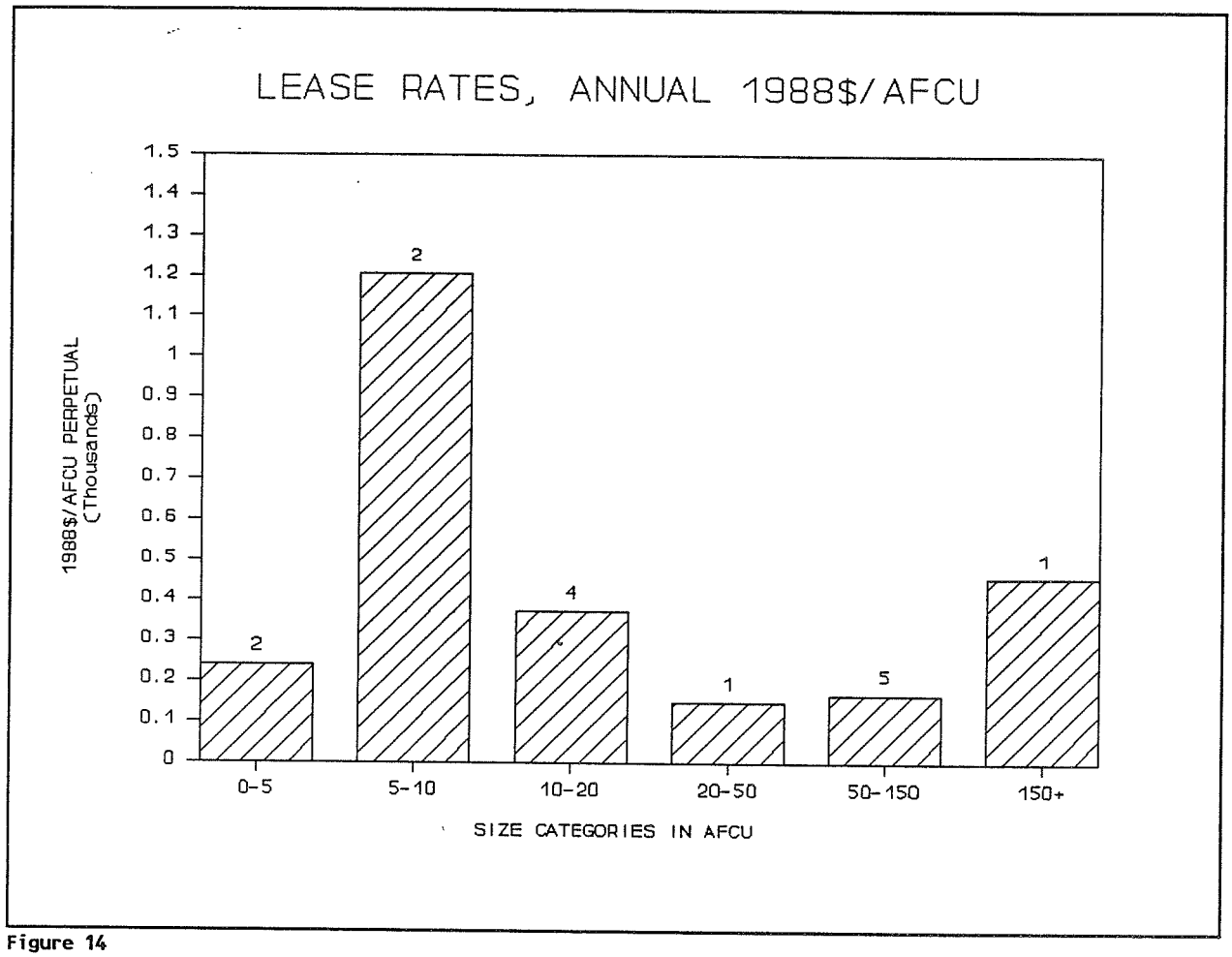


Figure 14

Transactions Costs: The filing and publication fees, hydrologic studies, attorney's fees and court costs paid by the applicant averaged $191/AFCU over the 87 survey responses that gave transactions costs. As with prices, there is high variability; the standard deviation for the whole sample is $712. There are large differences in average transactions costs among water regions (Figure 15), where averages range from $1.34 in the Southeast Ground-water region to $1083.77 in the Upper Rio Grande, as well as variation within regions, such as the Pecos River Valley, where transactions costs per single application range from $.05/AFCU to $1117/AFCU.

Transactions costs, like prices, are rising over time. The average transactions cost for 27 reported in the 1975-1979 period was $16/AFCU; for the 29 reported in 1980-1983, $216/AFCU; for the 31 reported in 1984-1987, $328/AFCU. Again, all costs are expressed in 1988$, so this increase represents an increase in real cost relative to the items indexed in the CPI.

Transactions costs decline with the size of application, as prices do. However, while prices declined for sales of more than five AFCU, average transactions costs remain quite high for applications between 10-20 AFCU ($395/AFCU). Average transactions cost falls to $60/AFCU for applications in the 20-50 AFCU range, to $36/AFCU for applications in the 50-150 AFCU range, and to $3.82 for those greater than 150 AFCU (Figure 16).

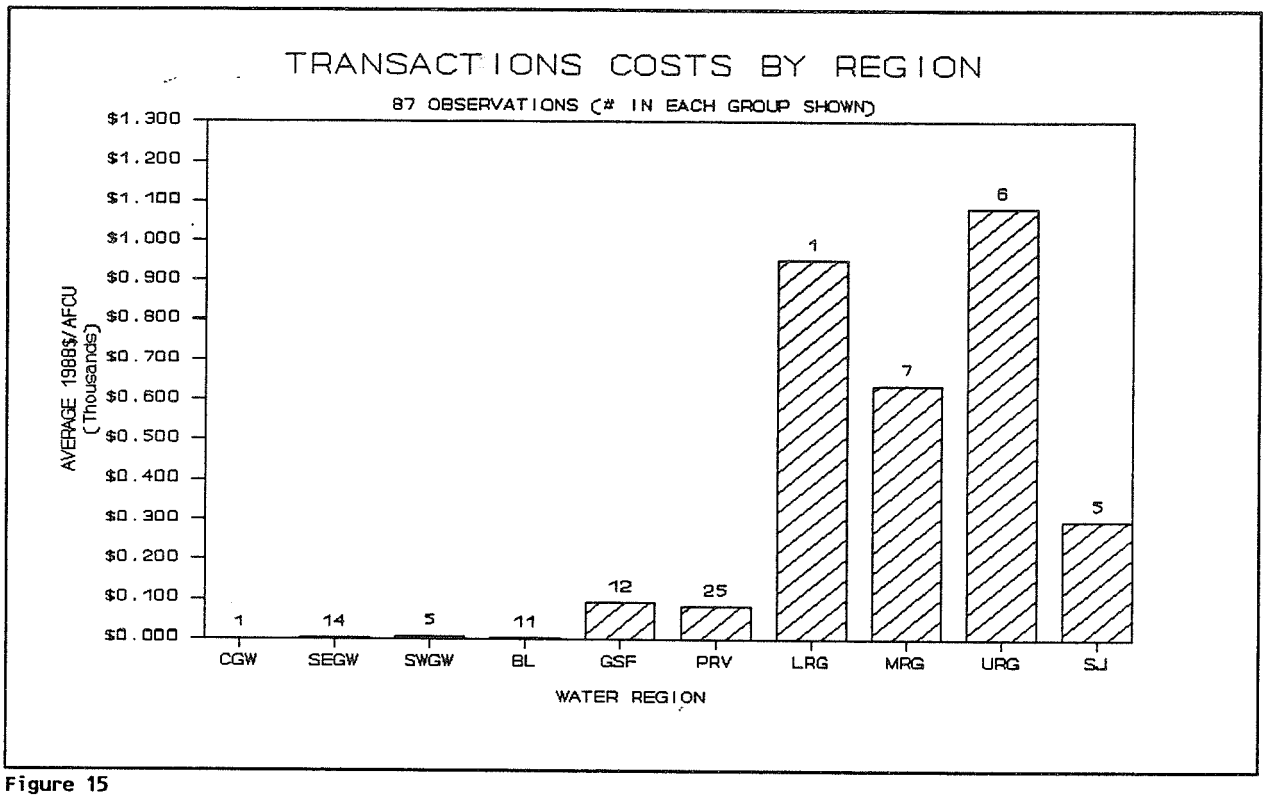


Figure 15

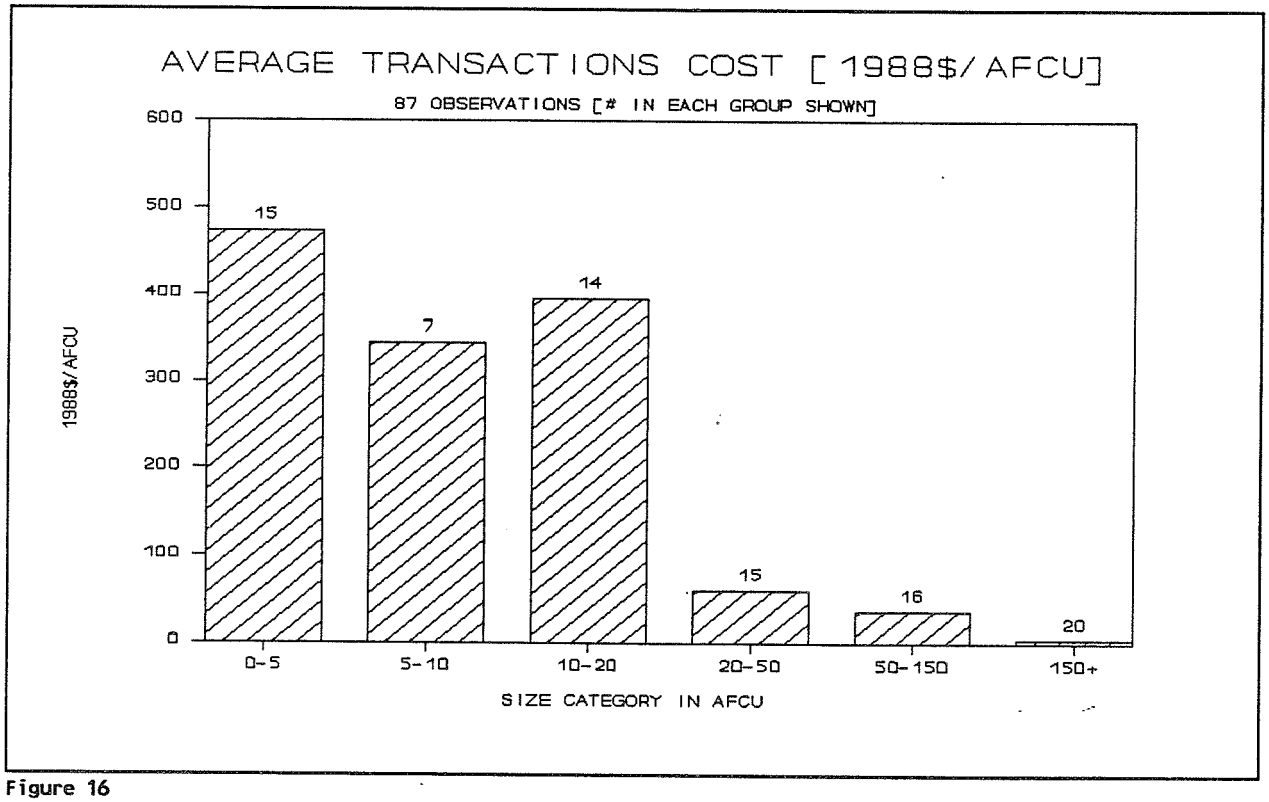


Figure 16

Types of Uses: We are, of course, interested to what uses water is moving. Table 2 shows the percentage of water in the whole census that changed from sector to sector. Because the applications use general and noncomparable terms for water uses, these sectors are extremely coarse, but the directions of movement are still interesting. Applications seeking to change place and purpose of use *within* agriculture make up 26.3% of the AFCU in the census. Since simple shifts in irrigation from field to field were eliminated from the census, most of these represent a change in the type of agricultural use or a change in the agricultural user. This indicates a great deal of activity in changes in water use in agriculture. Movements *out of* agriculture make up 29.4% of the AFCU in the census, while movements *into* agriculture make up 3.9%, indicating, as expected, that agriculture's share in the state's water rights is declining. More than a third (37.9%) of the AFCU in the census involve movements from one nonagricultural use to another, many of these municipalities adjusting their water management practices.

