APRIL 1994

WRRI Report No. 284

PROCEEDINGS

38th ANNUAL NEW MEXICO WATER CONFERENCE

Addressing Water Issues through Conflict Resolution

September 30 - October 1, 1993
Holiday Inn, Carlsbad

New Mexico Water Resources Research Institute
New Mexico State University • Box 30001, Dept. 3167 • Las Cruces, New Mexico
88003-0001

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Tom Bahr, Director
Bob Creel, Assistant Director
Catherine T. Ortega Klett, Editor

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April 1994

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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

The cultural, emotional and economic symbolism attached to water has made water conflicts inevitable. Given the scarcity of water in the arid west, conflict resolution and negotiation have become necessary vehicles for dealing with such a precious resource. Whether we face water issues from a manager's, developer's or user's perspective, each party brings to the table different interests and a multitude of attitudes. The 38th Annual New Mexico Water Conference attempted to examine the negotiation process and the best ways to get the various players to work together.

We heard different perspectives on how to manage water conflicts: an academic dean's view on how engineers might reduce water resources conflicts citing three examples where conflicts have existed or may occur in the future; several experienced water attorneys' thoughts; a professor's experience in environmental mediation of Virginia's instream flow; and a water manager's experience in a major water rights settlement. We also learned from speakers who have been involved in water conflicts and were able to provide some "dos and don'ts."

We headed south to Carlsbad this year. Mayor Bob Forrest welcomed participants and encouraged us to take time to discover Carlsbad's charm. Some participants took advantage of tours at the Waste Isolation Pilot Plant, and everyone seemed to enjoy the Thursday evening dinner at President's Park on the banks of the Pecos River.

The WRRI is grateful for the suggestions and support of the Water Conference Advisory Committee in planning the conference. We look forward to working with them as we plan the 39th Annual Water Conference.

Tom Bahr
Director

38TH ANNUAL NEW MEXICO WATER CONFERENCE

ADDRESSING WATER ISSUES THROUGH CONFLICT RESOLUTION

Holiday Inn
Carlsbad, New Mexico

Thursday, September 30, 1993

Session I - The Conflict Resolution Process

Moderator:	**Tom Bahr, Water Resources Research Institute**
8:30 a.m.	Managing Water Conflicts **Ernest T. Smerdon, College of Engineering, University of Arizona**
9:00 a.m.	Conflict Resolution: One Attorney's Perspective **Charles DuMars, University of New Mexico School of Law**
9:30 a.m.	New Tools for Water Planning and Issue Resolution **John Peterson and Glenn Olson, New Mexico Engineering Institute**
10:00 a.m.	Break
10:30 a.m.	The Adjudication Process **Martha Franks, New Mexico State Engineer Office**
11:00 a.m.	Conflict Resolution: Using Case Management Approaches in Stream Adjudications **Steven L. Hernandez, Hubert and Hernandez, P.A.**
11:30 a.m.	General Discussion

Session II - Case Studies in Conflict Resolution

Moderator:	**Elizabeth Newlin Taylor, Sheehan, Sheehan and Stelzner, P.A.**
1:30 p.m.	The Catron County Experience: Reaching a Memorandum of Understanding **Howard Hutchinson, Catron County Water Advisory Board and James E. Paxon, Jr., Gila National Forest**

2:00 p.m.	The Truckee-Carson/Pyramid Lake Water Rights Settlement **Joe Borgerding, Sierra Pacific Power Company**
2:30 p.m.	Addressing Conflict through the Dialogue Process or Don't Kill the Messenger **Lisa Robert, Aaron Rael and Richard Pacheco, Regional Water Planning Dialogue**
3:00 p.m.	Break
3:30 p.m.	Sharing the Pain: Mediating Instream Flow in Virginia **Richard C. Collins, Environmental Conflict Resolution Center, University of Virginia**
4:00 p.m.	Approaches to Indian Water Rights Settlement **T. C. Richmond, Arizona Department of Water Resources**
4:30 p.m.	General Discussion

Friday, October 1, 1993

Session III - Pecos Region Update

8:30 a.m.	Joining Forces: The Pecos River Native Riparian Organization **Tom Davis, Carlsbad Irrigation District**
9:00 a.m.	Conflict Resolution in the Pecos **Peter T. Kraai, New Mexico State Engineer Office**
9:30 a.m.	Transboundary Perspectives **Albert E. Utton, University of New Mexico School of Law**
10:00 a.m.	Break
10:30 a.m.	Perspectives on Waste Management **Ron Bhada, Waste-management Education and Research Consortium**
11:00 a.m.	Geohydrologic Studies for the Waste Isolation Pilot Plant **Peter Davies, Sandia National Laboratories**
11:30 a.m.	General Discussion

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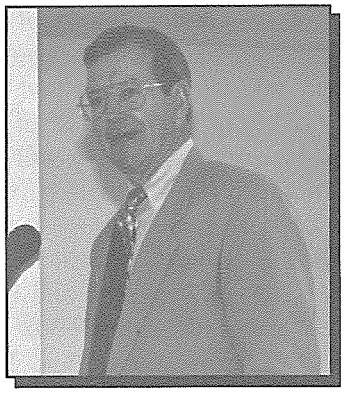

Ernest Smerdon has been the dean of the College of Engineering and Mines at the University of Arizona since 1988 and vice-provost since 1992. He previously held the James S. Cockrell Centennial Chair in Engineering and was director of the Center for Water Resources at the University of Texas Austin. For three years he held the Bess Harris Jones Centennial Chair in Natural Resource Policy Studies in the LBJ School of Public Affairs at UT. Ernest has served on and chaired several committees on the National Research Council and is currently a member of the Mexico-U.S. Foundation for Science Advisory Committee and the Board on Science and Technology for International Development. He has traveled extensively throughout the world.

MANAGING WATER CONFLICTS

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> The law is a tool, not an end in itself. Like any tool, our judicial mechanisms, procedures, or rules can become obsolete. Just as the carpenter's handsaw was replaced by the power saw, and his hammer was replaced by the stapler, we should be alert to the need for better tools to serve the ends of justice.
>
> —Warren E. Burger

INTRODUCTION AND BACKGROUND

In introducing the topic of the engineer in water resources conflict management, I first look at the costs of conflicts. For this background I rely heavily on two issues of *National Forum*-one in 1983 on Conflict Resolution and Peacemaking and another in 1991 on The Litigious Society. Abraham Lincoln more than 125 years ago said: "Discourage litigation. Persuade your neighbors to compromise whenever you can. Point out to them how the nominal winner is often a real loser—in fees, expenses and waste of time."

What is the real cost to the U.S. of our litigious society? What is that cost in terms of the diverted energy of very bright lawyers toward tasks that produce no wealth? Nothing is added to the nation's productivity by conflict and the costly court actions associated with these conflicts. What is the effect of excessive litigation on our nation's competitiveness at this time when the Japanese are still somewhat dominating us in technological progress in consumer goods, including many high-tech consumer goods? Also, China and other Pacific Rim nations are coming rapidly into the global competition scene. What

is the cost in terms of our nation's economic health and international balance of payments?

Lester Thurow, former Dean of the Sloan School of Management at MIT, reported that a Japanese steel official once said that the difference in the number of lawyers and our propensity for civil suits is why his country will eventually beat ours (Thurow 1983). That steel official may be correct because the resources devoted to litigation do not increase productivity. Derek Bok, former Harvard President and former law school dean, seems to agree (Bok 1982). In relation to legal regulations Bok has noted: "Legal regulations seem burdensome to the point that they conflict in dealing with progress, productivity and initiative." He continues: "The total cost of our system of enforcing rules and settling disputes appears more and more excessive." University of Virginia law professor A. E. Dick Howard estimated a decade ago that the total cost of legal services in the U.S. amounts to 2 percent of the nation's GNP. That is more than the entire steel industry (Howard 1982). Is it no wonder that the Japanese steel official dared predict that the Japanese will eventually beat us in economic competition?

We have drifted away from what our founding fathers envisioned more than 200 years ago. They wanted laws to protect individual freedom through common rules with the judicial system functioning in an important but limited sphere. The Founders would likely be surprised at the current attitude of "meet you in court." They wanted to avoid the condition that Yale College President Timothy Dwight mentioned to the 1776 Yale graduating class when he referred to "costly and needless litigations which retard the operations of justice" (Cannon 1983). It appears that, as Chief Justice Warren Burger once suggested, "we are well on our way to a society overrun by hordes of lawyers, hungry as locusts, and brigades of judges never before contemplated" (Burger 1983). The well-documented increasing case load in our courts provides ample evidence of the high cost of litigation.

HOW MIGHT ENGINEERS REDUCE CONFLICTS?

Conflicts in water resources may result from several types of misunderstandings. I mention some of the reasons for conflicts. First, national attitudes toward water resources change. To illustrate, during the first half of this century or more, water was judged to be a key factor in economic development. Our national goal then was economic development and few citizens questioned the water development projects that were proposed by agencies such as the Bureau of Reclamation or the Corps of Engineers. The economic importance of the projects was the overriding justification in those earlier days. Now, there are many other considerations including environmental and social issues that various groups insist be part of the decision matrix. This vastly expands the potential for conflict.

Another reason for conflict is that scientific data may be misunderstood or interpreted differently by different groups. One example relates to the question of environmental quality versus risk. A good question might be termed, "How safe is safe?" which was the title of a paper on this subject (Waterstone and Lord 1989). Waterstone and Lord discuss the risk of five parts per billion of trichloroethylene (TCE) in water. Epidemiological data suggest that drinking two liters of such water per day over a 70-year lifetime would cause up to two additional cancers per million people. The issue of balancing risk is very important when attempting to assess the additional threat due to this drinking water because 200,000 to 250,000 people among those typical one million will develop cancer from other causes. How do you compare risks due to drinking this water with those from other causes? Clearly, economics must be considered. There will always be great potential for conflict when there is no universally accepted way to measure risk or weigh risk against costs.

Another conflict-related issue results because engineers tend to think in discreet, analytical terms. To us, things tend to be "yes" or "no." Engineers find it difficult to cope with the grey areas of human judgement. Perhaps we fall into

the trap of rejecting the notion of compromise, and instead see any compromise as a sign of weakness. Someone once said: "In America, real men don't mediate." In our complex society, this is a frightening thought. Fortunately, that attitude is changing. Still, we subconsciously may be too quick to adopt that narrow view, even if we would not state it openly. The academic disciplines usually viewed as important in streamlining dispute resolution procedures include sociology, social psychology, political science, anthropology, economics and law. Unfortunately, few think of engineering in that role.

I am convinced that engineers should play a much larger role in public affairs work, including conflict resolution. However, to be totally effective in doing so, we engineers must broaden our views. We must learn to look beyond the hard facts of scientific data and recognize the human dimension. This means that engineering educators must begin to include some public policy courses in their course of study. I should hasten to add that it is also very important for those in the social sciences to include more courses in science and technology in their course of study. That way, the bridge of understanding can be better approached from both directions.

THE PROCESS OF CONFLICT RESOLUTION

Everything constructive that is accomplished is the result of a process. If we want to make changes that will improve the way we do things we must focus on the steps involved. Moreover, we must do this in a structured way. David Kearns, former CEO of Xerox Corporation once said, "Insanity is doing the same thing over and over and expecting a different result." We must change some of the things we do if we expect improvement.

Let us look at what might be some key steps in the process. Here are some of my thoughts on some essential steps. First, in every one of these steps, the most critical element is communication among the potential adversaries. So, the first three steps are communicate, communicate, communicate. Seriously, I believe that unless honest and open communication can be established, the chances for avoiding conflicts and quickly and economically resolving those that occur are much reduced. The steps I suggest, all involving communication, are:

1. Do a current situation analysis.
2. Search for areas of agreement, small as they may be.
3. In areas of disagreement, find those where you can agree on the approach to the solution to be used.
4. Establish a regular meeting schedule and the format to be followed before the conflict issues are discussed.
5. Remember that a solution that saves money and leaves *both* parties satisfied is a victory.
6. Progress is made through many little steps (mini-agreements). Keep record of progress being made.
7. Remember that courts are costly in time and in dollars.

Briefly, the current situation analysis is to obtain background information related to the conflict. It brings the historical facts and issues out in the open, including those that relate to culture and tradition. It also provides the opportunity to get the physical data out in the open and starts the process of resolving inconsistent "factual" data before discussions of the central issues begin. If there is confusion regarding definitions or meanings of technical terms, they can be resolved at this first stage. The current situation analysis helps establish the foundation for better communication during the conflict resolution/mediation process.

Find areas or issues in which you have agreement even if they seem insignificant and unrelated to the central issue of conflict. Resolving conflicts requires agreements and it will help to identify even small areas of agreement early. This process will help the potential adversaries to get to know each other.

Regarding the areas of disagreement, discuss the possible approaches to be used. Involving experts in mediation and alternative dispute resolution procedures will be helpful. Remember the cost in time and money of court actions and

the fact that when time and costs are considered, there may be no winners in litigation.

Regular meetings should be held and "ground rules" agreed upon before the meetings begin. These include the schedule, commitment to attendance, meeting format and such factors. The parties should agree that they will discuss issues, not people. Adopt the slogan of "criticize issues, not people."

Keep a record of progress, including agreements reached, even if they are small. If a bottleneck issue emerges, resolve to solve it at the next meeting so the process does not bog down. It is easy to have some critical matter pop up that in the end stifles communication. If meaningful communication stops, progress in conflict resolution stops. Therefore, keep the communication channels open at all costs.