DIRECTION OF CHANGES IN WATER USE

Moved from Sector to Sector in ACPPU	% of all water
Agriculture to Agriculture	26.3%
Agriculture to Ag and Nonagriculture	2.6%
Agriculture to Nonagriculture	29.4%
Nonagriculture to Agriculture	3.9%
Nonagriculture to Nonagriculture	37.9%

Table 2

A finer breakdown of sectors is possible for the survey data. In the 109 survey responses that give data on the use to which water was moved, the leading use is municipal, with 31.6% of the consumptive use in the whole group (Figure 17). This is followed by industrial uses with 25.1%; construction with 16.8% (many are applications from the state Highway Department); irrigation, mostly urban irrigation of parks and golf courses, with 8.3% (recall that changes from agriculture to agriculture were removed from the survey population); energy and mining, with 8.2%; and commercial uses (many are trailer parks), with 2.2%. The "other" category includes dairy uses, domestic, fishery, recreation, and storage, which together sum to 4.2%. Of the consumptive use represented in the survey, 3.5% was moved to multiple uses - municipal, industrial, and commercial.

SUMMARY AND CONCLUSIONS

The data collected thus far in the census of ACPPU and the follow-up survey of a random sample have raised more questions than they answer, but they do provide some clarification of the nature of the transfer process. First, to the surprise both of the research team and many people familiar with water administration in New Mexico, most applications to change place and/or purpose of use are processed quickly and cheaply: 75% within six months, and 76% at costs less than $50/AFCU. Some, however, are both costly and time-consuming: 5% of the finalized applications took more than two years, and 5% (not necessarily the same applications) cost more than $1,000/AFCU.

On the basis of the scanty data supplied by the survey, it appears all three sections of the Rio Grande have relatively high transactions costs. The high cost of transactions may be seen as consistent with the Rio Grande's higher population density, competition between long established users and emerging uses, and intensive conjunctive management of ground and surface waters on the river.

It is interesting that water *prices* on the Rio Grande, again on the basis of sparse data, are not among the highest in the state. The high transactions costs coupled with moderate prices suggest competition among Rio Grande water users has been more strongly expressed through actions aimed at protecting ownership interests in water rights (a competition that creates transactions costs) than in competing for acquisition of new rights (a competition that presses prices up). If we look at the ratio of transactions costs/AFCU to purchase price/AFCU (with a healthy skepticism due to the very small sample size) this distinction is highlighted (Table 3). While the Lower Rio Grande ratio of 73% can be discounted as there is only one observation each of price and transactions costs, the Middle Rio Grande ratio (39%) is based on 7 observations of transactions costs and 8 of price, and is not so likely to be spurious. The low ratios of both the Pecos River Valley (3.1%) and the San Juan Basin (12.6%) are likewise based on several observations. Price competition serves a valuable allocation function; while the protection of ownership rights is important, a high cost for this service suggests that net gains can be achieved by finding less costly ways to protect ownership interests. This appears to hold particular promise on the Rio Grande.

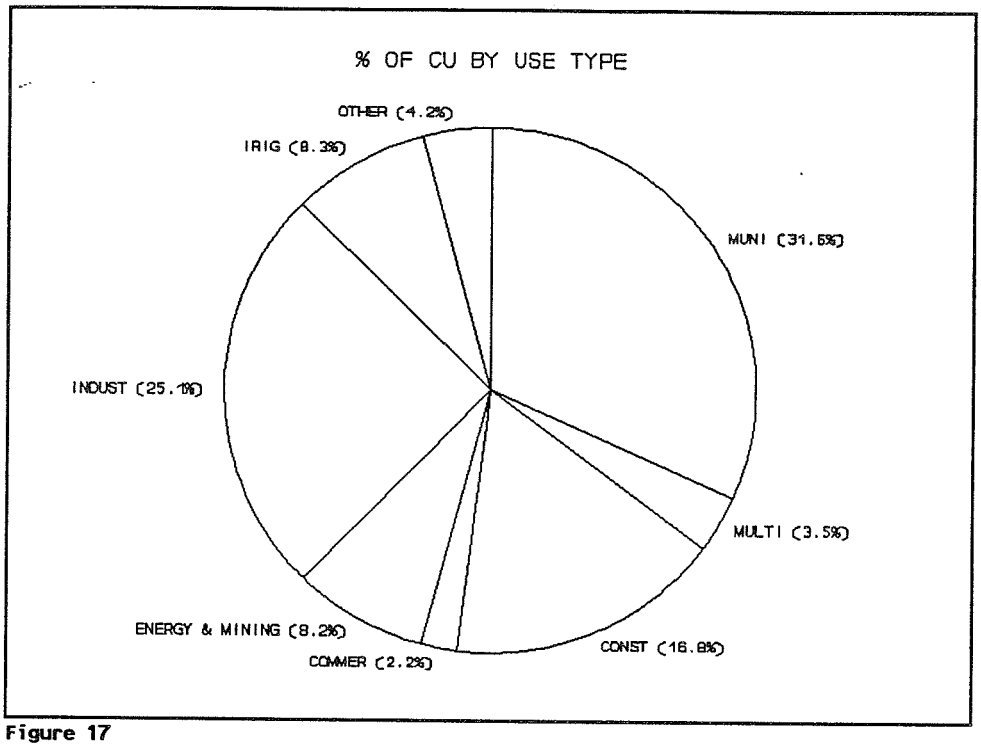


Figure 17

Transactions Costs/Price for Eight Water Regions

	Average TC	Average Price	TC/P
SEG	$1.34	$174	.8%
SWG	$6.89	$3316	.2%
GSF	$91.03	$4145	2.2%
P	$81.66	$2609	3.1%
LRG	$951.35	$1301	73.1%
MRG	$636.53	$1629	39.1%
URG	$1083.77	$2354	46.0%
SJ	$297.18	$2360	12.6%

Table 3

Prices and transactions costs both seem to be rising over time, but prices are rising slower than costs. The increase in average price in the sample from the 1975-79 period to the 1980-83 period was 5.3%; the increase in average transactions cost in the same period was 1205%. In the next period (between 1980-83 and 1984-87) the rate of increase in price rose to 34.8%, and the rate of increase in transactions cost fell to 51.8%, remaining higher than the price rate. Again, while the price increase reflects growing competition for water, the more rapid increase in transactions cost reflects a growing need for mechanisms to settle questions about changes in water uses.

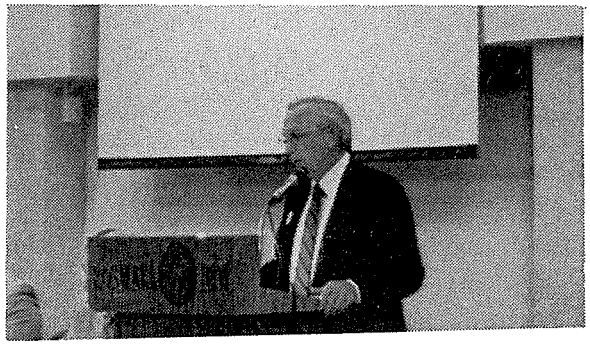
None of these data speak to the nature of the questions that create transactions costs. This research was initiated on the premise that many of these questions would be hydrologic in nature, and that a more explicit technical standard could reduce uncertainty and transactions costs. While this has not been refuted as yet by the data, neither has it been confirmed. An alternative possibility is that there exist specific areas of potential impairment which have not yet been clarified in law, giving rise to protests and high costs in an effort to make law in the protestant's interest. If this is the case, attention could profitably be paid to clarifying these impairment questions specifically. The relatively new public welfare criterion may be one such area.

While it is good news that the majority of applications to change place and/or purpose of use are quickly and cheaply processed, the minority of costly and drawn-out reviews deserve attention and

call for a remedy. Identification of the ambiguities that create these costs and delays will facilitate policy to resolve water-based conflicts more expeditiously. This is the objective to which this work is ultimately directed.

[1]AFCU: acre-foot (af) per year of consumptive use. This is a right to *consume* 325,900 gallons of water per year. Since most water uses have return flows, it is generally associated with a diversion right in a larger quantity.

J. Phelps White III, Roswell farmer and businessman, has been a member of the New Mexico Interstate Stream Commission since Bruce King's first administration. White is a member of the New Mexico State University Foundation Board of Directors and is active in the Nature Conservancy. He is a past president of United Way and the New Mexico Wool Growers Association and served on the New Mexico Military Institute's Foundation Board. White holds an associate degree from NMMI and a BBA from the University of Texas.



REGIONAL WATER PLANNING

J. Phelps White III
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P.O. Box 874
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It is a pleasure to be here and hopefully to make you more aware of regional water planning efforts in New Mexico. While all of us are continually engaged in managing water matters in our own way and in our own locale, the *planning* of this management activity is something that, whether we consciously realize it or not, goes hand in glove with our daily routine.

Planning comes in many forms. I suppose the first exercise in water planning in New Mexico goes back to the days of the Spanish settlers and the subsequent decisions made by those settlers, their governments, and their choice to follow the Doctrine of Prior Appropriation in the beneficial use and allocation of who uses what water and where. Even before that, I am sure the native Americans living in the arid Southwest had plans to maximize their use of this precious resource, even if it meant migrating to sources of water for their livelihood.

Today, conscientious water planning is more important than ever. The photograph on the conference program's cover illustrates only half of the story. It is a photograph of a flowing artesian well in the Roswell area. As you know, this artesian basin is one of the most prolific recharge areas in the United States. During settlement of the Roswell area, there were no less than four flowing, live streams passing in and around Roswell, at least two of which came from huge springs in the immediate Roswell area. This bountiful supply of water resulted in dramatic growth of the area and the Pecos Valley. It even brought in the railroad.

Shortly before the turn of the century, the first artesian well was discovered and susequently made Roswell one of the most attractive farming areas ever known. The largest artesian well in the world was just southeast of town and it was known to flow at least 12,000 gallons per minute. One historical account put it this way: "Government experts...assessed the situation and pronounced the flow *permanent*."

Today there are no flowing wells of any consequence and no live streams flowing through town. Of course, the Pecos is still out there - very tightly controlled by its present users, including the state of Texas. Today too, the site of the photograph on our program is no longer the same. The water is very brackish, the soil is alkaline, the original owners have long since gone, and farming is about as tough as it gets.

Now I don't mean to cast any disparity on our early farmers, nor do I intend to paint a picture of doom for the Roswell farming economy. Farming, and our local community are alive and well. However, the successes of our present economy, albeit far different than it was eighty years ago, is the

direct result of planning, both long and short range, by many of our far-sighted farmers and public officials.

Population trends in New Mexico tell an interesting story. One has to look also at the growth of population in our neighboring states, especially those states whose water supply is very closely related to waters originating on or flowing through New Mexico. With New Mexico's population now exceeding one million, with Albuquerque becoming another Phoenix, with Las Cruces turning rapidly into a major city, with newcomers flocking to Santa Fe, with virtually all our cities competing for the economic development dollar, and with very little unappropriated water to plan on, an ongoing and innovative system of water planning is essential.

As our growing population's need for water increases, so too does a proportionate share of the water going to agriculture dwindle. This is a truism throughout the world. As urban growth supplants agriculture, the beneficial use of water shifts, not only from rural to urban, but from use by a relatively few to use by large numbers of folks, all with different needs. Recent studies show that 70 percent of our water is dedicated to agricultural uses. Our farming and ranching economy is the backbone to the viability of New Mexico as a place to live. We cannot afford to lose this important activity and culture. With at least 90 percent of New Mexico lands engaged in agriculture, the resultant tax base is the key to virtually everything we do at both state and local levels. Our whole infrastructure is keyed on the value of agriculture - our schools and roads especially. So, as we talk about water planning, we must include all facets of our state, including agriculture.

As I mentioned, water planning has been around a long time. Even though every community, every county, and the state government itself has, in their own ways, constantly engaged themselves in planning for their water needs, each area or region of New Mexico is different. In many instances, however, local needs are not much different than the needs of the next community or county.

For example, the declining ground-water table in eastern New Mexico causes a great deal of concern. This area is studying the problem and is anxious to take actions toward a solution. Conservation will play a great part in the planning process. Furthermore, the situation in eastern New Mexico is in no way like that existing in any other part of the state. In Gallup, the physical shortage of water is of great concern. Northern New Mexico area residents are concerned about the implications of acequia water rights being transferred to other uses. Shifting traditional beneficial water uses to industry raises many questions for those regions of the state actively pursuing economic and industrial development plans. Future ground-water pumping in outlying Albuquerque areas, as it relates to transfer of water rights, is of concern. Regional water planning therefore becomes a viable option to these and many other regions of the state.

The need and desirability of regional water planning in its present form is the direct result of the New Mexico Legislature's enactment of Chapter 182, 1987 Laws (House Bill 337, as amended). These legislators, exercising some very far-sighted wisdom, recognized the problems facing a rapidly changing and growing political body known as the state of New Mexico. They recognized too, that although our water belongs to the people of New Mexico, every region has its own unique supplies and needs. This act placed the responsibility of regional water planning on the Interstate Stream Commission. This was a logical choice inasmuch as the commission is composed of eight gubernatorial appointees, each from the major irrigation districts of the state. A ninth member, by law, is the state engineer. In addition, for the first time, the commission was empowered to "..appropriate ground water or purchase water rights on behalf of any of the various regions of the state." The act does not permit the condemnation of water rights nor any action which may affect the water rights of Indian tribes. The present efforts to conduct regional water planning is a logical first step in fulfilling this legislative mandate, that is, the authority vested with the Interstate Stream Commission to appropriate ground water or buy water rights for the benefit of a specific region of the state.

The commission's mandate to set up regional water planning in New Mexico begins with its responsibility to design and implement a program in which applicants may apply for funding under this statute. Criteria has been established and the first grants were made in 1987.

The commission's authority to set criteria include:

1. Identification of the "planning region" and why it is hydrologically or politically appropriate
2. An appropriate planning process
3. Completion costs and timetables
4. Identification of other sources of funding for regional planning
5. Ground rules for regional applications and review guidelines for the commission leading to applicant funding to the applicant

Applicant eligibility under this act is quite broad, although the applicant must be a political entity or a combination of several political entities operating under a joint powers agreement. The applicant must be part of a "water planning region" as determined by the Interstate Stream Commission. When two or more parties join forces, they must demonstrate common political and economic interests.

The Interstate Stream Commission is now in its third year of implementing Chapter 182. The commission, with the support of Commission Secretary Reynolds and his staff, have entered this endeavor with the knowledge that the fruits of their labors will be a more secure and stable water supply for New Mexicans, at least for the prescribed forty years into the future.

To be honest, I personally had serious reservations concerning the result of each region submitting its own version of its water needs. I envisioned a monstrous "mishmash" of data, statistics, and plans that did not relate to other regions around the state, and the information would never be used. As we learned more about the motives of regional water planning, and what the end result might be, we began to realize that this was an opportunity for local government and its citizens to have a say in an issue that directly affects their future livelihood. In many ways, it is an opportunity they never had before. It not only serves to dispel any frustrations local folks might have toward "higher authority," but it gives them the chance to get involved in the decision-making process. To me, perhaps the most important benefit is the enhancement of local citizens' knowledge. A "sense of belonging" is a very strong need in most people's lives, and here is a chance for that desire to be realized.

The first appropriation, two years ago, was quite modest. It gave the commission a chance to get a better feel for the process, and it served to make the various areas of the state a little more aware of what the process entailed. The commission was given $150,000 to allocate to qualified applicants. Obviously, that amount of money would not go very far, however, there were only three applicants that first year, and all three received grants, which coupled with local monies, totaled an additional $130,000. Those grants went to the Eastern Plains Council of Governments, the San Juan Water Commission, and the Santa Fe Metropolitan Water Board. Indications are that these three entities have made good use of this resource.

In 1988, $250,000 was appropriated. Word got around and the commission found itself considering requests for $1,618,371 from fifteen applicants. The hearings, held in October of last year, further bolstered my feelings that regional water planning will not only provide tremendous amounts of useful information, but has given many people the chance to become more aware of their needs and what can be done about them. After two days of tough interviews with each of the applicants, the $250,000 allocation was awarded to six applicants. These awards went to the Southwest New Mexico Council of Governments and Black Range Resource Conservation and Development Water Task Force, the Southeastern New Mexico Council of Governments, the city of Gallup, the North Central New Mexico Economic Development District, the Mora San Miguel Water Plan Committee, and the Southeastern New Mexico Economic Development District.

This year, twelve applications requesting $828,355 were received. This year, $350,000 has been appropriated. Hearings will be held next week in Santa Fe, and I am sure the full appropriation will be awarded.

The state legislature has taken the strong position that regional water planning is vital to the future of New Mexico. Going back to one of the original intents of the legislation, regional planning is the key to the state being empowered to appropriate ground water or purchase water rights for the benefit of a given region. But first, a water plan must be in place. The governor is a strong advocate of the concept. With his background in agriculture, and his huge dedication to economic development for our state, he knows all too well that long-range planning of our water needs is perhaps the single most important element for assuring our future in this wonderful and dynamic part of the desert and mountainous southwest.

Charles Ault is a wildlife biologist with the U.S Fish and Wildlife Service, Division of Realty. He studied the effects of water development and land management practices on fish and wildlife in New Mexico from 1978 to 1986 with the service's Division of Ecological Services. Ault's responsibilities include the biological evaluation of lands in New Mexico, Texas, Oklahoma, and Arizona proposed for inclusion into the National Wildlife Refuge System, ensuring the Service's compliance with the National Environmental Policy Act relative to land acquisition, and coordinating the Service's acquisition proposals. The Indiana native came to New Mexico by way of the military. Ault holds a B.S. in Fishery and Wildlife Sciences from New Mexico State University.

WILDLIFE AND ASSOCIATED VALUES OF WETLANDS

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INTRODUCTION

Wetlands, what are they? Are they the vast coastal marshes that occur at the mouths of the many rivers that flow into the bays and estuaries along our nation's shores? Are they the silvery playa lakes that shimmer on the vast high plains region of western Texas, Oklahoma, Kansas and eastern Colorado and New Mexico? What about the verdant bottomland hardwoods that occur within the floodplains of the rivers that empty into the Gulf of Mexico. Or, are they the *bosques* of the Southwest? In truth, wetlands, by description, are many and varied. They are, in addition to the types previously mentioned, the peat-bogs, sloughs, bayous, back waters, marshes, swamps, and riparian areas scattered across these United States.

Do these wetlands have any value to Americans? President Bush thinks so. He has stated his interest in preserving these valuable resources in many public engagements. In one recent instance he stated:

> "So any vision of a kinder, gentler America -- any nation concerned about its quality of life, now and forever -- must be concerned about conservation. It will not be enough to merely halt the damage we've done. Our natural heritage must be recovered and restored."

The president went on to state:

> "It's time to stand the history of wetlands destruction on its head: from this year forward, anyone who tries to drain the swamp is going to be up to his ears in alligators. Our approach to wetlands conservation is driven by a new kind of environmentalism -- a set of principles that apply to all of the environmental challenges we face. We believe that pollution is not the inevitable by-product of progress. So the first principle is that sound ecology and strong economy can coexist. The fact is, our ecology and the economy are interdependent."

The president's feelings are supported by strong grass-roots support for environmental protection as revealed continually in recent public opinion polls.

condos to mud huts..." (Newsweek cover story: The Environment: Cleaning Up Our Mess, July 24, 1989, p.41).

WILDLIFE AND FISHERY VALUES

Wetlands are among the world's most biologically productive ecosystems and are crucial as habitats for fish and wildlife. Roughly two-thirds of the commercially important fish and shellfish species harvested along the Atlantic and Gulf coasts and half of the Pacific coast are dependent upon estuarine wetlands for food, spawning and/or nursery areas. A commercial marine fisheries harvest valued at over $10 billion annually provides one economic measure of the significance of coastal wetland resources.

Wetlands are important as natural areas containing diverse plant and animal life. Since they constitute only 5 percent of the nation's lands in the contiguous United States, these communities are, in general, rare. Their importance resulting from their rarity and plant diversity is shown, for example, by the high percentage of wildlife species using these areas. For example, an estimated 80 percent or more of the wildlife species in the arid southwestern Unites States depend upon wetlands for all or some of their life requirements.