There are many examples where agreements once considered virtually impossible were reached because communication between the parties was established and maintained. The 1980 Ground Water Management Act in Arizona is an example. It appeared that the interests of agriculture, the mining industry, and the cities could not all be met. A virtual impasse was imminent. Rump sessions were held to explore possibilities and the disagreeing parties were directed by the governor to meet until they could agree. Granted, there was a larger issue that hung as a dark cloud over the process. In this case, if agreement was not reached on a means to bring groundwater overdraft under control, the Department of the Interior approval to proceed to complete the Central Arizona Project would be withdrawn.

Another example is the agreement on a management approach to the Potomac River Basin. Here some advanced simulation technology was used to show that the best interests of all were served through cooperation of the many water agencies operating in the basin. Still, the power of the simulation models and computer technology would not have prevailed if the groups had not met and started to communicate meaningfully on the issues. They had to develop trust in each other.

Now, I will present briefly three case studies where better up-front communications and agreements could have prevented problems.

REDUCING CONFLICTS BY EARLY INVOLVEMENT OF ENGINEERS

Twenty-one years of my professional life have been spent in Texas, and I am familiar with its water resources issues. I cite three examples where conflicts have existed or may occur in the future. Parenthetically, I don't even want to think about the New Mexico-El Paso situation and the costly process of resolving that conflict. In the cases I present, I briefly discuss how some of these conflicts might be reduced if engineers were more involved at an early stage.

A few years back in Texas, there were 1,225 water districts and authorities (Smerdon and Gronouski 1986). Some of these are no longer active, but nonetheless exist on the books. At one point each achieved legal status through an appropriate approval process. There are perhaps twenty major river authorities and major municipal water supply districts among this group. In several instances, there is more than one river authority with jurisdiction in a given river basin. In other cases, a separate groundwater management district may be responsible for a groundwater aquifer that underlies a river basin that is managed by a totally separate river authority. Since the groundwater laws in Texas are essentially independent of surface water laws, the potential for conflict is quite evident.

The Stacy Reservoir Conflict on the Colorado River in Texas

There are two principal institutions which share surface water management on the Colorado River in Texas. The Colorado River Municipal Water District (CRMWD) is responsible for the upper reaches of the river. Its boundaries include the cities of Odessa, Big Spring and Snyder, as well as the Colorado River drainage area above the east county line of Coleman County (Smerdon and Gronouski 1986). The CRMWD is governed by a 12-member board of directors representing the three cities. The purpose of this

district is to supply water for the municipalities it serves and it does so through surface reservoirs and groundwater wells.

The Lower Colorado River Authority (LCRA) has a service area of 31,000 square miles, encompassing ten counties in the lower reaches of the Colorado River. The LCRA is governed by a board of 15 directors appointed by the governor with the advice and consent of the Texas Senate. The LCRA is involved in power generation with the lion's share of its revenue coming from that source. Therefore, the LCRA is involved in hydroelectric power as well as water supply. The CRMWD has jurisdiction on the upper reaches of the Colorado River in Texas, and the LCRA is responsible for the lower reaches. Both institutions own reservoirs and are responsible for providing water to customers in their respective regions.

On May 25, 1979, the Texas Water Commission granted a permit to the CRMWD to construct the Stacy Dam and Reservoir Project at the confluence of the Colorado and Concho Rivers (Booth 1985). The location was in the upper reaches of the Colorado. It would provide 113,000 acre-feet of water per annum to meet future municipal and industrial needs of CRMWD customers.

The LCRA objected to this project. An issue of concern was the meaning of "unappropriated water" and how return flow was considered in the unappropriated water determination. Here we had a "communication" problem. This resulted in the Texas Supreme Court reversing the decision of the Texas Water Commission, and remanding the matter back to the commission with instructions to reconsider the Stacy Dam application in view of the Texas Supreme Court's ruling on unappropriated water. This in effect killed Stacy.

Here was a conflict that seemed to be resolved because the Texas Supreme Court had acted. However, there was a larger issue at stake. The political leaders in the state of Texas had been working on a financing package involving state-supported bonds for several water activities including water supply, water quality, flood control, regional systems (sewer, water, and reservoirs), water conservation in irrigation and others. The referendums had been prepared for submission to the Texas voters and broad-based political support was needed for acceptance.

Although the Stacy Dam conflict appeared to have been resolved in the courts with the Texas Supreme Court action, it was not a good solution for the state because it polarized the voters—West Texas versus East Texas. All of the regional problems political leaders had worked hard to resolve with a broadly based bond package to finance water projects, benefiting all citizens of Texas, had been rekindled. The effort of the political leaders appeared to be for naught unless a satisfactory compromise to the Stacy conflict was reached.

Texas politicians do not give up easily on issues such as the Stacy Dam conflict. They decided to play hardball politics with the governing boards of the two water institutions involved. A law was passed placing all river authorities and water districts in the state under a sunset review. Since many districts operated facilities, the law would not permit the districts themselves to be abolished. However, the law provided that the sunset review could result in the current governing board members being removed and a substitute board be appointed by the governor.

The governor, lieutenant governor (who heads the Texas Senate), and the speaker of the house of representatives met individually with the boards of directors of the CRMWD and LCRA regarding the Stacy case. A miracle happened! Within a matter of days the two contending governing boards reached a mutually acceptable agreement. That ended the fight. The Stacy conflict came to an end, but only after the legislature had passed a sunset law providing the potential to reorganize water agencies. The statewide water development and environmental programs provided in the bonding program could proceed if the bonding authority passed.

In the required referendum, bond proposals amounting to over $1 billion were supported by more than seventy percent of the Texas voters. Of 256 counties, ranging from desert western counties to humid southeastern counties, only 24 opposed the proposition. No vote on a water financing referendum since 1897 had received

such widespread support, save the water bond issue of 1957 which followed the most severe drought on record in Texas.

How could this costly conflict in Texas, which was only resolved as a result of hardball politics involving astute political leadership by the lieutenant governor and others, have been avoided? I believe that when two quasi-public water agencies operate on the same river basin and do so essentially independently, conflict is unavoidable as the water resource of the basin is stretched to its limit. If engineers and hydrologists had been more directly involved in framing the water institutions on this river basin, I believe the potential conflicts could have been minimized. The upstream versus downstream development issue involves complex hydrology that should be treated before the issues come to court, as opposed to having hydrologists as expert witnesses supporting the arguments on each side. Laws creating water districts which adhere to political boundaries and ignore hydrologic reality are an open door to conflict.

Edwards Underground Water District/ The Guadalupe-Blanco River Authority/ San Antonio River Authority Case

Here is a case where the Guadalupe-Blanco River Authority (GBRA) and the San Antonio River Authority (SARA) have responsibility for management of surface waters in two adjacent river basins covering a region in the vicinity of San Antonio, Texas, and to the east and southeast of that area. The GBRA serves ten counties, but not the entire basins of the Guadalupe and Blanco Rivers. Its nine-member board of directors is appointed by the governor. The SARA covers four counties including Bexar, where the city of San Antonio is located. SARA is governed by a 12-member board elected with half from Bexar County, and two each from the other three counties. The Edwards Underground Water District (EUWD) is responsible for managing the groundwater in a portion of the Edwards Limestone Formation, and it overlaps GBRA and SARA in several counties. The two river authorities have responsibility for managing the surface water, including water conservation, water supply and environmental quality. The EUWD is responsible for the conservation, protection, and enhancement of recharge of the Edwards Aquifer. The Edwards Aquifer exists in a karst topography subject to rapid recharge of the limestone aquifer in certain areas. Where the formation intersects the surface, there is a direct interplay between the surface water hydrology and the groundwater hydrology. This fact was not recognized in the approval of the three various entities and each governing board manages its operations essentially independent of the other. The potential for conflict is large.

While the conflicts that have existed so far have been relatively minor, it makes little scientific sense to have water management organizations structured as these are. The EUWD would like to build detention structures in the recharge area to detain surface flow for recharge into the aquifer. This purpose would enhance the flood control mission of SARA, but it certainly conflicts with the objective of GBRA, which is more involved in water supply and hydroelectric power production. Therefore, GBRA wishes to maximize flow to its surface water reservoirs for subsequent sale and power production, as well as other uses. San Antonio is currently 100 percent dependent on groundwater and the city has a close tie with EUWD concerning water management.

Again, like the Stacy case, this example is presented to show that water institutions that are organized without adequate attention to hydrologic realities pave the way to conflict. Again, engineers and hydrologists should involve themselves to a greater extent in the political process of formulating such institutions so that potential conflicts are minimized.

Water Supply for the City of Houston

This case comes from a study by Dan Sheer (1985) and illustrates the importance of operating procedures in maximizing the water yield from various combined supply sources. The city of Houston is located in the San Jacinto River Basin. Its water supply comes from Lake Houston and Lake Livingston, which are owned by the city, and potentially from Lake Conroe,

which is owned by the San Jacinto River Authority. The city also uses groundwater which is now managed by the Harris-Galveston Coastal Subsidence District, a district created to control subsidence which has amounted to nearly ten feet since the turn of the century in the most critical areas. Maximum safe groundwater yields have been determined based on the requirement of controlling subsidence. The Brazos River, managed by the Brazos River Authority, is a short distance west of Houston and it flows directly into the Gulf of Mexico. There is no bay or estuary system at the mouth of the Brazos River so the environmental benefits to fish spawning and nursery areas of periodic flood flows does not exist there.

Here we have a case of four institutions having the potential for helping provide water supply to the city of Houston. Sheer has shown that the independent safe yield of the three lakes is 1,533,000 acre-feet per year. Safe annual groundwater yield is 337,000 acre-feet per year, giving a sum of independent yields from the three lakes and groundwater of 1,870,000 acre-feet per year. This assumes uncoordinated, independent operation of the three reservoirs. If the three reservoirs were operated jointly in a coordinated manner, the dependable safe yield would increase from 1,533,000 to 1,660,000 acre-feet per year, an increase of 8.3 percent. If the three reservoirs were operated jointly with groundwater supply, recognizing that temporary overdrafts of groundwater would not create severe subsidence problems, the joint yield increases from 1,870,000 acre-feet to 2,220,000 acre-feet per year, an increase of 18.7 percent. This clearly indicates the scope of water supply increases which are possible by jointly operating water supply systems. If the surplus flows of the Brazos River, which serve no significant beneficial use in the Gulf of Mexico, were captured, an additional 200,000 acre-feet of water could be provided.

This study, one of many of this nature by Sheer, clearly indicates the potential for increased dependable water supply through integrated management of water resource systems. However, such joint management is not easy when so many independent water institutions are involved. Future conflicts may exist which could have been avoided if the hydrologic facts of the water systems were better understood when the water agencies were established. This, again, illustrates the increasingly important role engineers can play in avoiding water conflicts by being more proactive in the political decisions regarding water institutions.

ACTION WE MIGHT TAKE

Certainly, the engineers should look at the factors which are key to the feasibility of water projects. Sometimes the key reason for our work is improvement of a needed service to people and our job is to find a way to solve the problem. We may come up with physical solutions to the problem and in so doing lose sight of the real problem. We must better explain our assumptions and the precise meaning of the terms we use. An example is the expression, "dependable water supply." I could ask you to define "dependable water supply" and I venture to say that many of you would give me a different answer. So, we have communications problems which may lead to misunderstanding and conflict.

I suggest that on every project we should conduct an "analysis of potential conflict" (APC). I am not interested in building bureaucracy, but when a project involving the public is built, I think we should do an APC. It should be part of the project documentation. The engineers and hydrologists should look at the potential conflicts and how these could be resolved. We should think of the potential conflicts which might result from the various uncertainties, the lack of knowledge, the assumptions, etc. Then we might come up with expert systems (artificial intelligence) approaches to resolving conflicts. We could even use simulations to help with the process. Ideally, we might develop a procedure whereby we can look at various types of conflict and establish a framework for solving them before they actually exist. It is difficult to be totally rational in the heat of a contentious battle. The APC process would allow us to play "what if" games before-

hand and, thereby, avoid conflicts or quickly resolve them if they occur. These are like the "war games" of the Department of Defense.

Engineers should reexamine some of our programs with an eye toward conflict resolution. We have many cooperative programs in our engineering colleges. These coop programs are involved with industry. It would be fantastic for engineering students who work with water resources problems to engage in an experimental coop program involving the agencies concerned with conflict resolution. This would give the students experience interacting with the public. It would illustrate how we can play an important role in helping to solve these problems. It could involve an internship type of experience.

I emphasize to students that I don't care how good the engineering solution is, if the public doesn't want it, then it's not a solution. Moreover, if it is likely to result in conflict, it is not a good solution. So, I think having some of our colleagues actually experience internships involving public policy and conflict resolution issues would be extremely important.

At one time water development was driven by physical potential for development. And now the overriding question is whether the activity satisfies the desires of the public. Many have blamed engineers for projects developed in the past. But that's what the political leaders and the public wanted and it's best we not forget that fact. Nonetheless, we need to adjust the way we do things. Perhaps we need to look at some modifications in our curricula. Engineers will always play a role in natural resources development and, therefore, should prepare ourselves to better interact with the decision makers on water projects. We must be up front with our input on resolving conflicts. If not, too often the courts will have the last word.