Essential breeding, spawning, nursery, nesting, migratory and/or wintering habitat for a major portion of the nation's migratory and resident fish and wildlife are provided by wetlands. Almost one-third of the nation's threatened and endangered plant and animal species depend heavily on wetlands. Of the approximately 108 species currently listed by the New Mexico Department of Game and Fish as endangered, almost 70 percent depend on wetland habitats for food, shelter, or breeding. Nationwide, millions of water-associated birds including waterfowl, shorebirds, wading birds, gulls and terns, rails and other groups depend on marshes, potholes, sloughs, swamps, mudflats, and other wetland types.

OUTDOOR RECREATION VALUES

Wetlands support boating, swimming, sport fishing, hunting, bird-watching, nature observation and study, and other wetland-related recreational activities that generate billions of dollars of expenditures annually. For example, 17.4 million hunters spent about $5.6 billion on supplies, lodging, transportation and other related expenses in 1980. Of these totals, 5.3 million hunted waterfowl, spending about $640 million. In total, fish and wildlife-related recreation in 1980 was a $41 billion industry, largely based on wetland resources.

Participation in water and wetland-related outdoor recreation by Americans twelve years and older was estimated in 1982-83 at 53 million for boating, 64 million for fishing and 22 million for bird-watching. Recreation in wetlands, such as hiking, nature observation and photography, swimming, boating, and ice skating is generally not evaluated in economic terms. Many people simply enjoy the beauty and sounds of nature and spend their leisure time walking or boating in or near wetlands observing plant and animal life. We are all aware of the thousands of people that picnic, walk, jog, bird-watch, or simply stroll along the Rio Grande Bosque in Albuquerque and the Santa Fe River in Santa Fe, and visit the Bitter Lake National Wildlife Refuge along the Pecos River just north of Roswell. The aesthetic value of wetlands is extremely difficult to evaluate or quantify monetarily. Nonetheless, it is an important aspect, because in 1980 alone, 28.8 million people (17 percent of the United States population) took special trips simply to observe or photograph wildlife.

WATER QUALITY VALUES

Wetlands can help maintain water quality or improve degraded water by removing, transforming and retaining nutrients, processing chemical and organic wastes and pollutants, and reducing sediment loads. Wetlands intercept runoff from uplands before it reaches the water and help filter sediments, nutrients and wastes from flood water. However, it is important to remember that wetlands have a finite capacity to perform this function.

Wetlands temporarily store flood water, slow water velocities, reduce bank and shoreline erosion, and slowly release stored water downstream, thereby saving lives and property. Inland wetlands located along major streams and around lakes stabilize shorelines and channel banks and buffer developed uplands from storm, wave or erosion damage. Coastal wetlands serve these functions as well as providing a buffer to reduce potentially devastating effects of storm surges.

Flood conveyance and reduction functions of wetlands relate to their capacity to store and slow flood water, thereby increasing the duration of the flow and reducing downstream flood peaks. Many cite the Corps of Engineers' 1972 study of the Charles and Neponset River watersheds in Massachusetts as a prime example of the socioeconomic values associated with protecting wetlands to maximize

flood control benefits. In this study, the Corps estimated that loss of the 8,423 acres of wetlands within the basin would result in annual flood damages of over $17,000,000.

SUMMARY

As we can see, the values of wetlands in this country are many. And there are many among us that appreciate those values and want to preserve and enhance them into the future. I believe if we work together we can stop the rate of loss of our nation's wetlands and achieve some gains for future generations of Americans.

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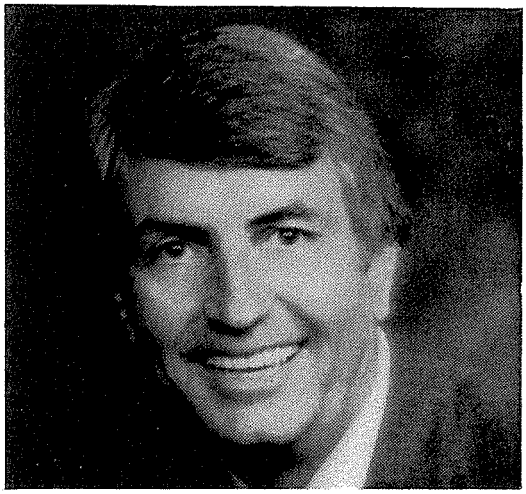
Garrey Carruthers, the 24th governor of New Mexico, and former agricultural economics professor at New Mexico State University, began his political career in 1959 as state president of the Future Farmers of America. In 1974, he became a White House Fellow under President Gerald Ford and he served as Acting Director of the Water Resources Research Institute from 1976-1977. In 1981 Carruthers was appointed assistant secretary of the Interior Department, where he was responsible for the Bureau of Reclamation, the Bureau of Land Management, and the Office of Water Policy. The Interior Department was reorganized in 1983 and Carruthers became assistant secretary for land and minerals management. He resigned at the end of President Reagan's first administration to return to New Mexico.



VIEW FROM THE TOP

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Tom Bahr sent me a letter awhile back asking me to participate in this conference and said he wanted the view from the top. I have not been on top since I had his job as director of the Water Resources Research Institute. Things have gone downhill ever since. However, I will give you my view on what is going on in water resources.

This is the thirty-fourth annual water conference. I can still remember when Dr. Ralph Stucky started these conferences some years ago. It is hard to believe we have gone through thirty-four and still have a lot to talk about in dealing with water resources. It is a pleasure to be back at the Water Resources Research Institute-sponsored conference, the thirty-fourth annual version.

Water has always been a trendy subject in New Mexico. We have been talking about water for thirty-four years, and one would think in thirty-four years, one could solve water problems. My assessment in looking back over the years of water conferences is we have tended to look at water quantity concerns.

We are in this fine river valley where we have just recently had a little contest with the state of Texas. We lost a little lawsuit with an original claim of $301 billion in alleged damages suffered as a consequence of a dispute over how we measure water. We settled that case very recently for $14 million. Fourteen million dollars is about right and is the reason the registration fee has gone up for the conference. We just do not have the $14 million to pay these guys in Texas. You must understand how irritating it is for a New Mexican to agree, and I hope you Texans will forgive me, to pay Texans for water. We do not mind paying occasionally the Coloradans for water because the water does flow from Colorado into New Mexico, but Texas is at the other end.

As we look at the history of water resources in our state, we have fought at various times with Texas, most recently in the Pecos Valley. We have sided with Arizona, California, and Colorado in fighting the Texans. Lawyers have become so extremely wealthy as a result of our many years of litigation in water resources that they have sent their

grandkids to prestigious, expensive universities on the fees they have raised--prestigious, expensive universities like New Mexico State University, the Harvard of the Southwest.

We have won some of these litigious battles and we have lost some. I would venture to guess that we are going to debate water quantity for a long time in New Mexico. It is not over yet. Contests are underway now in the courts and there will be other contests in the future to determine who really has the right to water resources.

The trend now, as I see it from my position as governor of New Mexico, is that water quality will be the issue of the 1990s. Water quality will be the issue very simply because failure to protect water quality is the same as fighting with Texas over water. Either Texas will fight to take it away from us or we will degrade water such that we will not be able to use it anyway. Therefore, it makes no difference whether we are fighting with Texas or whether we are fighting with ourselves over protecting water resources. We are going to have to protect water quality or we in fact lose water rights in the state of New Mexico. That will be the focus in the 1990s.

Some issues before us today are worthy of media consideration in that they all pretty much deal with water quality and the dangers of degrading water resources. First and foremost, and one that will be on the agenda of the coming legislature, was on the agenda of the last legislature, and may be around for a little while longer, is a little thing called "landfills."

We have discovered landfills to be probably the most topical issue nowadays as we talk about protecting ground-water supplies. Let's look back two years ago. This administration decided to promulgate some rules and regulations dealing with landfills and how landfills ought to be properly operated. I instructed members of the administration, particularly the Environmental Improvement Division, to go forth into the communities and talk about what rules and regulations we need and should have. During the two-year process of developing rules and regulations, it was rather quiet. The minute we promulgated them, I was sued by everybody who was anybody in New Mexico, including some of the mayors here. I see in the audience today two or three of my mayor buddies, my good friends in the mayor business and the county commission business. I did not know I had made so many enemies on such a delightful issue as regulating landfills.

We used to have in excess of 230 or 240 landfills. The mere promulgation of those rules and regulations led to an immediate reduction to 130 landfills in the state, simply because we had so many landfills out there not being properly run. There was some suspicion on the part of county commissioners and city council people, that if they did not close these improperly run landfills fairly soon--and there was a grace period as I recall - they would have to close them rather quickly or be subject to some cleanup costs and fines for violations. Thus, we ended up with 130 operating landfills in the state of New Mexico. That is the current situation. However, many of those landfills are still very poorly run and endanger ground water in the state of New Mexico. Several are on the Environmental Protection Agency (EPA) Superfund list and you know when you make the ol' EPA Superfund list you have one crummy landfill on your hands.

The cost and problems associated with landfills continue to grow. In 1960, New Mexicans generated 2.65 pounds of garbage per person per day. In 1986, according to the Environmental Improvement Division, New Mexicans generated 3.58 pounds per person per day. We are a disposable society. We used to live without all the disposables we have nowadays. In fact, plastic, the wrapping on everything now, was not used fifteen to twenty years ago. Back then at the meat counter, you received your meat wrapped in a brown paper wrapper. You did not collect all the plastic that is now creating a problem because some of it is not degradable. We are now a disposable society in New Mexico. We have not doubled, but we certainly have increased the amount of garbage we generate today.

The solution as we see it in my administration, is that we are going to have to move to far fewer and much better managed landfills than in the past. We think it is a priority issue for the environment to move to fewer landfills and better managed landfills. The landfill problems in New Mexico led to the promulgation of the rules and regulations now in litigation. I would not suggest to you that we are going to solve that law suit. I think what is probably going to happen is the legislature will give it a run in the coming legislative session and see if we can solve it legislatively. Then perhaps the law suit will be withdrawn.

However, we were correct in developing landfill rules and regulations, even though we just did it this year and it led to litigation and landfill closings. We should have done it many, many years ago. I do not know why we waited so long to acknowledge that landfills are creating problems for ground-water resources, but we did. Let me give you an example. There is a famous landfill in New Mexico called Lea

Acres Landfill, an infamous landfill would be a better way to put it. If we had originally gone into that site, we believe the site could have been brought into compliance in its early stages for about half-a-million dollars. But because we let it go too long, the cost of investigation alone for that particular landfill was $1.5 million. We believe now the cleanup of that particular single landfill could cost between $5 and $50 million. You can see an economist like Ron Cummings made this estimate. Five to fifty million dollars is quite a range. We will assume that five is the low and maybe a reasonable estimate would be between $15 and $20 million. It is difficult to ascertain how much it will cost to clean up a landfill. The troubling thing is we are not quite sure how much damage we have done to the groundwater reserve in that area. That damage cannot be reclaimed in any way. It would take centuries in some cases for that ground water to improve.

The statewide cost of cleaning up landfills the right way is going to be high, but not really too high. We have looked at the costs with the assistance of economists at the University of New Mexico. We looked at our new rules and regulations and what we ought to be doing with landfills in the state. We came up with the following estimates: If in fact, we took the 130 landfills still remaining and brought them all into compliance, it would cost New Mexicans about $18 million per year. We would need $18 million more dollars to keep all the landfills right now and bring them into compliance with the new rules and regulations. However, there is a small problem other than the $18 million dollars. Sixty-four percent of the cost would only take care of 16 percent of the waste. That is, the small communities would pay handsomely for properly managed landfills. Albuquerque, Las Cruces, Roswell and some other cities have sufficient capacity and load and could cover the costs substantially. But if you brought those cities into compliance, 64 percent of the new cost would handle only about 16 percent of the waste.

Because county commissioners have jurisdiction within counties, we wanted to look at a scenario in which we would have thirty-three landfills, one in each county. If done that way, it will cost an additional $10 million per year across the state, and in this case, 50 percent of the new cost will handle only 12 percent of the waste. Thus, what my task force has decided and what I am going to support, is movement rather quickly into a truly regional landfill proposition where we establish landfills to serve a population between 25,000 and 100,000 people. This would mean only eighteen to twenty landfills in the state of New Mexico. The beauty of this is that we could reduce the cost substantially to about $9.4 million. We could reduce the cost to about $1 more per ton to put garbage in landfills than we are paying today. We are currently paying about $12 per ton. We believe if we only have eighteen to twenty landfills, we could pay about $13 per ton. Under the first scenario where we would use the current landfills, in some small communities it would cost $96 per ton to put garbage in a landfill. If we had a regional landfill system, which would require us to go out and build some new landfills in the appropriate places, we still believe we could do it for $1 more per ton. That will be the thrust of the legislation you will see in the near future.

The big debate though, quite frankly, is "Who is going to pay for this?" I do not think the cities and my good friends the mayors and the county commissioners in their lawsuit were contending that we should not take care of landfills and the water system. I hope that is not the contention of the law suit. They have said, "Governor, you ought to raise taxes to pay for this." The governor said, "No mayor, you ought to raise the taxes and take care of it there." Well, it is an interesting debate, but frankly, New Mexicans are the only ones we can charge for this. Sometime soon we have to decide whether the state government is going to raise the taxes or the local government is going to raise the taxes. The taxes will be exactly the same and the people paying it will be exactly the same.

The other debate, when we get beyond, "Who is going to do this?" concerns the two different ways to proceed. We can use general fund taxes, that is, gross receipts tax and income tax. We can pay for it that way or we can employ a user's fee. The difference of opinion here once again will be between myself and other public policy officials. Frankly, I think whoever creates garbage ought to pay to haul it away to the landfill. There are others who believe it is a general problem and, therefore, we should use general fund money because it is a little less painful when you do not realize the money is going out of the general fund. You have to pay taxes in a lump sum and we benevolent public policy officials, of course with very cost-effective measures, spread those dollars over very exciting programs, which we all support. In my view, however, those who create most of the garbage ought to pay most of the fees. Those who create very little garbage ought to pay lesser fees, and that would be on a user-fee basis. I will tell you, politically I am in the minority. The legislature yesterday authorized use of gross receipts taxes to pay for the new landfill

requirements. Landfills will be a big issue in the coming legislative session. It must be resolved this time, simply because we have endangered the ground-water supply for so many years.

The second thing that comes to mind as we talk about ground water and water quality in particular, are problems down in this country and in the northwest corner of the state having to do with water quality and oil and gas. Oil and gas is a major industry in the state of New Mexico and a major industry down here. About 20,000 jobs in the state of New Mexico are directly associated with oil and gas. That is certainly major. They make $736 million per year. It is nearly a billion-dollar industry. When the price of gas goes up a little bit, it will be a billion-dollar industry. The industry generates a lot of revenue and a lot of tax revenue in the state.

As a consequence of production and refining, in the past the industry has presented some major problems for water quality. New Mexico was one of the first states to recognize it was up to the oil and gas business to take on the question of what to do with brine. Brine is one of the by-products of oil and gas production. In 1960, New Mexico chose to ban unlined pits for brine. Brine used to be put in unlined pits, and the brine could and would percolate into the ground-water supply. In 1960, our state started requiring reinjection of that brine water. Now, in some areas of the state, brine is used as part of the technology for secondary recovery--to reinject it, create greater pressure in the field, and therefore get more oil from the field. As a consequence of that action in 1960, not only have we forestalled a serious problem with ground-water degradation in our state, but we have developed workable technologies for reinjection.

But now we face other problems, like an oily sludge created in natural gas and oil production. We also have a new problem having to do with residue in tank pits. Closer to home, in terms of the oil and gas industry, not on the production side but on the consumption side, are leaking underground storage tanks.

So these are the concerns we have. What is the state going to do about it? Right now we are in negotiation countrywide, and I share that responsibility with Governor Sinner of North Dakota. We are trying to develop ways of managing these kinds of problems at the state level simply to forestall the EPA taking over this authority. The EPA has indicated that they want to take over this authority, and that is pretty frightening to people in New Mexico because we have always wanted to take care of our own problems. We are independent out here. We had the vision to do some of these things properly years ago, twenty or thirty years ago. In this particular arena, we would be better off if we had control locally through our Environmental Improvement Division and the Oil Conservation Division than if we turned it over to EPA. The EPA is going to work with us on that basis. Governor Sinner and I have developed a program to accomplish this. We prefer a state approach. No one prefers the federal approach unless we, in the state, fail to assume our responsibility. We should know more about this in the next year or two.

Lastly, as we look at water quality, there is a new enthusiasm, a new excitement in this state for education regarding a host of areas that impact on water quality. We are looking for alternatives while we educate for the acceptance of those alternatives. Of course, the most famous project we have in New Mexico dealing with potential impacts on water quality is the Waste Isolation Pilot Project (WIPP), which merely by my mentioning it, will get me on the front page of any newspaper in New Mexico. The mere mention of the Waste Isolation Pilot Project suggests a host of things from transportation issues to whether Carlsbad is an appropriate site. But in all of our deliberations over the Waste Isolation Pilot Project, there has been an overriding concern with its impact on water resources. I would suggest to you, perhaps in part because of something I once said, and Mayor Forrest will attest to this, when I testified down at the Waste Isolation Pilot Project early in my administration: I said, "What I think we have here is an experimental program and instead of calling it the Waste Isolation Pilot Project, I recommend to those assembled that it be renamed the Delaware Basin National Laboratory." You have to understand the project is in the Delaware Basin but it sounds like it is on the east coast when you mention Delaware National Laboratory. I thought it might deflect a little heat. What you learn about the Waste Isolation Pilot Project, better named the Delaware Basin National Laboratory, is that, in fact, it is still an experimental project. It is the first experimental project of its kind in the deposition of low-level transuranic wastes in a domain with which we have not experimented in the past. We have discovered that not only in this country, but around the world, people are interested in our efforts to find out scientifically how it is going to work. A blue ribbon panel, of which Tom Bahr is a member, is working with Secretary of Energy Watkins. Secretary Watkins is now moving toward, as a result of what is going on in the evaluation of the WIPP site,

the concept of a Delaware Basin National Laboratory.

Some exciting things are happening in the state right now you should know about. One is the proposed new waste management consortium, of which the Department of Energy is supportive. It is called the Waste Education and Research Consortium. It will have three major components. There will be a training and undergraduate education program including a new degree, an associate of science of hazardous waste management, offered at the Carlsbad branch of New Mexico State University. A new certificate will also accompany a bachelor of science degree acknowledging hazardous waste management expertise. I think this is going to be one of the really hot academic programs in New Mexico. If you think about what we face in this country, hazardous waste management is going to be a fine career for those who are properly trained.

The second component will be research and graduate education. About $1.5 million will be available in grants for researchers at three universities. Proposals will be solicited for that funding. There will be some ancillary facilities developed for this waste education research consortium. Laboratories will be located in Carlsbad, Las Cruces, and Hobbs. Carlsbad's facility will deal naturally with nuclear waste and may be located at the Waste Isolation Pilot Project. It is anticipated that Hobbs' facility will focus on oil and gas and the problems associated with the disposition of wastes from oil and gas. New Mexico State University's laboratory will operate an air, water, and soil facility, enhancing the capabilities they already have in those areas.

It seems to me we are moving in the right direction. The courses associated with the so-called Waste Education Research Consortium will be carried on our Technet system. Technet is the new fiber optic system connecting all our laboratories, universities, and some of our businesses. We currently have a civil engineering course in hazardous waste management with an average enrollment of about twenty students each semester. This year, just to show you the interest in the subject, 107 students have signed up for the course.

Also, I think there is something that has been needed in our state for a long period of time, a new University of New Mexico master's degree in water resources administration. I understand the Commission on Higher Education has approved the degree program. The program will focus on something I think needs to be focused on and that is administration instead of technical aspects of water resources management. As we deal with hazardous wastes, landfills, and everything else, the administrative aspect is going to be just as important as the technical aspect. The new master's program anticipates a Spring 1990 start if all goes well. Already twenty students have signed up and forty-five more have asked for information. It is an unusual degree and we think it will be an exciting degree. Twenty-five faculty members are involved. It consists of a consortium of three universities with the lead people from the University of New Mexico.

In terms of the environment, a new movement is underway. We have already taken action at the state level by my appointment of a task force on recycling. We have set up the task force to do two things: to encourage recycling in the state of New Mexico and to begin the necessary educational process of recycling. With recycling, you can retain your resource. We have been recycling many commodities in this country for a long time. However, due to high recycling costs in some cases, we have not always encouraged recycling strongly.

How many of you have ever used reclaimed motor oil in your car? Back when I was a kid, that was all I could afford. We have a lot of products that can be recycled but in our state for some reason, I think in part because we do not have the demand structure here, we do not have enough recycling to create a new industry. We found that in ten agencies of your state government--it is a little embarrassing to admit this - we throw away 730 tons of paper a year. The Santa Fe landfill gets most of this stuff. On a daily basis, we probably send to the Santa Fe landfill one-fourth of this room's capacity in paper alone. Paper is one commodity that can be recycled. A five-ton purchase of recycled paper, paper that is 100 percent recycled, can save enough energy to heat a home for three years. We need to encourage that kind of recycling and the task force I set up should do that.

New programs will be developed in landfills and wastes. New Mexico has made good progress toward dealing with the many challenges of safe and effective waste disposal, but there is still much to be done. It will require the commitment of everyone in this state, including government, private industry, and individual citizens to achieve our long-term environmental goals. The work of this conference has been and will continue to be a key part of meeting that challenge. Thank you.

PLANNING BY LOCAL GOVERNMENTS: A PANEL DISCUSSION

Six representatives of local southeastern governments addressed conference participants with their water planning concerns. Each representative devoted a few minutes to their special interests and then responded to questions posed by the moderator and the audience. The following has been transcribed and edited.

Panel Moderator:

Ron Cummings, University of New Mexico, Department of Economics

Panel Participants:

William F. Brainerd is now serving his second term as mayor of Roswell. He has been in private law practice since 1955 after graduating from The University of Texas Law School in 1952. He received a BBA from West Texas State University and during World War II served with the U.S. Navy in the Asiatic/Pacific theater.