Note: This paper is a revision and expansion of a paper entitled, "Expanding the Role of the Engineer in Conflict Management," prepared for an Engineering Foundation Conference in Santa Barbara, California. The proceedings of that conference were published in 1989 in *Managing Water Related Conflicts: The Engineer's Role*, edited by W. Viessman and E. Smerdon.

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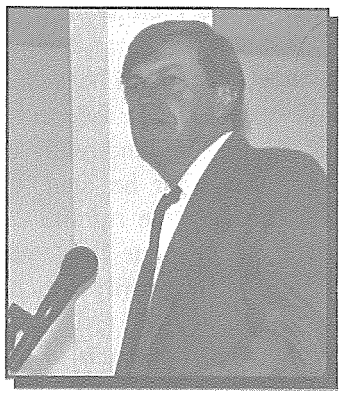

CONFLICT RESOLUTION: ONE ATTORNEY'S PERSPECTIVE

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Conflict resolution in water is something in which I've been involved for some time. Today I'll discuss the principles of conflict and how, in the water area, there seems to be a tremendous motivation to presume that because someone owns something, it necessarily leads to conflict.

How many people in this audience have had a quiet title lawsuit on their home? Three, four or five of you. Does that mean the rest of you do not own your homes because there is no judicial decree that says you are the owner? Most of you have never looked at your property's abstract. You have neighbors but you do not presume that because you have not had a court decree indicating that you are the owner, the boundaries are necessarily wrong. Conflicts occur occasionally when somebody's dog barks too loudly or somebody makes a mistake and builds something on your property. In general, the judicial process is not essential to making you the owner of your property or eliminating conflict between you and the people who live around you.

Fifteen years ago, the Santo Domingo de Cundiyo land grant board came to me and said that they had a grant in northern New Mexico consisting of 2,500 acres of common land on over 100 separate parcels. Virtually no one living on this land was able to obtain mortgage money because everyone in the area was named Vigil, there had been only two probates in the last 150 years and nobody had ever surveyed their property. Thus, these people were unsuccessful in getting a title binder. They wanted me to quiet title all parcels of land. I, along with my fellow workers at the Land Title Demonstration Project agreed; it didn't sound too tough.

There were two ways to go about solving the problem. One would be to presume that because people did not have good title documents, they were necessarily in conflict. You could abstract each parcel, many of which were

pretty small tracts, and provide each individual with an abstract of their property with title documents. You could then say that an individual's fence belongs over there, and if they try hard enough, maybe they can beat their neighbor out of his land because even though he has been using it for 35 years, that land really belonged to your ex-cousin, and after he died, through the genealogy, you became the rightful owner. That is one approach; to presume that everyone who owns something is necessarily in conflict with everyone else.

We took another approach to the problem. We took aerial photographs of the town, met at the town hall with all the individuals involved, and had everyone mark their boundaries on the map. Everybody knew what they owned. Only one fist fight occurred over a fence. We adjusted the map to scale, put the boundaries together, and let everybody agree on what everybody owned. We then provided quiet title in one lawsuit and we did not file the suit until we had worked for a year and a half figuring out how to deal with the problem. In one lawsuit, everybody's boundaries were settled. The main point is that we had started with the proposition that anyone who owns something is not necessarily in conflict with everyone else who also owns something that touches or concerns his land or water. We were not involved in making promises to people. We were not encouraging people to get more than what they currently use, or warning people that they may be hurt by what someone else claims.

From a lawyer's standpoint, not to counsel people on those two situations makes me a little nervous. It is the way we lawyers make money—using the judicial process to keep people from taking something from someone else or to encourage someone to get more than what they currently may own. A difference exists, of course, between water and land. Whether or not you actually use the land, or fence the land, it is your land and while can lose it by non-payment of taxes, you can not lose it by forfeiture or abandonment. Land boundaries do not move and the quantity of land does not vary with streamflow. The point is that ownership does not necessarily imply conflict.

Why is there so much conflict when the resource involved is water, not land? There are a number of reasons and I will give you a few. The first is that when a commodity's price rises, there are significant arguments as to what should be done with that commodity. For example, as land prices increase in an arid state, there is discussion on how the land should be used. Zoning laws become very powerful tools.

Likewise, water is often the source of power to stop someone from doing something. In areas like Santa Fe, Albuquerque or Las Cruces, you find that when there is a real or perceived scarcity of water, the ability to keep water from flowing to somebody can allow you to pursue some other goal totally unrelated to the real value inherent in the resource, such as stopping development or protecting wildlife needs. The water becomes nothing but a whipping boy for other goals. From those who care about the good, equal and fair allocation of water resources, this is a terrible thing.

Another reason for so much contention is that water conflicts make great press. I never saw so many one-liners in my life as during the El Paso suit. Once when I was in Austin, a lawyer who was a sarcastic gentleman said, "Well, you know in New Mexico they just want that water for those pecan trees and there is no basis for that argument, except maybe on an I.Q. level a pecan tree's is higher than a New Mexican's." It makes great press if there is a potential for water conflict. The press itself generates it and creates a tremendous amount of animosity where often it should not exist.

In the context of government allocation of water, water is power. It has been so since the Reclamation Act and continues to be. Those in government in positions of power, the Secretary of the Interior on the domestic level, for example, are in immensely powerful positions. Bruce Babbitt wields a tremendously significant resource in water, and politicians, of course, love power and love to wield it. One way to create conflict is to unilaterally make a choice about a water project relying on engineering studies which optimize the engineer's view of aquifer coefficients, to the extent that individual rights

are trampled. Designing a project for people creates conflict because you have government unilaterally redirecting resources around and over individuals.

Real individual conflicts over water exist, and there are many imaginary conflicts. My great-grandfather and father loved to tell the story about how someone once came onto our ranch and fenced off the waterhole that had been in use for 35 years. My great-grandfather shot the guy and went to jail for a month for the shooting. That was a real conflict. But there are many illusionary conflicts created because the legal processes dealing with water often hamper our ability to resolve problems in the same way as with land titles.

I would say in this room, as knowledgeable as you people are, if I were to ask you to each write down the size of your water right, what determined the right, and how sure you are that you own the right, you would each give a very different answer. If I asked you to tell me what documents you relied upon in making your determination, you really couldn't tell me what they were. Think of this in the context of an adjudicaton suit.

Contemplating a town of 20,000 people, all suing each other in an attempt to prove ownership is frightening and does not make much sense. If there is a need to prove ownership, it must be because the people do not understand what it is they own. If you want to avoid conflict, you do not go into an area where water supply exceeds demand, where people are getting along, where water shortages are very rare. You do not go with some hypothetical list of names, start an adjudication suit, and send everybody a complaint in the mail. This scares people.

For example, Arizona groundwater law contains a grandfather clause pertaining to all domestic and ranch-type wells. Years ago, my father called and asked me for ideas concerning one of his wells that was next to an Indian reservation. He wanted to know what I thought he should do about it. I told him to claim as much water as he wanted out of it, and asked him how much water he had used. He indicated he pumped water to 10 acres and I told him to claim all 10 since nothing could go wrong if he did. He filed as such and two days later he received a complaint in the mail for $150 million in which he was the defendant. He sent it to me with a note that said, "Son, take care of this." I asked him how much his well had gone down since he had been pumping. He said the water level had been going up every year for the last five years because a surface water diversion had been moved and everybody's well water had increased. There was no conflict on the face of it. He had become a nominal defendant in a massive suit involving 10,000 people claiming $150 million worth of impairment by everyone, jointly and separately. This made no sense.

Before you start down that road, before you put my kids through college, I would recommend that we look at doing some things differently. I think there are four possible goals inherent in trying to eliminate conflict. These goals would involve a process that would help make our water records more like land records so that we have a system for identifying who owns what with confidence, even if you have not gone to court. It is not necessary to have a judicial decree to own something. The lawyer's bar association in Colorado was a lot smarter because to have a water right in Colorado you have to have a judicial decree. That explains why they have more water lawyers per capita than any other place in the world—more water lawyers, more water laws and more lawsuits. I am not a fan of that system. I do not think you have to go to court to own something.

The second thing to be done is to get a good handle on supply. How much of the resource is there? Once you get into a lawsuit over water, you immediately have war—dueling geologists and hydrologists, captives of the client who hires them. They build the models and do the things they are asked to do. The discovery rules and the entire process is not conducive to communication. As a lawyer, if I am asked for all my hydrologic data, I say, "Time-out. That is privileged information and you can not see it. You will have to wait till we get into court." You hope at some point to get an edge on the hydro-

logic parameters of the aquifer, the transmissivity rate, the hydrologic conductivity of the soils, and so on. To avoid conflict, before any major lawsuit attempting to allocate or determine ownership in an aquifer gets underway, there should be a rule that all the hydrologists and all the people who are going to participate must get together and form a hydrology committee and a water supply committee. All the data should be shared and a model for aquifer coefficients and streamflows should be developed jointly. When the committee of hydrologists representing various interests is done, the description of supply must be available to everyone and considered prima facie proof of the situation. What good is it to have a water right on paper if the supply is such that junior priorities are never going to be met? You will end up spending a lot of money in litigation.

Thirdly, identify not only present use but future demand. A water policy demand-side committee should be formed. In a typical adjudication suit, where people are trying to tie-up as much resource as possible with respect to municipal supply, demographers are hired. How many people are going to live in Aztec, or Questa, New Mexico in the future? Well when molybdenum prices increase, there are going to be 600,000 people living in Questa according to my predictions. If there are, then we can tie-up a 40-year supply for 600,000 people times 13 acre-feet per capita per day because they are very clean up in Questa. Thus, we have a huge demand. Why not require that prior to going to court, you attempt to settle the issues by bringing people together to work on water demand, using projections from common demographic data. Do not get involved with boring demographers, get the demographers to agree in advance and once the demographics are completed, then it is prima facie true of what the situation is, given low and high ranges.

There also is a potential for conflict over the water one needs to grow crops. For example, someone might say, "You know, it takes me up here in Aztec 18 acre-feet per acre per year to grow my alfalfa." They might say this because they know that the price of water rights is increasing all the time. If they use 18 acre-feet per year on their alfalfa and they have 10 acres, they have 180 feet of water rights. That scenario is not helpful, having people in court using agronomists. I remember someone from an agricultural university taking a deposition. I asked him what he felt the duty of water was for particular crops. He based his answer on his experiences of pumping water from a nearby lake. I told him that the farm was located about five miles away from the lake, and asked him for his experience in the area in question. He said he had never been over there—he had never driven up that road—he had simply gone directly to the lake for water to do his work.

Huge debates arise about duties of water. Wouldn't it make sense to put together a regional committee with people who had historically practiced farming in the area, and allow them to arrive at a reasonable duty of water? The state engineer could participate because he dictates water usage. Thus, before you get to court, both sides have agreed on the demographics and on agricultural consumption.

The fourth area for attaining agreement is water conservation and reuse. Surely all agree that in all regions, conservation and reuse are critical concepts. Both are directly a function of your current water rights. Whatever may have been the law in 1950 is not the law today. When transferring a water right today, there is a requirement that the amount of water you have used historically and the amount you intend to use is measured by principles of water conservation. Industry's ability to reuse water is a part of that calculus. Those items should not be litigated but decided in advance of any litigation.

I do a lot of work in the Middle Rio Grande Valley. We transfer a lot of water rights. When you put together a water rights transfer package, you have two documents: a set of land title documents and a set of water rights title documents. The title documents for agricultural water rights include all the documents showing you as the owner of the land. The water rights title abstract contains all the documents indicating ownership of the water right. Those documents and records are often in a state of substantial

confusion, but it does not require a lawsuit to get them in better shape.

People do not have good records of their water rights because there is no really good place to index them, and there is no one good set of maps to determine a good baseline. Not enough effort has been made in the past to use the high tech innovations like GIS software. Therefore, it is very difficult to develop a set of water records like land title records. For example, on one declaration form I read, an individual claimed to be the owner of all the water and all the beer in the Milky Way Galaxy.

In addition, there are no really good ways to provide people the opportunity to even make their claims. The first time most people ever consider their water rights is when they are asked to file an answer to a complaint in a lawsuit in so many days or they lose their water rights. Or they get a complaint and an offer of judgement from the State Engineer indicating that the State Engineer Office has reviewed their property and they either have none or half of what they thought they owned. Prior to initiating a lawsuit, there should be somebody in charge of giving people the opportunity, tools, and support to make their claims. It is a tremendous tragedy that in many areas, particularly in rural areas, people are losing the ability to ever explain the size of their claim or protect it if it is a pre-1907 right because the elderly people who have the information concerning the pre-1907 water rights are dying. It does not take a lawsuit or a lawyer or a judge to get that information while it can still be obtained. Before you go to court, everybody should be given the opportunity to come forward and make a claim. An index of claims should be developed and it should reside in a neutral place, not in the State Engineer Office. Records could be contained in a water rights inventory storehouse similar to where county records are kept.

During earlier stages of the *Amodt* case, I wrote a book on Pueblo Indian water rights. I disagreed with both sides in the Amodt case, and made everyone unhappy. My commentary then concerned how water rights adjudications create a growth industry for historians. Suddenly, when you are involved in an adjudication suit, people come out of the woodwork who are willing, for money, to study the area's history. Historians are captives of particular points of view. Instead of this, what is needed is an unbiased history of an area's development.