Wendell Chino has served as president of the Mescalero Apache Tribe for 32 years and has been in office longer than any other Indian chief. was born on the Mescalero reservation and graduated in 1951 from Michigan's Western Theological Seminary. Since he was first elected, the number of tribal members has increased from 1,200 to 2,935.

Max Clampitt is serving his fifth term as mayor of Hobbs and his seventeenth year on the city commission. Clampitt recently retired after 25 years of service with the U.S. Postal Service. A lifelong resident of Lea County, he attended schools in Eunice and Hobbs and at one time owned a small business in Eunice.

Bob Forrest was elected mayor of Carlsbad in 1986. He is co-owner of Forrest Tire Company, which headquartered in Carlsbad and has branches in Hobbs, Roswell, Lovington and Odessa. He served as a Carlsbad city councilor for five years and is founder and president of of the Carlsbad Association for Retarded Citizens.

Frank Potter is city manager of the Village of Ruidoso. Potter is a New Mexico native, born on a ranch five miles west of Ragland. He has lived in Ruidoso since 1958 and began working for the Village of Ruidoso in 1964.

Ernest Thompson has served as mayor of Artesia since 1972. He is chairman of the National League of Small Cities, U.S.A. and of the Southeastern New Mexico Economic Development District. Thompson also has been appointed to the Governor's Taxation and Revenue Study Committee and is active in many civic organizations.

MR. BRAINERD: The planning problems facing each community will vary considerably depending on the resources, size and type of basin in which they are located. Roswell is a very fortunate community in that it is in a recharge basin now experiencing higher water levels than it has experienced in many, many decades. Within the last three years, some springs that have been dry for probably fifty years or more started running in the city of Roswell.

To facilitate planning and the acquisition of water for future growth, the city has a water advisory board, an ad hoc committee of 25 members who are very knowledgeable in the water area. The board is chaired by Fred Hennighausen, a former employee of the State Engineer Office (SEO), a practicing attorney here in Roswell, and a Roswell city councilor. The board has been part of the city for many years and at its direction and with its valuable assistance, we have acquired a number of farms and ranches around Roswell. We have acquired the Kerr ranch for its water rights, now called the Kerr water field, south of here.

Before the basin was brought into balance, that is, when the pumping was greater than the recharge into the basin, we had to retire a number of city wells in the northern part of the city due to increasing salinity and brackishness of the water encroaching from the north and east. Unfortunately, each well-head had its own area to service and there was a real interconnection among wells so we had to completely rebuild the total water distribution system within the city. It has been a 20-year project.

Our water rights acquisition program has been ongoing. We have water rights in the bank right now, which covers a population of 100,000. But in order not to retire the water rights and dry up the land, the farming areas acquired in the past are now leased to farmers at a cash rental. This is done to cover the cost of acquisition - hopefully the cost will be diminished over a period of time before we actually need to put the water rights to use.

The governor indicated earlier today that he wanted to keep the regulation of water quality at the state level and not the federal level. I heartily applaud that. Let me give you an illustration why. The Environmental Protection Agency (EPA) required the city of Roswell a number of years ago to chlorinate its drinking water to protect the people from bacteria that it might contain. It was not demonstrated that there was any bacteria, but that's beside the point. We just completed a new wastewater treatment plant two years ago, partially with EPA funds, partially with state funds, and a substantial portion with city funds. The EPA, in its wisdom, said before we could put our water into the wastewater treatment plant we would have to dechlorinate it; the chlorine wasn't good for the fish. We had a real headknocker over that. We said, "That's great. It's going to cost over a $1.5 million. Where's the money?" They said, "That's your problem." This has been a persistent attitude. I'm sure some of the other mayors have encountered the same attitude. We pointed out to the EPA that the chlorine never reaches the Pecos River. It evaporates within a mile or two in the stream. It is not a problem to fish or anything else. The argument fell on deaf ears. The staff was sitting around one day discussing this matter and wondering if it were true that in order to seek employment with the EPA, the primary requirement was that you'd have to flunk the Rorschach test.

These kinds of regulations are increasing costs incredibly and unnecessarily. We are going to be confronted with all kinds of increasing costs if the regulations are merely reasonable. But when you put unreasonable regulations on top of that and then require cities to pass costs to consumers or to increase their tax rates, it's going to become so burdensome that it will be intolerable. One of the primary things we at the local level are going to have to do is to start defending ourselves against imprudent and irrational regulation. Thank you.

MR. THOMPSON: It is a pleasure to be here to talk about water in the city of Artesia. We do have problems. We are in the same basin as the city of Roswell but I don't think they have the problems we have. About a year ago, people started calling city hall saying the water was smelling bad and discoloring clothes. We brought in a company to do a study. We found something in our water that had never been there before - manganese. We don't know where it came from; the engineers haven't told us from where it came. We also have iron bacteria causing a problem. The engineers estimate it will cost $3.5 million to clean this up.

We are unique in Artesia in that all our wells are independent of each other - there is no central collecting point. Thus, we are going to have to put a treatment plant into each well. This will cost about $300,000 per well. We don't have the money so we will have to raise our water rates, which by the way, are the cheapest in the state. It looks like we are going to have to double those rates. Like the city of Roswell, I think we can take care of our many problems with the fine people we have in our city. We are trying to take care of the problems we have with the amount of money we have. Whatever happens, the city of Artesia will be happy to cooperate with the state, the federal government or whoever is going to direct our water in the future.

MR. FORREST: We are pretty fortunate in Carlsbad. A hundred years ago our city was discovered. The discovering families made the decision back then that if they could get water to the lower valley of Carlsbad, it would be a great place to start a new town. The first town was called Eddy, and later, when it was developed, they called it Carlsbad. Three flumes were built to get water from the upper part of Carlsbad to the lower valley. Two wooden flumes were built in the early 1900s and both washed out when the Pecos River flooded. Finally a concrete flume was built. It opened up about 14,000 to 15,000 acres of farmland, which became Carlsbad. Farming was our main livelihood until 1935 when the potash mines were developed.

We've kind of taken water for granted in our area. Fifty years after the concrete flume was completed, the Brantley family and other farmers in Carlsbad decided they needed to dam up the river. It took almost forty years for Congress to approve it and close to $150 million was spent on it. Now we have a very fine dam above Carlsbad.

About five years ago when the economy was getting a little tough and the price of oil went from $35 to about $10 a barrel, we decided we needed to diversify the economy of Carlsbad. We called in some experts to tell us what we could do to develop our city to its best potential. After the $10,000 study

was completed, we were told our number one asset was the Pecos River. I guarantee you now, thirty years from now and fifty years from now, it won't be our potash reserve, it won't be our oil and gas, it's going to be our water that will provide economic health. The Pecos River is a tremendous asset to our city.

Recently we went to the legislature in Santa Fe. We are trying to develop a canal up through the downtown area like the San Antonio river mall. We were surprised by the Santa Fe legislators who gave us $2 million for our $8 million project.

I've been mayor for just three-and-a-half years and I wish I could take credit for our water situation. If we were in as good a shape with our economic development as we are with our water, we wouldn't have any problems. We enjoy about 25,000 acre-feet of water rights. Mayor Thompson, I'd like to challenge you to the lowest water rates in New Mexico. I think Carlsbad has them. We do have a good supply of water. We have not abused our water rights in the Capital Reef. We have very tough restrictions including the casing of all wells in the immediate Capitan Reef area for any oil company wanting to go in and drill.

We are probably one of the few cities in New Mexico or the United States that did not have to ration water last summer because of the available water in the Capitan Reef.

Enough cannot be said about Steve Reynolds and the former Mayor of Carlsbad, Walter Gerrells for these water rights. We have enough water for a town of 75,000; we are about 25,000 right now. There is a lot of potential for water harvest in the Double Eagle system where there is about 8,000 acre-feet of water rights that we are not using. In the Capitan Reef, there is about 9,800 acre-feet of water rights being used. I think the easiest way to see the quality of water is to go through a city and look at the evaporative coolers. The rust on the bottom tells you the quality of water they have. We have about 12,000 acres of industrial water rights down the river. If the right deal comes along, and I don't mean a deal for 10 jobs, but someone who has 200 jobs they would like to bring to the Carlsbad area, we have about 12,000 acre-feet of water rights available for that industry.

We have had some problems at Brantley Dam this first year. We had a beautiful lake early in the summer but saw it depleted to almost 5,000 or 6,000 acre-feet of water. We are currently in contact with water rights owners in Texas to try and talk them into selling those water rights to New Mexico. We will move those water rights up to Brantley Dam so we can take advantage of that beautiful lake.

The city of Carlsbad owns about 6,000 acre-feet of river rights downstream. We have done an excellent job protecting our water and our natural resources. I do not know of a city that is blessed anymore than Carlsbad with all of its natural resources: water, potash, oil and gas, salt beds, sulfur mines, beautiful Carlsbad Caverns, and two national parks. We have a lot for which to be thankful. We have a quality of life out here in southeastern New Mexico second to none. I've been to California and it's just a matter to time before we have to put a lock on the roads to keep the people from coming to Carlsbad and southeastern New Mexico.

We recently visited El Paso, as we are always looking for economic development opportunities. I made a trip to Juarez to visit a twin plant and watched as a little Hispanic girl about thirteen years old built a color TV. They paid her a dollar an hour. I don't think that is the answer to economic development. I think there are other ways to do things.

The more I see them the more I appreciate the potash mines. I appreciate the WIPP project. The governor got away before I could mention that if he doesn't get that thing open in his term, we're going to call it the Carruthers National Laboratory. Thank you for having us here today.

MR. POTTER: I was raised on a ranch about 5 miles west of Ragland, about 4 miles north of Jordon, New Mexico. Yesterday as I listened to the agriculture portion of the conference, I thought about the ranch on which I was raised. I was born in 1944 on that ranch and while I was growing up, the average rainfall in New Mexico was about 12.2 inches of rain. For about ten or fifteen years though, we got about 5 inches of rain a year, so we didn't really know what water was.

I'll provide you with a little bit of Ruidoso history. Ruidoso is located on the upper Hondo of the Pecos River drainage basin. The 1980 census revealed that the county of Lincoln was growing at a rate of 4.5 percent, Ruidoso represents approximately 50 percent of the population and was growing at a rate of 10 percent per year. The total 1980 economic output of all sectors of the Pecos River basin in Lincoln County was $161.8 million and 37 percent of that was in retail sales. The agricultural economy of the Pecos River in Lincoln County represents about $15.9 million or less than 10 percent of the total economic output. Thus, Lincoln County is not a big agriculture producing county.

The total area of the Pecos River drainage basin in Lincoln County is 2,229,200 acres, about 74 percent of the county. Private lands comprise about 60 percent of ownership. The projected 25-year water demand is about .8 percent per year.

Ruidoso is unique in that we are in the tourism business. We are probably one of the only areas that will have a chance to charge the Texans for the water they use and hopefully offset the Pecos settlement payback. Seventy-six percent of the homes and businesses in Ruidoso are owned by out-of-state, Texas residents. Ruidoso has a very young water system. We did not have a water system until 1952 and as you can imagine, we had to start playing some rapid catchup. We have in the Hondo River basin some early water priority rights dating back to around 1870. Ruidoso was able to purchase some of those rights and we now have two primary sources of water. Water in the Eagle Creek Water Association, which is located in Alto, was purchased from the railroad commission after the war.