Perhaps the fourth sort of general information needed is an historical development of water use. This information should be available to everyone, supported by public money, and generated by a committee representing all interests. The final product would be a good description of the evolution of water use in an area. If an individual lives in a certain part of the stream system, they can offer what they remember their grandfather said or did, with appropriate proof. Many historical facts are highly relevant and significant in the process. None of this data gathering requires going to court.

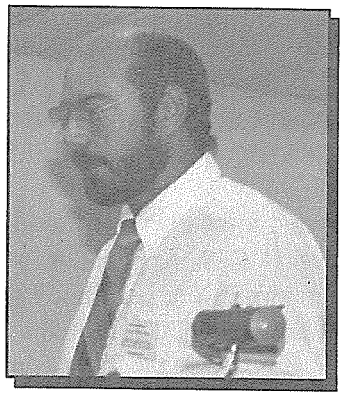
In my personal opinion, no one should ever be able to claim abandonment against his neighbor. If there is an abandonment or a forfeiture of a water right, it is between the state and the individual. It is not the business of someone's neighbor to go down to the State Engineer Office and try to forfeit another person's water rights. That is a built-in conflict, and not allowing it would eliminate a tremendous number of *inter se* conflicts. If you allow such a practice, you are creating conflicts that are inconsistent with the purpose of the adjudication law. Secondly, to help straighten out the records in a stream system, there should be an absolute amnesty by the state on abandonment, for at least the last 25 years, so that people who have not fully understood the importance of beneficial use, and for those who are unaware of the nature of water law can be protected.

The state ought to focus on the four goals I am suggesting and it ought to be done outside of a lawsuit. If there is a lawsuit, no *inter se* abandonment should be allowed. People are pretty much aware of the amount of water they are using. People will rarely ask for more than what they believe they are entitled to if they fully understand the system.

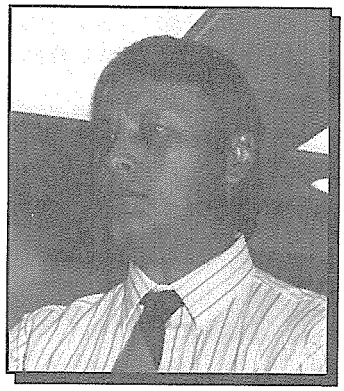
Perhaps there should be a lawyers' court and a non-lawyers' court. All small claims could be handled by alternative dispute resolution with no

lawyers present or involved in anyway. People could try to work out their conflicts in this way first and if they are unable to, then proceed to court if they have a real dispute with their neighbor over someone affecting someone else's headgate or directly impairing their rights. Large claims should be handled separately and possibly broken into separate lawsuits to simplify matters. Get those big water rights issues out of the dispute and don't make people pay a lot of money for something they don't really care about.

John Peterson is currently the geographic information coordinator at the University of New Mexico's New Mexico Engineering Research Institute. Most recently he has been active in the development of techniques incorporating GIS technology for compiling and disseminating geographic information for environmental and other types of decision support. John currently sits on the board of the New Mexico Geographic Information System Council and is active in the state's Resource GIS Clearinghouse Program.



Glenn Olson is a senior staff member at UNM's New Mexico Engineering Research Institute. His background includes an 18-year career as a computer systems analyst and systems engineer. His achievements in the field of GIS include the development of stand-alone and distributed systems for water quality analysis, sustained agriculture, management of environmentally hazardous materials, and geolinking large textual databases. He was a presenter at the 1993 Arc/Info Users Conference and is a recipient of a software development grant from the International Geodesy Institute.



THE STATEWIDE WATER RESOURCE PLAN INFORMATION SYSTEM: EXPANSION OF THE INVENTORY OF FLOOD PROTECTION NEEDS GIS APPLICATION

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INTRODUCTION

As water resources issues in New Mexico continue to gain attention, information of all kinds pertaining to spatial relationships, such as administrative districts, existing tabular data, and past and present project reporting, are valuable assets to state water planners and decision

makers. Historically, useful water resources information pertaining to the same community or geographic region might be recorded at several federal and/or state agencies without being pooled as a collective inventory for general access. This paper summarizes the second phase of development of the Statewide Water Resources Plan Information System (SWRPIS), formerly referred to as the "The Flood Protection Needs Inventory GIS Application." Work described in this paper was performed for the Soil Conservation Service's (SCS) Albuquerque office and in conjunction with the New Mexico Interstate Stream Commission. With the expansion of report information contributed by the SCS, and its potential use with the Statewide Water Plan, this application's name was changed to reflect more properly its utility for water planning at all levels, as requested by the state's Water Resource Plan Coordinator.

BACKGROUND

In FY92, the Corps of Engineers (COE) Southwest Division, Albuquerque District completed and delivered the first compilation of the New Mexico Statewide Inventory of Flood Protection Needs, in report and dBaseIII Plus© format, hereinafter referred to as the "Flood Protection Inventory" (FPI) to the New Mexico Interstate Stream Commission as part of the Planning Assistance to States Program established in 1974 (Corps of Engineers 1992). At the request of the Albuquerque District Corps of Engineers Planning Department, the New Mexico Engineering Research Institute (NMERI) was commissioned to convert the FPI database to a menu-driven GIS-based report query application.

The FPI database consists of Study Data reports and Federal Emergency Management Agency (FEMA) Data reports. The Study Data report includes pertinent data from completed Corps of Engineers planning studies conducted for communities, counties, or river basins that identify flooding problems and solutions. The FEMA Data report consists of National Flood Insurance Program (NFIP) information for New Mexico communities.

NMERI completed and delivered the product of the first phase of the "The Flood Protection Needs Inventory," Geographic Information System application to the Corps of Engineers and the New Mexico Interstate Stream Commission in May 1992. This FPI GIS-based application was a completely menu-driven query tool for accessing Corps of Engineer Flood Control Project and FEMA Reports and Information since 1974 by corresponding geographic parameters, that is, communities, counties, or river basins. The application was prepared using Environmental Systems Research Institute's ARC/INFO© version 5.0.

The task applied the process of geographically linking the original data sets to a spatial reference, making the original data sets suitable for use in a GIS. Geographic linking or "geolinking," is the process of relating a data set with a "soft" spatial reference (e.g., community name) to a data set with a "hard" spatial reference such as latitude and longitude. The link is made through the use of data elements common to both data sets and database techniques known as relational operations. This technique combined the data elements from both data sets to locate and describe a place of interest. In this case the community, county, and river basin names found in a database were used to geolink to the digital USGS Geographic Names Information System, the County Boundary, and aggregated USGS Hydrologic Unit GIS coverages, respectively, for New Mexico. Sample reports from a FPI query session appear in Figures 1-3.

SECOND PHASE OBJECTIVES

The second phase's primary objective of the "SWRPIS GIS Application" was to expand the information base of the FY92 Flood Protection Inventory GIS Application to include four types of SCS water-resources related project report descriptions, which can be queried by their representative geographic reference such as communities, counties, or river basins. A second-

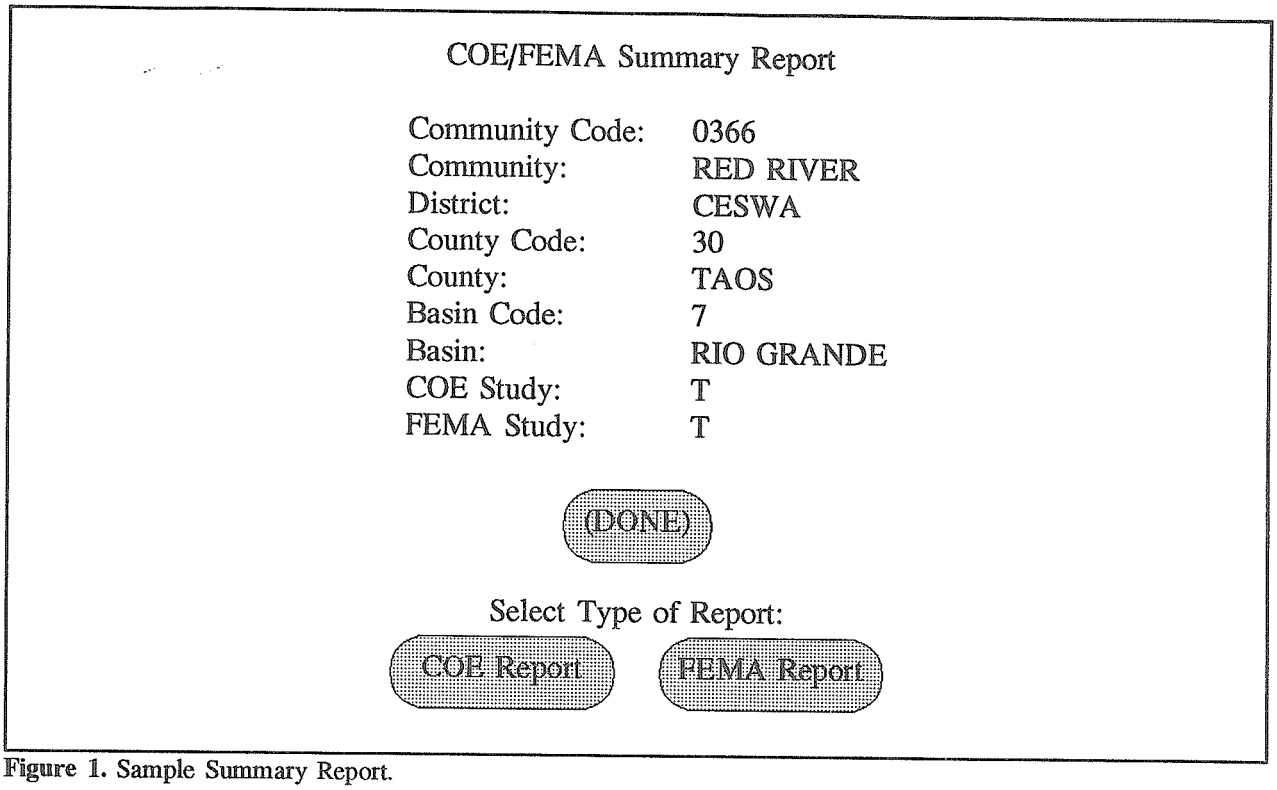

Figure 1. Sample Summary Report.

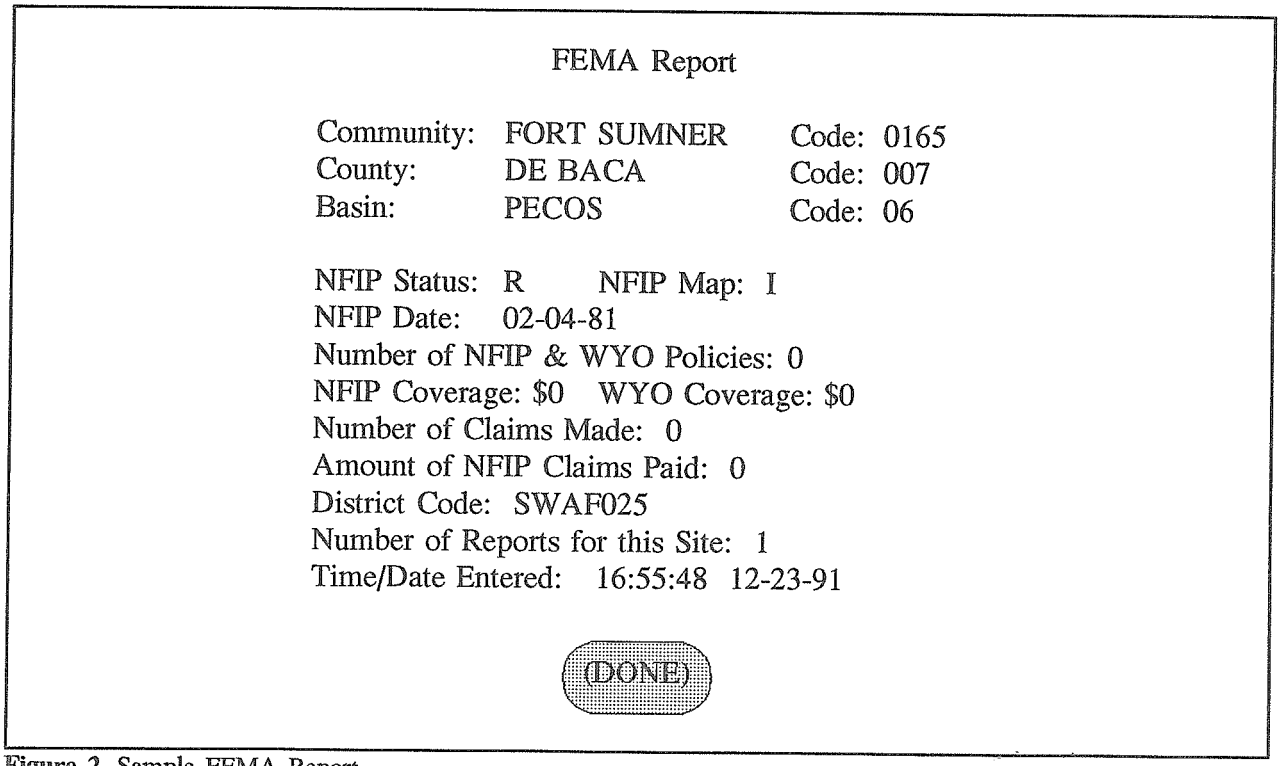

Figure 2. Sample FEMA Report.