In the 1970s, we found that if we were going to continue to grow, we had to do some things to stay on top of tourism development in New Mexico. The first thing we did was a hydraulic analysis. Ruidoso is unique in that it is located in the mountains and has a water system that must serve an area that varies in elevation by 1100 feet. Ruidoso commissioned a hydrologic analysis of the system using that 1100-foot differential and an in-depth historical study. We combined the reports to determine how we could apply the findings. Probably the most complicated matter was the 27 different pressure zones we have in the system and how to apply the analysis to that area. We also looked at how to apply the results given the source of the water and the water rights we own. How to report data to the state engineer to comply with state statutes and our own water rights obligations was studied. We just finished a LOTUS computerized program that reports total water usage to the SEO in Roswell. Currently, we have about 16 diversion points on the program. The information needs to be calculated on a computer to benefit Ruidoso.

We are also happy to say that we think we have adequate water rights and if we manage our system properly, we probably can maintain growth up to 25,000 or 30,000 people. Geographically speaking though, we can not be much larger than that because we are bound on the south by the Mescalero Apache Indian reservation, to the east and west by U.S. Forest and to the north by Alto Village and state land. Thank you.

MR. CLAMPITT: Our problems in Hobbs are a little different than the ones mentioned this morning. The city of Hobbs doesn't have a river any closer than 69 miles to the west. All our water is produced by underground water sources from the Ogallala Formation. Wells are drilled to about 125 to 160 feet below ground. We have a good water supply and good quality water. We think we have enough water to carry us to our latest projections around the year 2020 with our current population. An increase in the population, of course, will cause our water usage to go up.

We have a problem with the policy of the SEO that limits our long-range water planning to forty years. Forty years might seem like a long time, if you are sixty-five years old. But for a city, we don't feel forty years is enough. We would like to see some changes made in that area. There is also a current policy allowing anyone to buy a tract of land with a minimum of 3/4 acre outside but adjacent to the city limits, drill a well and install a septic tank. Not only do we feel that these septic tanks are possible pollutants to the aquifer, the waste water is also going into our water supply.

We are getting better acquainted with the wellhead protection act soon to be in effect. We feel it is a good act but it needs to provide sufficient funding to enable our service stations, oil companies, and others storing petroleum underground, to come into compliance. We have several private service station owners who have had to close down their stations because they simply could not afford to come into compliance with the regulations. I have no problem with the regulations--only the lack of funding that has been alluded to by some of the other speakers.

Another unique problem concerns cities in eastern New Mexico. We are competing with Texas farmers in the area for water from the same aquifer. The city of Hobbs is only 4 miles east of the state line. The Texas farmers in the area who have cotton farms, beet farms, all kinds of peanut farms, pecan farms and so forth have no restrictions on their drilling. We have restrictions with which I happen to agree. I think Steve Reynolds and his crew have done a good job over the years in controlling water production. Although the unlimited drilling in Texas is not a particular problem in Hobbs right now, it certainly is in some of the smaller communities around the state. The smaller towns do not have the resources or staff the city of Hobbs has to hire geologists and engineers to conduct a survey and develop a water program. These towns need a serious study on what is available in order to make long-range projections. We feel funds should be

made available to these small towns. However, we will not turn down any requests for assistance from these towns.

It is fine when state agencies like EID or federal agencies like EPA come up with contamination findings as in the manganese situation. However, we would like to have programs that show us what to do along with some funding to help us come into compliance. Thank you.

MR. CHINO: The governor labeled his speech *View from the Top*. will give you the *View from the Bottom*.

One of the interesting things about the Indian people is the perceived condition of various Indian communities in the state. We are used to drinking good, clean water from streams and creeks. But in this high tax society of ours, we are amazed that anybody should take sewer water and put it into their drinking water and drink it again. That is difficult for us to understand, but I guess that is what is going on in a good part of the country. The Mescaleros have not started recycling water yet. We still drink water from the streams and clean wells.

I am grateful for the opportunity to participate on the panel this morning. In the context of Indian tribes, I am going to voice our views concerning planning and the use of water. In our opinion, the biggest obstacle to planning by local governments is the state of New Mexico. The Mescalero Apache tribe is a community which has done extensive planning for future economic development based upon the reservation's water resources. The state of New Mexico has taken every opportunity to defeat these plans even when it is clear that the non-Indian community will profit from development as well as the reservation.

In 1974 and 1975, the tribe constructed Cienegita Reservoir into the development of the Inn of the Mountain Gods. The state of New Mexico took the tribe to court to try to stop the project. The reservoir was completed despite the opposition and the state's objections. Since that time, it has become clear to everyone that the reservoir has resulted in a more steady and reliable flow of water to all downstream water users. In addition, the development has brought increased tourism to the area to everyone's benefit. The state's fight against the reservation reservoir was short-sighted and contrary to everyone's interest.

For fifteen years, the state has poured money into attacking the water rights of the Mescalero Apache Tribe. The state has refused to negotiate or even discuss investment in common reservoirs for the benefit of all. The State Engineer Office has spent nearly $1 million in extra fees alone and more in attorney fees to attack tribal water rights.

The state legislature has expended more than $500,000 to non-Indian parties to pay attorney fees and extras in attacking the tribe's water claims. This money would have been better spent working with the tribe to develop water supply streams that could benefit all of the communities.

Instead the state has done a disservice to all New Mexico citizens by denying access to major sources of good water. The tribe had planned to develop more than 10,000 acre-feet of water per year from a peak ground-water source that can be accessed only from the reservation. The proposed pumping from the Pajarito area would have had a negligible impact off the reservation even after fifty years of pumping. This evidence was presented at the trial in 1986 in the Lewis water case tried in Roswell. The ground water is pooled beneath the reservation in fractured rock areas which have stored this water, making it available for pumping on the reservation. This water cannot be pumped from locations off the reservation. The state hydrologist knew this and did not contest the evidence of the small impact of reservation pumping on non-Indian communities.

Nevertheless, the state attorneys vigorously fought the tribe's claim to this valuable reservation water resource. In July of this year, the state won that argument in district court. That water is no longer available to the tribe or to anyone else pending appeal of the case.

When the state of New Mexico ignores us, I throw right back, "Why attack these developments? It hurts everyone." Growth on the reservation helps the surrounding communities. It provides employment and pumps tourist dollars into local shops, gas stations, motels, and restaurants. The tribe has developed a ski area, the Inn of the Mountain Gods, the hunting and fishing industry, and recreational sites as part of their overall water development plan. We have done much, but there is much more to do if we are to reduce the high numbers of unemployed.

As local communities, we have in common the need for development of existing water resources. When the state of New Mexico repeatedly talks about cooperation and actively defeats the planning of communities for development of water resources, the state is hurting all of us, all of us will suffer.

DR. CUMMINGS: Before moving to questions from the audience, I would like to pose one question. I hope you share my enthusiasm with the breadth and depth of the discussions we have heard today. The

biggest part of the discussions have focused on two major themes: water management and scarcity. In finding ways to possibly manage scarcity, Chris Nunn talked to us about markets and the potential for markets to solve problems. Bill Brainerd spoke to us about local development costs that are a major problem for cities as they deal with water scarcity, in particular with water quality. And then of course, Max Clampitt has talked to us about the problems of having enough time to plan adequately for cities.

A second major theme has focused on opportunities and challenges in terms of water resources management. Phelps White has talked to us about new state opportunities for economic planning. Bob Forrest just told us about the opportunities they face in Carlsbad. But what strikes me as overriding a large part of these discussions are problems perceived by people who are trying to deal with water resources planning and its interface between the federal and state government, and state and local governments. This morning we heard Tony Willardson essentially calling for a reexamination of the proper interface between state governments and the federal government. This brings to mind that for some time, Tom Bahr has been pushing the idea that if you characterize the nature of the partnership between the federal government and the state government prior to 1980, you could very simplistically describe the covenants of that partnership as the feds pay the bills and they call the shots. Post-1980, the federal government in some ways can be seen as having abrogated some part of that partnership. They no longer pay the bills, but to many, they still call the shots. The question that then arises is, should the states renegotiate, redefine this contract, this covenant of the partnership, between state and federal governments? Mr. would like also to see the partnership redefined between state and local governments.

When you talk about the interface between the federal government and the state government, what is your view of what that interface should look like? What do you want from the federal government, other than money, of course? How can the federal government help you in a productive way? How would you like to see that interface between federal and state governments improved?

MR. BRAINERD: Speaking strictly from Roswell's viewpoint, I have a very deep feeling that the federal government and the state are overreacting in the area of regulation. We have a hard time distinguishing between the state's Environmental Improvement Division and the federal Environmental Protection Agency in many areas. I would like to see the states take on the responsibility entirely or get out of it. We just have too many regulations bestowed on us. Santa Fe is becoming as bureaucratic in certain areas as the federal government.

One of the biggest problems we see at a local level is a lack of funding for all the mandates coming from Santa Fe and Washington. To give you an example, the Community Development Block Grants that were set up years ago as federal aid to cities has diminished from $55 billion annually to about $17 billion. Meanwhile, the number of regulations and mandates coming down to the cities are increasing. We have absolutely no taxing authority at the local level other than that given to us by the legislature. So we are put in a terrible bind because we have all these mandates coming from the state and federal governments with absolutely no ability to implement or pay for them.

For this reason, in 1985 or 1986, the citizens in New Mexico passed a constitutional amendment saying in essence, if the state is going to mandate local government an increase in service or facilities, the state much provide a means to pay for it. This is the essence of the lawsuit the governor was complaining about saying all of us poor old mayors ganged up on him. The state made all these landfill regulations and then said, "You boys go out and do it like we tell you, but you pay for it." The lawsuit is not against the need for better landfills or that cities are unwilling to do what is necessary to bring those things into compliance. It is a test of that constitutional amendment to see whether it actually means, in a legal sense, what we feel it means. Otherwise, we are going back to the status beforehand. I would like to see if the states are going to regulate landfills, the federal government should get out of it. I am not certain whether the states can do a much better job than the feds. They have demonstrated an ability to screw up corn flakes.

MR. THOMPSON: We have a problem with landfills in Artesia. We are finding that for many years oil companies were putting waste in our city landfill and we did not know, nor did they, that it was illegal to dump some of the things they dumped. Now the federal government and EID people have come in and said, "You're wrong in what you've put out there." Okay, who has been wrong all these years, say back forty years ago? The city of Artesia is saddled with having to cleanup when no one knew thirty or forty years ago that what they were doing was illegal. Those people are gone, Artesia is saddled with the problem and its going to be mighty expensive because we have to drill four test wells in our present landfill. In the old landfill north of town, we

will have to drill several test wells. These will be at our own expense. You can see that these problems are hurting smaller cities given their limited funds. Like Mayor Brainerd, I think if we are going to mandate something to cities, we should mandate a little financing with it. I think it's necessary to the things they are requiring us to do.