COE Report

Community: ABIQUIU 0004 County: RIO ARRIBA 022
Basin: RIO GRANDE 07 District Code: SWAS001
Agency: CESWA Study Type: WCML Sponsor: CORPS OF ENGINEERS ALBQ DIST
Date Initiated: Date Completed: 02/01/82
Original Cost: $100,000 O&M Cost: $0 Jan. 1992: $130,000
Annual Project Benefit: $1000 Benefit Cost Ratio: 1.2
Number of reports for this site: 1

Report Title: ABIQUIU DAM AND RESERVOIR OPERATED IN ACCORDANCE WITH THE WATER CONTROL MANUAL TITLED ABIQUIU DAM AND RESERVOIR, RIO CHAMA, NEW MEXICO, APPENDIX A TO RIO GRANDE BASIN MASTER REGULATION MANUAL (FEBRUARY 1982).

Project: EARTHFILL STRUCTURE FOR FLOOD AND SEDIMENT CONTROL WITH SPF LEVEL OF PROTECTION. PROJECT IS AUTHORIZED TO STORE 200,000 AF OF SAN JUAN-CHAMA DIVERSION WATER. MAJOR WATER USERS INCLUDE CITY OF ALBUQUERQUE & RIO GRANDE CONSERVANCY DISTRICT.

Study Area: ABIQUIU DAM IS LOCATED ON THE RIO CHAMA NEAR THE TOWN OF ABIQUIU, NM, ABOUT 32 MILES UPSTREAM FROM THE CONFLUENCE OF THE RIO CHAMA AND THE RIO GRANDE. THE RESERVOIR HAS A DRAINAGE AREA OF APPROXIMATELY 2146 SQ.MI.

Remarks: AUTHORIZED BY FLOOD CONTROL ACTS OF 1948 AND 1950. REPORTS INCLUDE ABIQUIU RESERVOIR REALLOCATION-RIO CHAMA STUDY SUMMARY & APPENDICES A,B,C, (1981) AND ABIQUIU RESERVOIR, DM NO. 19, INITIAL RESERVOIR FILLING PLAN/FLOOD EMERGENCY PLAN (OCTOBER 1983).

Status: DAM COMPLETED IN 1963. REC FACILITIES COMPLETED IN 1981. REPORTED FLOOD CONTROL BENEFITS COMPUTED FOR 1991 & CUMULATIVE BENEFITS AMOUNT TO $230,209,100 TO DATE. B:C RATIO FROM 1960 HOUSE DOCUMENT & THE O&M IS AVERAGE ANNUAL SINCE PROJECT COMPLETION.

Time/Date Enter

(DONE)

Figure 3. Sample COE Report.

ary objective was to enhance the one to many relate functionality of the database retrieval operations by rewriting the SWRPIS in ARC/INFO© version 6.1.

APPROACH

We assessed the added functionality and capabilities possible in a GIS implementation of this database type, then determined the steps needed to develop and implement the GIS with its related software, datasets, data structures and data layers. Finally, we produced a definition of the development schedule and sequence. As with the project's first phase, the methodology was the same:

1. Import files from the SCS Prelude© database system into INFO usable file structures.
2. Condition the SCS data sets, as required, to be suitable for use in ARC/INFO© GIS software.
3. Acquire public domain GIS data sets for use in spatially locating the SCS study sites.
4. Link geographically the SCS data sets with the GIS data sets to allow GIS manipulation of the report data.
5. Design and implement a GIS application to allow spatial query and analysis of the SCS data.
6. Retain, wherever possible, the current functionality of the original FPI and SCS databases.

DATABASE PREPARATION

The GIS database for this task incorporated two primary data types: first, the attribute data, comprised of the study site summaries and reports residing in the SCS databases on a personal computer, and second, the spatial data, comprised of ARC/INFO© coverages available on a UNIX-based workstation. The development and implementation platform chosen for this application was ARC/INFO© GIS software running on a DEC Station 5000/200 workstation. The workstation required that all data be suitable for this environment.

Attribute Data

The first data type, the attribute data, consisted of four data sets, the Snow/Soil Survey data set (Snow-Soil.Survey), the Watershed Project data set (Watershed.Project), the River Basin Studies data set (River Basin.Studies), and the Resource Conservation and Development Program data set (RCD.Reports). At the onset of this task, these four data sets were contained in a Prelude© database in the internal database format. These data sets were extracted from the Prelude© environment in an ASCII format using internal functions, and transmitted via Local Area Network to the workstation. Once in the workstation environment, the data was conditioned for insertion into the GIS database management system, INFO. Four data structures designed to accommodate the SCS data were then implemented in the GIS and the data were imported into these data structures through the use of ARC/INFO© utilities. This now made the SCS data accessible in a GIS environment.

The SCS maintains four databases which contain information about significant studies and projects. These studies and projects are completed under five programs. The four types of SCS reports which were built into the SWRPIS GIS application and their attribute files containing the SCS databases are described below.

1. Snow and Soil Survey Reports - The SNOW-SOIL.SURVEY file summarizes inventory and monitoring efforts of the SCS. The file contains soil survey and snow survey information. In 1896, Congress first authorized soil investigations, and in 1935 (Public Law 74-46) transferred the soil survey program to the SCS. This program inventories the nation's soil resources, records the location of soils, predicts soil performance under defined use and management, and facilitates the transfer of soil information. The program contributes to the knowledge, understanding and proper use of land resources. In 1939, the U.S. Department of Agriculture assigned the snow

survey responsibilities to the SCS under the authority of Public Law 74-46. The snow survey program collects basic hydrometeorological data and issues water supply forecasts. The basic data is available to the public and the scientific community. The forecasts are coordinated with the National Oceanic and Atmospheric Administration.

2. Small Watershed Program Reports - This program provides technical and financial assistance to communities. The assistance helps solve a broad range of water resources problems and related land-resource problems. These projects are limited to areas of 250,000 acres or less. The SCS and the local community share in the cost of installing improvements.
3. River Basin Program Reports - The second program authorized by Public Law 83-566 is the River Basin Program which provides technical assistance to local communities to solve any water resources and related land-resource problems. The program produces reports from: Floodplain Management Studies, in which detailed analyses of flood-prone areas are presented and alternate ways to reduce flood damages are developed; Cooperative River Basin Studies in which specific problems occurring over a large geographic area are defined and analyzed; and Flood Insurance Studies, which can be contracted with the Flood Insurance Administration.
4. Resource Conservation and Development Program Reports - Public Law 97-98 authorized the Resource Conservation and Development Program, which provides technical assistance to rural disadvantaged areas from the entire Department of Agriculture. New Mexico has nine authorized Resource and Conservation and Development Areas. Report summaries contained in the SWRPIS application summarize the program's measures which were installed with USDA financial assistance.

Spatial Data

The second data type, the spatial data, consisted of three ARC/INFO® coverages available in the public domain: USGS GNIS, the Hydrologic Unit thematic coverage, and the County Boundary coverage. Also, one converted AutoCad coverage of water planning areas with associated names, provided by the Interstate Stream Commission, was incorporated during the first phase. All mapped coverages used were available at a scale of 1:500,000 and covered the geographic extent of New Mexico. All ARC/INFO® coverages used were drawn from the New Mexico Resource Geographic Information System (RGIS) Clearinghouse. The SWRPIS application is built in a Lambert Conic projection in meters with the following parameters:

1st Standard Parallel	33 00 00
2nd Standard Parallel	45 00 00
Central Meridian	106 00 00
Origin of projection	30 00 00

It should be noted that both the GNIS coverage and the USGS Hydrologic Unit coverage required some modifications which are described below.

- Community Names Coverage - The USGS GNIS required some modification to accommodate the use of "unofficial" names in the original FPI data and to correct some deficiencies in the current GNIS such as locating communities not found in the GNIS.
- State Engineer Office/SCS River Basin Coverage - The eight digit USGS Hydrologic Unit coverage required some enhancements to allow aggregation of the units into the State Engineer Office's (SEO) recognized major river basins for basins officially recognized by SCS. This included hand digitizing components of basins recognized by the SEO, which were not included in the USGS line work. The aggregated hydrologic units were then used to generate a river basin coverage. It should be noted that until addressed further for issues of spatial accuracy, the SEO River Basin coverage used in this GIS application should be considered an unverified data set for use in this application only.

- County Boundary Coverage - The County Boundary coverage was used as it was received.
- Statewide Regional Water Planning Areas Coverage - As was mentioned, the Statewide Regional Water Planning Areas coverage, was obtained from the Interstate Steam Commission in an AutoCAD® format. This coverage was converted into a DXF format using an internal AutoCAD® function and then converted into ARC/ INFO® coverages using ARC/ INFO® utilities. Two data layers were extracted and converted: the Planning Area boundaries and their names. Figures 4-8 contain maps of the Regional Water Planning Areas coverage, the County Boundaries coverage, the Eight Digit USGS Hydrologic Units and Codes, the COE River Basin coverage, and the SEO River Basin coverage.

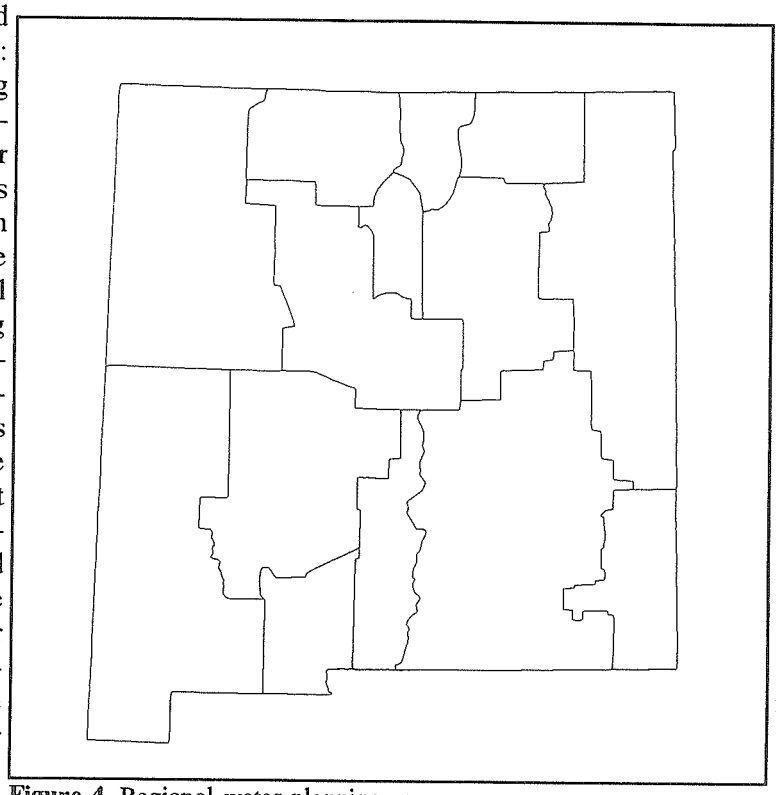

Figure 4. Regional water planning areas.

Relate Tables

The last significant data preparation task was the generation of a data table which allowed the GIS to relate the spatial data to the attribute data. These so called "relate tables" define the six SCS and six original Corps of Engineer data table relationships required for geolinking. This relate table is an original data set developed for this application (Table 1).

The attribute databases provided to NMERI by the Corps of Engineers and the SCS were geolinked via the relate tables to the spatial data. To spatially access the COE and SCS data, a user-friendly interface was developed.

USER INTERFACE

The user interface for this application is a menu-driven combination of graphic and text windows displayed simultaneously on the user terminal. The user interacts with the menus and display windows through the use of a mouse-activated cursor. Menu selection or study-site designation is achieved by pointing and clicking on the particular selection. To select an area for zooming, the user points and clicks on two diagonal points bounding the area of interest. User options may be used in any order or combination and for either the entire state or for any portion of the state, that is, any zoomed area. Table 2 specifies and describes user options. Tables 2-4 outline the lists of user options presently available in the SWRPIS.

CONCLUSIONS AND FUTURE POSSIBILITIES

In accordance with the stated objective, the four SCS data report files were incorporated as part of the SWRPIS GIS application. Also in the best interests of this application's utility, the FPI Application, originally written in ARC/INFO version 5.0, was rewritten in version 6.1 to take advantage of its added functionality. With this project's successful completion, it is clear that GIS is well suited to this application of access to

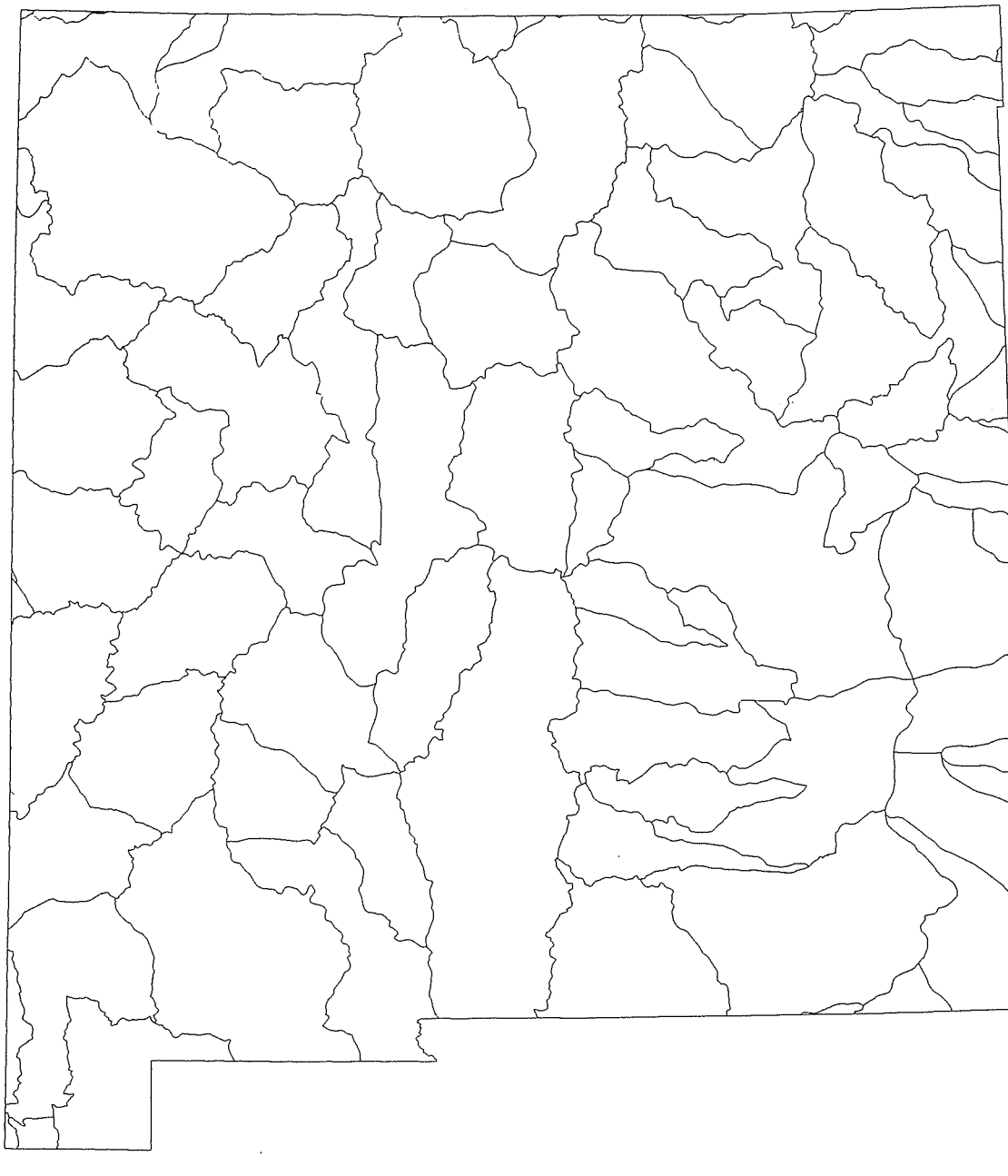

Figure 5. New Mexico state hydrologic units.

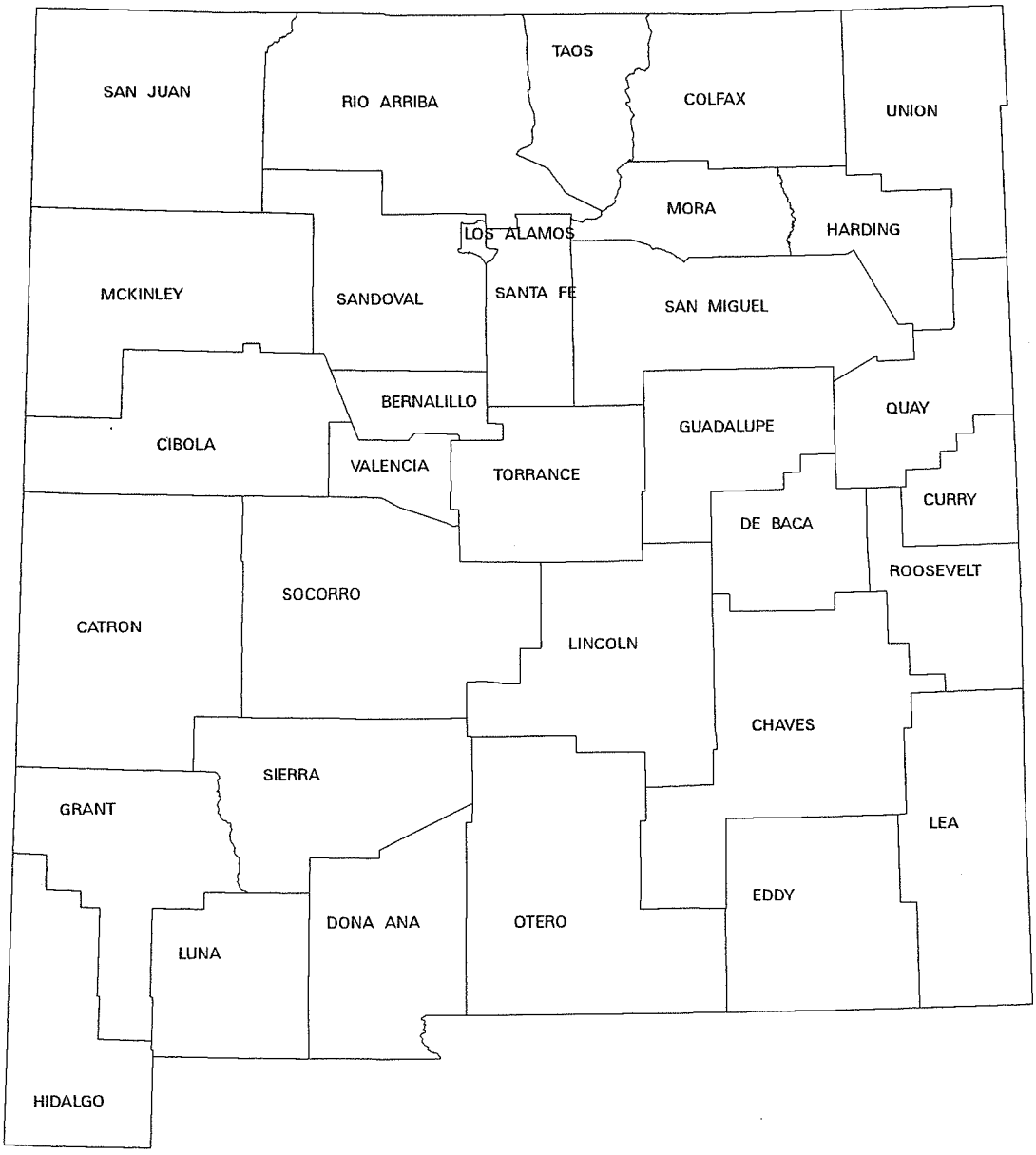

Figure 6. New Mexico counties.

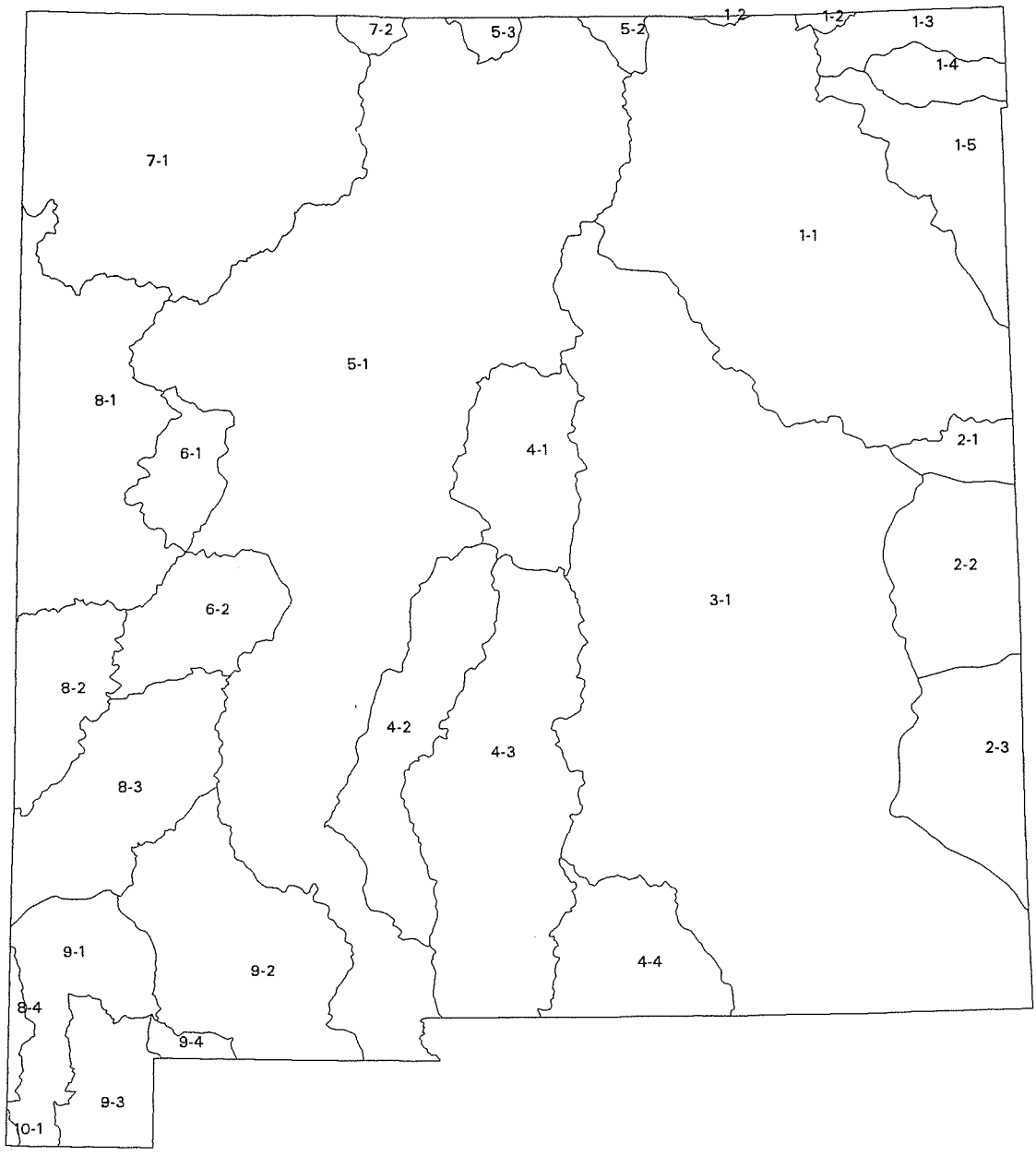

Figure 7. New Mexico State Engineer Office/SCS New Mexico river basins.

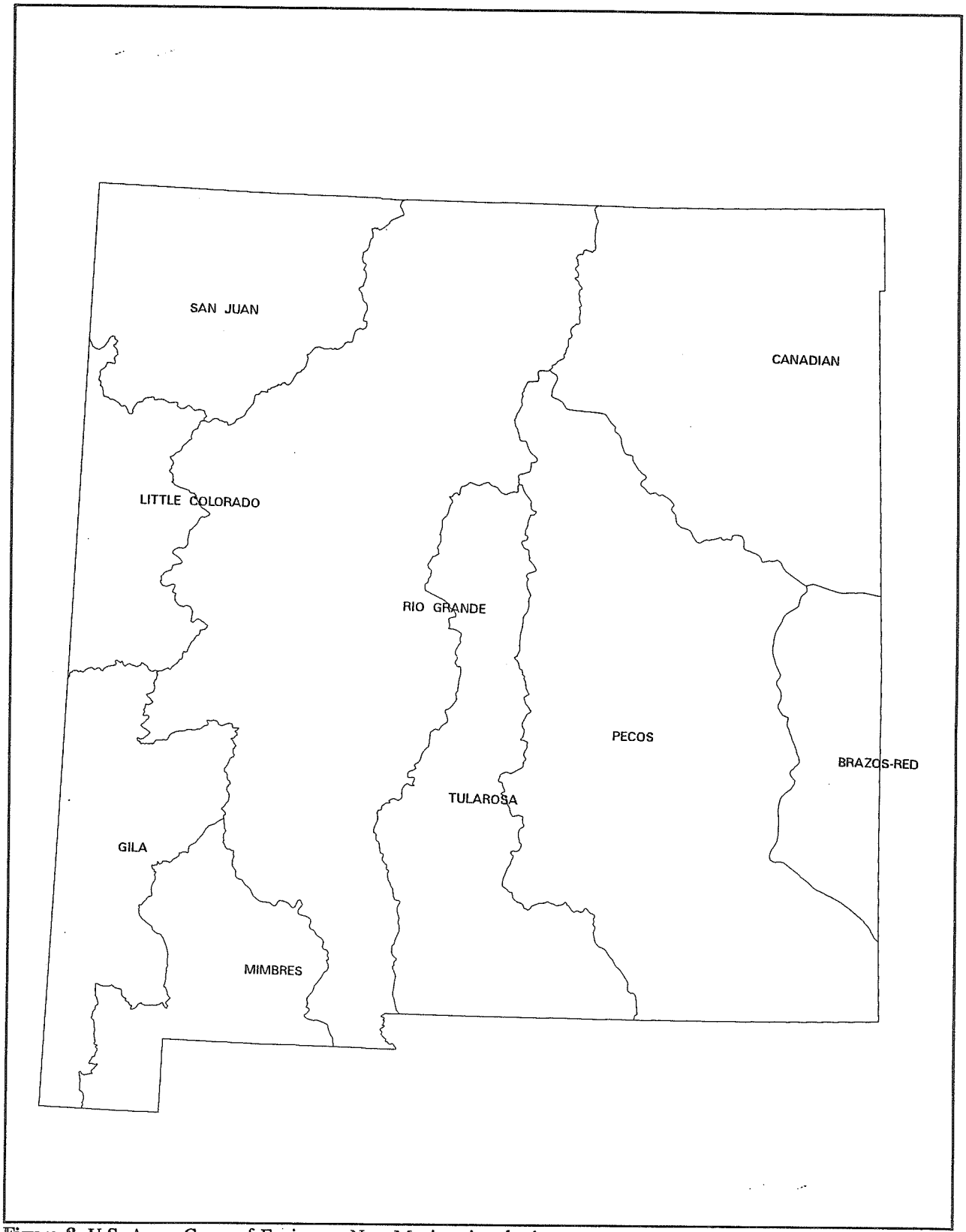

Figure 8. U.S. Army Corps of Engineers, New Mexico river basins.