MR. CLAMPITT: Quite briefly, I would just say that we need one thing above all else. We need consistency and cooperation from our federal and state agencies when it comes to cleanup. The left hand needs to know what the right hand is doing. We get conflicting reports from the state and federal governments. Take the example of putting chlorine in the water. Somebody says to put it in, somebody else says that you have to take it out. That seems inconsistent to me. Apparently one time in a baseball game, an umpire was terrible and he kept making some really terrible calls against one particular team. The manager went out and complained, "Look, we know you're sorry, but be consistently sorry for both sides."

MR. FORREST: Just recently the cities lost their revenue sharing. In Carlsbad, revenue sharing used to be close to $700,000 and that stopped about two years ago. I'm sure Roswell received close to $1 million. I disagree with the governor when he says the one who releases waste in the landfill ought to pay for it. We had a case in Carlsbad. I am in the tire business in Roswell, Hobbs, Lovington, and Carlsbad. There is quite a problem with what to do with used tires. I know there are problems after you trade them in, but they came from you. At the landfill in Carlsbad, someone came up with the bright idea that they would start charging us a dollar for every used tire dumped. So when we would sell a set of tires, we would say, "Would you like to take your old ones with you? They make good swings and things like that." Pretty soon tires start showing up all over the city. Finally, the city decided to put these tires in the landfill and get rid of them right. The city did not want them stacking up on vacant lots, letting them create places of mosquitos to breed and that sort of thing. You are not going to wish the problem away and it is a problem that rests with everyone. It's like closing a cemetery - pretty soon the dead bodies start showing up everywhere.

DR. CUMMINGS: We would now like to invite questions from the audience.

MR. BLACK: I am Jack Black from Carlsbad with my friend James Lowry. We are representing a newly organized group. We call ourselves the Eddy County Citizens Committee. We are mostly retired, although not totally. We are vitally interested in grassroots participation in working with our municipalities and commissioners on water resources management. I guess we are a special interest group in that we intend to represent the public welfare. I'll address my question to Mayors Thompson and Forrest. As we attempt to work, we try to identify the people with whom to work. Do you realize that across the nation the water problem is great and it exists in a lot of communities where planning has taken second place? Efforts have been made both in quantity and quality. If you had to identify one of the greatest mistakes that has been made in the past concerning planning, what would it be?

MR. FORREST: The biggest problem we have in Carlsbad is that the former mayor kept water prices too low. In our area, I cannot think of anything I would change, but I know we get a little criticism because our water rates are so low. We ought to raise them to conserve water, but the water industry is a big part of the income to the city budget. When you get retirees like yourselves in our city, and you try to raise water rates, or the garbage rates, the people come back with the fact that they have fixed incomes and that sort of thing. But I think the overall water picture in the city of Carlsbad, including how the water-well system works, and how the water-rights system was set up, I think we are very fortunate to have the system we have. Carlsbad is blessed that it enjoys the older water rights on the Pecos River. But with hindsight, I cannot see much that the city or the state could have done much differently. Winning the Pecos lawsuit, even if we have to pay Texas $14 million, was a great victory for the state of New Mexico.

MR. THOMPSON: I think the regulations that keep coming down that we are not accustomed to are the biggest problem we face. Every year or so we have new regulations. These put quite a burden on our city as it does in the county. I know it is imperative that we have good, clean drinking water and plenty of it. We are often at a loss as to what is causing our water problems and certainly the engineers do not always know. Like Mayor Brainerd, we are concerned about dechlorinating water. We have never had to chlorinate our city's water. Now we have to put in a dechlorination system that is going to cost a lot of money. Regulations are eating our lunch.

MR. BRAINERD: Let me make one comment that builds on what Ernest Thompson was saying concerning conflicting regulations. I can see one that will have a great impact on communities. The governor alluded to the fact that EID has put out its regulations on landfills and these regulations are very stringent. However, the EPA has not yet drawn up its regulations. Now, I will bet anybody here any amount of money that those regulations are not going to be compatible. Which do we follow? The feds say one thing, the state says another. Now we have a built-in conflict that will have to be resolved. I had hoped the state would hold off with its regulations until we find out what EPA was going to do this coming year. The regulations then could have been compatible. But, by moving out as they have without knowing what the feds are going to do, we are going to have a conflict on our hands and somebody is going to pay for it.

MR. THOMPSON: A short time ago I was told that the landfill problems would not be the city's problems. The state was going to institute regulations and put pressure on people who dump in our landfills. Illegal dumping was my problem. My reply was that with all the open spaces we have, given the regulations, county people are not going to worry about bringing material to the landfill; they are going to find some open space and dump it in the county. Then whose problem is it? I don't think it is the city of Artesia's problem if they are dumping into open county space.

MR. CHINO: The Indian communities face a problem when stringent solid waste disposal laws cause city disposal problems. We don't want wastes dumped on Indian reservation borders next to these communities any more than other folks who are dumping it on us.

MR. CUMMINGS: Are there any other questions from the audience?

AUDIENCE: Mayor Forrest, do you know the percentage of water you get from your wells out by Dark Canyon versus the water that comes via pipeline from the Ogallala? Is there thought of transferring land with unused capacity to potential users like the city of Hobbs or anybody that might be able to use it? My concern is that the Ogallala is being depleted. The renewable pump at Dark Canyon does get recharged. Is there is a possibility of using the renewable source and saving the nonrenewable source for other users at peak times?

MR. FORREST: We sell about $1.5 million worth of water in the Dark Canyon to the Ogallala - a little less than what we use for the city. The city is almost at maximum water rights with Dark Canyon. Probably within the next year or two, we are going to try to transfer some of that water for use by city residents. We are also going to talk with the city of Artesia about selling them some of the water. We are looking for future uses of this water, but some of it will go to Carlsbad and we will be out of water rights within a couple of years. We do sell a lot of Dark Canyon water to the Double Eagle system, to a water flood system in the oil business. This is a water system Carlsbad purchased some fifteen years ago.

JAMES LOWRY: My name is James Lowry and I'm from Carlsbad. I receive a quarterly defense monitor from Washington, D.C., put out by a nonpartisan group of retired army and navy officers who monitor the defense expenses of this country. According to the defense monitor, the U.S. is spending several billion dollars a year more than they need to be spending on defense. You could solve some of your problems with that money. When are the citizens of this country going to wake up and become aware of this? When are they going to start raising hell with their congressmen and senators to cut out all that malarkey? Then you'll have more money for some of the things you need.

DR. CUMMINGS: Thank you very much. Any comments or any other questions?

AUDIENCE: I am with the Water Defense Association. I have a question for Mr. . My question focuses on the state cooperating with the tribe on some of the water issues you mentioned. You claim the state has not ended its attack for water from the tribe. The tribe claimed twice the amount of water that is available in the stream. The January court decision with the final order in July provided the tribe with a quarter of the water that is in the stream, increasing the tribe's water right by 62 percent. Don't you think the grievance filed on behalf of the tribe is a little bit out of line? The tribe showed an unwillingness to cooperate to a fair and equitable distribution of the available water.

MR. CHINO: Aamodt, 1986 or 1987, the day the State Engineer Office approved the use of ground water in the Eagle Creek area by the Village of Ruidoso for more than 8,000 feet of water per year despite the fact that it was argued against the Mescalero water claim in the same area for 4,633 feet.

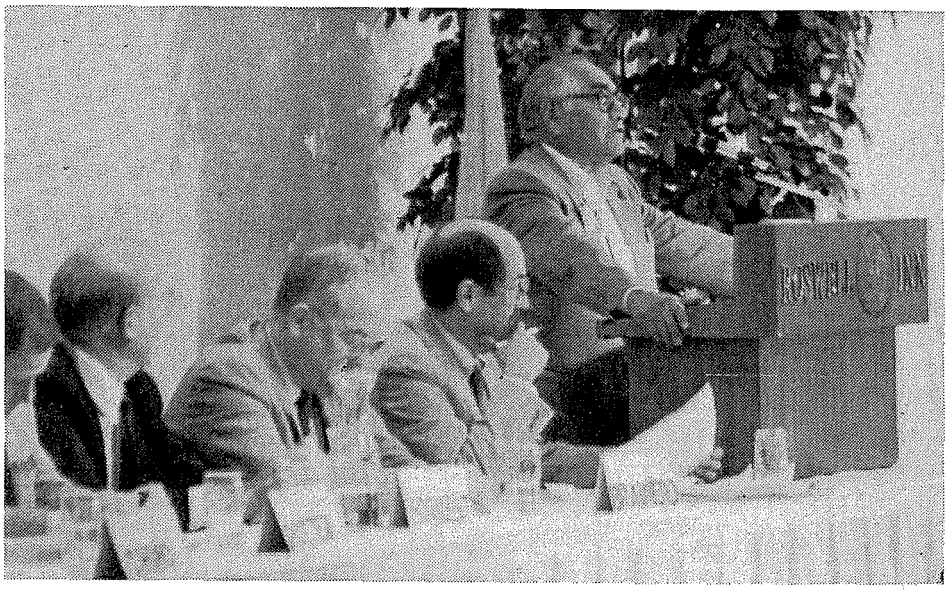
Well, these are some of the background inequities that I am aware of. I don't care whether it is the state or the federal government. I heartily agree with the gentleman that we don't need another moonshot. We are going to have to take care of where we live before we start thinking of where we want to live.

DR. CUMMINGS: Are there any other questions?

MR. MARTINEZ: I am Sammy Martinez, president of the Acequia Association. Las Vegas, where I'm from, is way up north on the Pecos River basin. It is up where the water originates, up there where you get from 10 to 25 feet of snow packed up in the mountains. When you live up on the mountain, you see the water come down when we get a good warm spring. We don't have underground water, but we have a lot of surface water from various creeks coming from the canyons. We have six or seven streams coming into the main river. The city of Las Vegas was curtailing water use this summer. I think the only water rights we have from the Gallinas River is for human consumption. I have heard that Roswell and Carlsbad have purchased property and acquired water rights with the property. Also, we heard the mayor of Carlsbad say he has 12,000 acre-feet of water that he can go ahead and shift its use. Meanwhile, up here in the north where the actual Pecos River basin starts, where we have water flowing to you people here, we have a shortage of water. Also in the north, just like the Indian tribes, we are stepchildren to any dedication. We don't get much cooperation from the State Engineer Office when it comes down to problems. However, if we do anything wrong, the State Engineer Office and their attorneys are on top of us.

DR. CUMMINGS: Thank you, sir. Any response?

MR. BRAINERD: Just one thing, most of the recharge coming into this basin is from a huge area going all the way up into Estancia. Most of our water does not come out of the Pecos River system per se. It comes from the recharge into the San Andreas Formation, from a large, large area to the west and north. We are part of the system and I don't have any solution to your problem, but I just think it ought to be verified that most of our water, and Carlsbad's water also, comes from a different direction.



Wendell Chino speaks as (from left) Frank Potter, Bob Forrest, Bill Brainerd, and Ron Cummings listen.

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