TABLE 1. DATABASE RELATE TABLES

Relate Table : CEO.REL	Relate Table: SCS.REL
GNIS	WATERSHE
COMMUNITY.SUMMARY	WATERSHED.PROJECTS
INFO	INFO
NAME	NAME
COMMUNITY	COMMUN
ORDERED	LINEAR
FSWA	RO
FSWA.REPORTS	RIVBAS_A
INFO	RIVER_BASIN.STUDIES
NAME	INFO
COMMUN	NAME
LINEAR	COMMUN
SSWA	LINEAR
SSWA.REPORTS	RO
INFO	RCD
NAME	RCD.REPORTS
COMMUN	INFO
LINEAR	NAME
C_FSWA	COMMUN
FSWA.REPORTS	LINEAR
INFO	RO
COUNTY_NAME	RIVBAS_B
COUNTY	RIVER_BASIN.STUDIES
LINEAR	INFO
C_SSWA	BASIN_NUMBER
SSWA.REPORTS	BASIN_NUMBER
INFO	LINEAR
COUNTY_NAME	RO
COUNTY_NAME	RIVBAS_C
LINEAR	RIVER_BASIN.STUDIES
B_SSWA	INFO
SSWA.REPORTS	COUNTY_NAME
INFO	COUNTY_NAME
BASIN_NAME	LINEAR
BASIN	RO
LINEAR	SNOWSOIL
	SNOW_SOIL.SURVEY
	INFO
	COUNTY_NAME
	COUNTY_NAME
	LINEAR
	RO

bibliographic information. Databases like those found in the SWRPIS, when converted to a GIS application, hold tremendous potential uses for water resource and other natural resource managers.

1. Currently the SWRPIS is divided into two parallel yet separate query systems: Corps of Engineers and SCS. This means that to retrieve a comprehensive picture for all reports for a level of geography (community, county, or river basin), the user must toggle the search between the two agency's databases. As the number of agencies participating in the SWRPIS increase, it is

likely that a user would want to acquire a comprehensive summary of reports in one search operation. To better serve a user interested in accessing all reports available for a defined geography, the SWRPIS query logic should be adjusted to facilitate comprehensive report retrieval in a single operation.

2. Expand the applications query capability to include other units of geography such as searches by regional planning districts, soil and water conservation districts, other political boundaries, such as state and congressional districts, and others.
3. Investigate the feasibility of "snapshot" printing of reports and maps to postscript printers and plotting devices.
4. Include additional water resource and base theme GIS layers, that is, surface hydrography, Roads, SCS 11 digit code watersheds, USGS groundwater site inventory of wells, and others, for enhanced geographic reference and visual analysis.
5. Explore PC/Software based mechanisms and Wide Area Networks for remotely accessing the water resource information found in the SWRPIS by non-ARC/INFO® based users.
6. Continue to add pertinent federal, state, and special institutes' water resource information to the SWRPIS.
7. Breakout Real Property Infrastructure, that is, channels, dams, etc., from non-infrastructure producing studies.

REFERENCES

Peterson J.L., T.A. Moore, and G.M. Olson, NMERI OC 92/33, *The Flood Protection Needs Inventory Geographic Information System Application*, Final Report to the US Dept. of Interior, Fish and Wildlife Service, Region 2 Water Rights Program Manager, Albuquerque, NM, May 1992.

Corps of Engineers, Albuquerque District, *New Mexico Statewide Inventory of Flood Protection Needs*, Final Report to the Interstate Stream Commission, January, 1992.

TABLE 2. LIST OF MAIN MENU OPTIONS

Menu Option	Description/Purpose
Hydrologic Units	Draw the Hydrologic Unit Boundaries
COE River Basins	Activate the drop down menu to draw the COE River Basins
Brazos-Red	Draw the Brazos-Red river basin
Canadian	Draw the Canadian river basin
Gila	Draw the Gila river basin
Little Colorado	Draw the Little Colorado river basin
Mimbres	Draw the Mimbres river basin
Pecos	Draw the Pecos river basin
Rio Grande	Draw the Rio Grande river basin
San Juan	Draw the San Juan river basin
Tularosa	Draw the Tularosa river basin
All	Draw all river basins
Boundaries	Draw the River Basin Boundaries
Basin Names	Draw the River Basin Names
SCS River Basins	Activate the drop down menu to draw the SCS River Basins
Animas Basin	Draw the Animas river basin
Brazos River	Draw the Brazos river basin
Canadian River	Draw the Canadian river basin

TABLE 2. LIST OF MAIN MENU OPTIONS (CONTINUED)

Menu Option	Description/Purpose
SCS River Basins (cont.)	
Carrizo Creek	Draw the Carrizo creek river basin
Costilla Creek	Draw the Costilla creek river basin
Dry Cimarron River	Draw the Dry Cimarron river basin
Estancia Basin	Draw the Estancia river basin
Gila River	Draw the Gila river basin
Jornado del Muerto	Draw the Jornado del Muerto river basin
Lea Plateau	Draw the Lea Plateau river basin
Little Colorado	Draw the Little Colorado river basin
Mimbres Basin	Draw the Mimbres river basin
Navajo River	Draw the Navajo river basin
North Canadian River	Draw the North Canadian river basin
North Plains	Draw the North Plains river basin
Pecos River	Draw the Pecos river basin
Playas Basin	Draw the Playas river basin
Purgatoire River	Draw the Purgatoire river basin
Red River	Draw the Red river basin
Rio Grande	Draw the Rio Grande river basin
Rio San Antonio	Draw the Rio San Antonio river basin
Rio Yaqui	Draw the Rio Yaqui river basin
Salt Basin	Draw the Salt Basin river basin
San Agustine Plains	Draw the San Agustine Plains river basin
San Francisco River	Draw the San Francisco river basin
San Juan River	Draw the San Juan river basin
San Simon Creek	Draw the San Simon Creek river basin
Tularosa Basin	Draw the Tularosa river basin
Wamel Basin	Draw the Wamel river basin
All	Draw all river basins
Boundaries	Draw the River Basin Boundaries
Basin Names	Draw the River Basin names
Counties	Activate the drop down menu to draw the Counties
Borders	Draw the county borders
Names	Draw the county names
Water Planning Areas	Activate the drop down menu to draw the Water Planning Areas
Borders	Draw the Water Planning Area borders
Names	Draw the Water Planning Area names
COE Study Sites	Activate the menu to query and display the COE Reports
SCS Study Sites	Activate the menu to query and display the SCS Reports
Tools	Activate the Tools drop down menu
Zoom	Zoom the display
Reset	Reset the display to the statewide coverage
Clear	Clear the display
Quit	Quit the application

TABLE 3. COE QUERY AND DISPLAY MENU OPTIONS

Menu Option	Description/Purpose
Communities	
COE Studies Only	Display the COE Community Study Sites
FEMA Studies Only	Display the FEMA Community Study Sites
Both Studies	Display Both Study Sites
All Study Sites	Display All Study Sites
Summary	Query/Display the Report
Counties	
COE Studies Only	Display the COE County Study Sites
FEMA Studies Only	Display the FEMA County Study Sites
All Study Sites	Display all County Study Sites
Report	Query/Display the Report
River Basins	
Study Sites	Display the River Basin River Sites
Report	Query/Display the Report
Tools	
Zoom	
Reset	
Clear	
County Borders	
County Names	
COE Basin Boundaries	
COE Basin Names	
SCS Basin Boundaries	
SCS Basin Names	
Water Planning Area Borders	
Water Planning Area Names	
Return	

TABLE 4. SCS QUERY AND DISPLAY MENU OPTIONS

Menu Option	Description/Purpose
Communities	
Watershed Projects	Display the SCS Watershed Community Study Sites
River Basin Studies	Display the SCS River Basin Community Study Sites
RCD Reports	Display the SCS RCD Report Community Study Sites
Summary	Query/Display the Report
Counties	
River Basin Studies	Display the SCS River Basin County Study Sites
Snow/Soil Survey	Display the SCS Snow/Soil Survey County Study Sites
Summary	Query/Display the Report
River Basins	
Study Sites	Display the River Basin Study Sites
Report	Query/Display the Report
Tools	
Zoom	
Reset	
Clear	
County Borders	
County Names	
COE Basin Boundaries	
COE Basin Names	
SCS Basin Boundaries	
SCS Basin Names	
Water Planning Area Borders	
Water Planning Area Names	
Return	

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THE WATER RIGHTS ADJUDICATION PROCESS IN NEW MEXICO

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I'd like to begin by talking about the adjudication process, and then look at some specific cases and the issues that have arisen in those adjudications. Then I will talk a bit about the hopes and possible cures for the difficulties that have emanated from the adjudication process.

Professor DuMars talked this morning about how the adjudication process was conceived as a kind of quiet title suit. He noted that this meant that an adjudication does not confer title; even without an adjudication people still own their water rights. What adjudication means is that each person gets a piece of paper with which you can prove your rights to your neighbors. When the adjudication statutes were passed, we hoped that all rights in the state could be determined, and we would know exactly how much water everybody owned. That, of course, would provide several benefits; it would make water much easier to administer, it would give everybody their fair share of water, it would provide us with information on what water supplies exist, and also it would enable us to meet our obligations to other states consistently.

THE PROCESS OF AN ADJUDICATION

The Hydrographic Survey

To achieve these goals, a hydrographic survey must first be developed. Statute requires that the state engineer produce or accept a hydrographic survey covering the entire state. This is designed to provide as much information as possible prior to any adjudication. You want to go out into the field, see what people have been doing, talk to people, look at records, and take aerial photographs to determine as much as you can about actual water use; then draw a hydrographic survey. In several cases, particularly in the Jemez case, we were very careful not only to do the hydrographic survey, but also to conduct many interviews with people in the area to try to

resolve legal questions in advance. That effort was only partly successful as you will see.

Having completed a hydrographic survey, and with the advice of his legal division, the state engineer must determine whether to file an adjudication suit in the area. It is possible for a private party to initiate an adjudication suit. More often, however, the State Engineer Office (SEO) has commenced the suit, only because hydrographic surveys are outdated quickly if they are not enshrined in the law, and the SEO is in a position to coordinate the hydrographic survey with the lawsuit. The state statutes direct the state engineer to apply limited resources for adjudications in those areas which need it the most, which has been construed to apply to irrigated areas.

Who Participates

Because one goal of an adjudication is to determine water supply, all water uses affecting that supply may be included. However, there are in practice a few exceptions, some of which have become controversial. In some cases, for example, we have persuaded the court to exempt *de minimis* uses from adjudication. As a practical matter, this exemption applies mostly to domestic wells. We do not want to join in an adjudication lawsuit all the thousands of people who have drilled wells in an area. In one case that argument was accepted; in another case, the special master rejected that argument as unconstitutional. We also do not adjudicate stock ponds of less than 10 acre-feet or tracts too small to map.

The state traditionally has not tried to adjudicate non-diversionary uses, that is, rainfall farming or flood-plain farming. The use in this category causing the most controversy has been instream flow. You probably are aware of the contention over that issue. The state customarily has taken the position that if nobody is diverting the water, there is no basis for a water right. Under this analysis, an instream flow right cannot be recognized under state law. Some federal statutes, such as the Wild and Scenic Rivers Act, specifically reserve water for instream flows, however, in some cases, we have had to confront the difficulties in administering non-diversionary use that state law recognizes. I think that resolving these differences is possible and is on the way.

Technically, every water user in a basin is a party to the adjudication. Usually, however, an adjudication suit shakes down to a few very active players. The first is the state. The state views itself as the stake owner who holds title until determined otherwise by the courts. Second, the United States is usually, if not always, a major player in adjudications. Other players for whom the United States holds the brief are the Indian tribes and pueblos across the state. As a formal matter, tribal and pueblo claims are simply subfiles within the adjudication. As a practical matter, the controversy surrounding those particular types of subfiles have a huge effect on how the adjudication proceeds. Third, in some parts of the state, acequia associations have banded together to promote common interests. Finally, irrigation districts also are big players in water rights adjudications. As you see, we have a large crowd of fairly diverse interests. That alone makes some of these lawsuits difficult to handle.

What Happens

After the SEO has completed the hydrographic survey, and someone has filed suit, the determination of rights begins. Ordinarily the court appoints a special master because the court does not want to spend the time required by each of the many subfiles.

The state then, based on its hydrographic survey, makes offers of judgment to all water users asking the water user to agree with the state's assessment of their rights. We have a pretty good record of acceptance of these offers. Upwards of 80% to 90% of our adjudications are resolved through acceptances of our judgment offers.

When water rights disagreements exist between the state and a water user, the disagreement goes to a hearing in front of the special master. In addition to this, a certain percentage of defendants neither formally disagree nor sign their offers, and at that point we enter into what is called a default judgment.

When disagreements are worked out and default judgments have been entered, the case is ready for the *inter se* phase when people talk about their neighbors' water rights. It is unquestionably a very divisive time. It is difficult to see how to drop this phase because it is true in water, unlike land, that if my neighbor gets more, I get less, provided our priority dates are equal or mine is later. All water users involved in the lawsuit really do have an interest in how much water their neighbor gets. Also all people are not straightforward about their water rights. Many people are, but inevitably there are a certain number of people who ask for whatever they think they can get. The best check we have on those people is their neighbors' testimony. So while I sympathize with the desire to avoid the divisiveness of this phase of the adjudication process, it is very difficult to see how to correct it.

When we finish the *inter se* phase—and a considerable amount of time has passed in most cases—the court enters a final decree which sets forth the water rights. The court appoints a water master, often a State Engineer Office staff member, and from that point it should be easy street. The water master administers the rights as determined in the final decree.

REASONS THE PROCESS DOESN'T RUN SMOOTHLY

By way of illustrating when the adjudication process does not work very well, let me discuss a few cases and the kinds of issues that have developed. One is that New Mexico, in terms of water rights, is a huge state and the State Engineer Office is a fairly limited agency without the resources to give these cases the time and effort they deserve. It is very frustrating to get pushed around by court deadlines from this case to that case, forced to forget about one case in trying to deal with another. It is very difficult to juggle these cases and get much done. I am sympathetic to the public who find it very irritating when a motion is filed and a great deal of time passes before any action is taken. In one case, the special master wrote a report on a motion that was made four-and-a-half years ago, and we still do not know what the court will do about it. It is especially difficult when individuals are paying lawyers to monitor these cases.

Limited state engineer resources play a role in McCarren Amendment issues. The McCarren Amendment is a federal statute which dictates whether or not the United States will be an active player in a case, based on the inclusiveness of the adjudication. We argue over that issue a lot.

One thing which matters a great deal in terms of settlement and negotiation is the peculiar evidentiary problems that are connected to water rights. For example, if the state's research shows that a priority date of 1850 was appropriate for a water right but a claimant believes, without any evidence that seems persuasive to us, that 1800 was the priority date, we do not have any discretion to split the difference at 1825 because there is no evidentiary basis for that middle date and because the difference hurts the claimant's neighbors. It limits the state's effectiveness in that there are some issues on which it is really not possible to compromise.

The same problem arises with respect to the negotiation of Indian water claims, an issue that people are very serious about these days and trying very hard to accomplish. We had one successful negotiation in New Mexico with the Jicarilla Apache tribe. That negotiation was successful because the Jicarilla settled for San Juan-Chama water. The water they get under the negotiation does not come from private water users on the two streams involved. It is a rare situation where we have a "chunk" of water with which to negotiate. Most of the time, whatever water the tribes and pueblos get, just like whatever water anyone else gets, is going to come out of the pool that is available to everybody. What that means for settlement purposes is that everybody has to sign off on the settlement because everybody is affected by it. That is very hard to accomplish when you are dealing with cases having hundreds, maybe thousands, of defendants and all their signatures are required on a compromise document. It is, in fact, impossible. We look for ways to settle the case which avoids that necessity without compromising anybody's rights.

You are aware of the cloud we have hanging over us because of the Texas vs New Mexico decree in the Pecos case that requires New Mexico to have a certain amount of water at the state line on a regular basis to meet our compact obligations. We have been engaged in an adjudication of the Pecos River since 1956. I do not know how much closer we are to achieving the ability to get water to the state line under the prior appropriation system. The prior appropriation system posed many problems to administering the water in such a way as to meet this compact. Shutting down the junior users, which are largely wells, does not effect the river much; it doesn't produce water at the state line within a reasonable time. Of course shutting down the senior—largely surface water—users, which would actually give us water at the state line, is contrary to the prior appropriation system. We are finessing the prior appropriation system through the ISC purchasing legislation. In a way we kind of shrugged and gave up when we started the program, which enables the Interstate Stream Commission (ISC) to purchase water rights and simply keep them in the stream. This may, by the way, have a de facto effect of having an instream flow on these parts of the river.

Concerning Indian water rights, when the Pecos adjudication arose, the water rights claims of the Mescalero Apache tribe were analyzed by the court under a federal reserved rights quantification doctrine called "Practicably Irrigable Acreage" or PIA. This doctrine means that the tribe will be awarded enough water to irrigate as much of their reservation as could be irrigated practicably. The heart of the problem is defining "practical." The courts have said they meant "economically" practical, but that is very hard to determine. It is difficult to tell whether that includes analyses on markets and crop shortages and just how much the funding source should be taken into account. In the Mescalero subfile, the state presented a case which would require the tribe to comport with certain federally produced economic standards for determining what irrigation projects are sufficiently economically feasible as to merit federal funding. The tribe pointed out correctly that the set of standards used is extremely difficult, maybe impossible, to meet. In today's economic climate, large irrigation projects simply don't do well. To tie an Indian water right's award to a requirement of economic feasibility of these projects, therefore, is disastrous to the Tribe. Yet, to relieve the Tribe of the stringency of the appropriate standards is to render the PIA measure subjective. The court went along with the state's argument. We are still struggling with what the Mescalero case's outcome will mean.

The New Mexico Court of Appeals upheld the district court's decision in that respect, although they changed the priority date. The New Mexico Supreme Court recently has refused to consider the appeals that were filed by practically everybody. We are now in the time period within which people can ask the United States Supreme Court to review these appeals. That case may provide more guidance on Indian water rights from the United States Supreme Court. Indian water rights claims usually present a situation where one of the claimants in the basin is claiming a good deal more water than they have ever used historically. Where a lot of water is going to come out of the basin that has not before been part of people's accommodations and arrangements, there will be disruption, bad feelings and bitter litigation.

One issue in the Taos case demonstrates the difficulty of the settlement of water questions. Sometimes people along two or three ditches will get together and say, "Let's forget our priority dates, let's share the shortages." Often these agreements have been in place for years when an adjudication suit comes along. Within the adjudication context, it is hard to know what the state should do. Our statutory mandate is to determine people's priority dates. We are in the position of saying to people, "We don't care that you're getting along. In fact, some of you have better rights than others and could take it all." That is undoubtedly divisive. We are working very hard to accommodate customs whenever possible and very much encourage people to negotiate with each other to recognize historic custom whenever possible. This is one of the clearer instances

where what we are trying to do under adjudication just does not conform to the kind of right that people think they have. We are trying to obtain a prior appropriation right when, in fact, people have not been using the prior appropriation system. In this case, and in Indian water rights cases generally, the prior appropriation system is not part of people's understanding when they use the water.

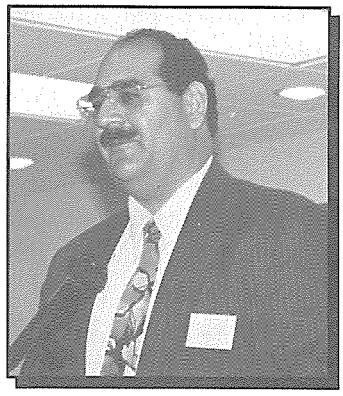
Another example is pueblo water rights, entirely different from Indian water rights. The "Pueblo Water Right" is a claim made by the City of Las Vegas, and proffered by the City of Santa Fe, that because these cities—pueblos—were part of grants from the king of Spain, they have an expanding and virtually unlimited right to use whatever water they need for municipal purposes. Such a right is alleged to be both prior and paramount to every other right in the basin. It is a type of water right that does not fit within the state law prior appropriation system.

CONCLUSION

SEO adjudications are a vast subject to talk about and even more so to conduct. The central endeavor is to tabulate, describe and try all water rights suits in the state, but it is not at all clear at this point after decades of experience, with new kinds of water rights being raised, that this task is even possible. It is certainly not possible for all the water right owners to see their rights recognized because the prior appropriation system does not accommodate some of the kinds of rights people are requesting, such as informal agreements among ditches to share shortages. Ownership of project rights is another instance where it is not clear how it fits into the state's understanding of individual property right ownership of water rights. The Indian claims and pueblo water rights are other examples. Finding a common denominator for all the disparate types of claims would enable us to administer rights under state water law. It is very hard to see how this can be done and it certainly can not be done without seeming enormously unfair to someone.

So is there an alternative? The state water plan is an enormous step forward in finding an alternative, and we hope to get support from the legislature this year. That essentially would be a global settlement that ignores all these legal problems and helps people agree on how to effect a realistic parceling of water rights. It will not depend greatly on legal rights in my view. It also would require a specific task force to focus on alternatives to adjudication.

Steven Hernandez worked as assistant city attorney for the City of Tucson where he was involved in drafting new groundwater legislation and represented the city in its negotiations for water from the Central Arizona Project. He served in the Solicitor's Office, Department of Interior, Washington, D.C. from 1980-1981. Steve was actively involved in the litigation of the City of El Paso's applications to appropriate water from New Mexico and was successful in having the applications dismissed on behalf of the Elephant Butte Irrigation District. He is post-chair of the State Bar Section of Natural Resources, Energy and Environmental Law Section and is a member of the Model Water Code Task Force.



ENVIRONMENTAL DISPUTE RESOLUTION IN STREAM ADJUDICATIONS: THE ARIZONA EXPERIENCE

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INTRODUCTION

Traditional alternative dispute resolution processes have been adapted to help resolve many environmental disputes and we now see the literature using the term Environmental Dispute Resolution (EDR). (Painter, 1988, The Future of Environmental Dispute Resolution, *Natural Resources Journal*, 28:146). A study by the Conservation Foundation of 161 completed environmental mediations indicated that of the 161 disputes, 86 involved specific land-use issues. Seventeen involved natural resource and public lands management, and water resources. Aside from using EDR to resolve many of the Indian tribe claims to water in Arizona's pending stream adjudications, there has been a similar technique developed by claimants and protestants in resolving objections to water rights filings in the San Pedro River adjudication.

THE ARIZONA STREAM ADJUDICATION PROCESS

The Problem

The problem is clear. Since there is not enough water to meet everyone's demands, a determination of priorities and a quantification of the water rights accompanying those priorities must be made. Obviously, such a task can be accomplished only in a single proceeding in which all substantial claimants are before the

court so that all claims may be examined, priorities determined, and allocations made. United States v. Superior Court, 144 Ariz. at 270, 697 P.2d at 663 (1985).

The Statute

In 1979 the Arizona Legislature finally enacted a general stream adjudication statute that would allow the adjudication of Indian water rights in state court (Arizona Revised Statutes Annotated §45-251 to -260 SUPP. 1984-85). After the statute's passage, the Salt River, Verde River, and Gila adjudications were transferred from adjudication under the State Land Department to the Maricopa County Superior Court. The San Pedro River adjudication was transferred to the Cochise County Superior Court. The Arizona Supreme Court consolidated these adjudications in one proceeding assigned to the Maricopa County Superior Court.

The Rationale

The complex and lengthy process of the stream adjudication was rationalized by the Special Master, John Thorson (J. Thorson, Rules for Proceedings Before the Special Master, page iii, 1991) as follows:

- Adjudications are an effort to recognize, quantify, and prioritize water rights that, in some cases, extend back into the 1800s.
- These adjudications will result in a centralized record of the water rights that are recognized.
- Many of the earliest water rights on Arizona's rivers and streams are claimed by Indian tribes and federal agencies. While these federal and tribal water rights may be senior to other water rights established under the prior appropriation doctrine, the nature and extent of these federal and Indian claims have never been comprehensively adjudicated in Arizona state courts. These legal proceedings are the opportunity to recognize, quantify, and prioritize these federal and Indian water rights.
- The general stream adjudication will lead to better management of Arizona's water.

Steps in the Proceedings

1. Between 1979 and 1986 approximately 960,000 summons were served on potential claimants.
2. Hydrographic Survey Reports (HSR) were prepared in both stream systems. Following the reports various parties filed objections to each watershed file report (WFR) found in the HSR to make "contested cases."
3. The parties to these contested cases typically are the landowner, lessees and the objectors.
4. A targeted case management approach was approved in the San Pedro Adjudication. Under this approach, the Special Master selected individual watershed file reports to resolve major objections.
5. In April 1993, the Special Master selected 54 contested cases concerning the water rights of eight water users who own land or lease land from the Arizona State Land Department, U.S. Forest Service or U.S. Bureau of Land Management.
6. The cases involve stockwatering, stockponds, small reservoirs, domestic, and irrigation related to domestic uses. A map of the San Pedro watershed and subwatersheds appears in Figure 1.
7. I was able to organize seven of the eight landowners into a single group. All conflicts over water between the landowners were resolved. This became a very effective settlement tool since the group could speak with one voice.

TARGETED CASE MANAGEMENT APPROACH

The decisions reached by the Special Master in the targeted cases will be binding on the litigants involved and will also be precedential in subsequent contested cases. If a litigant in a later case disagrees with the application of the same ruling, the litigant must demonstrate to the Special Master that the circumstances in the later case differ, that new or additional evidence requires a different result, or that there are other reasons why the earlier ruling should not apply.

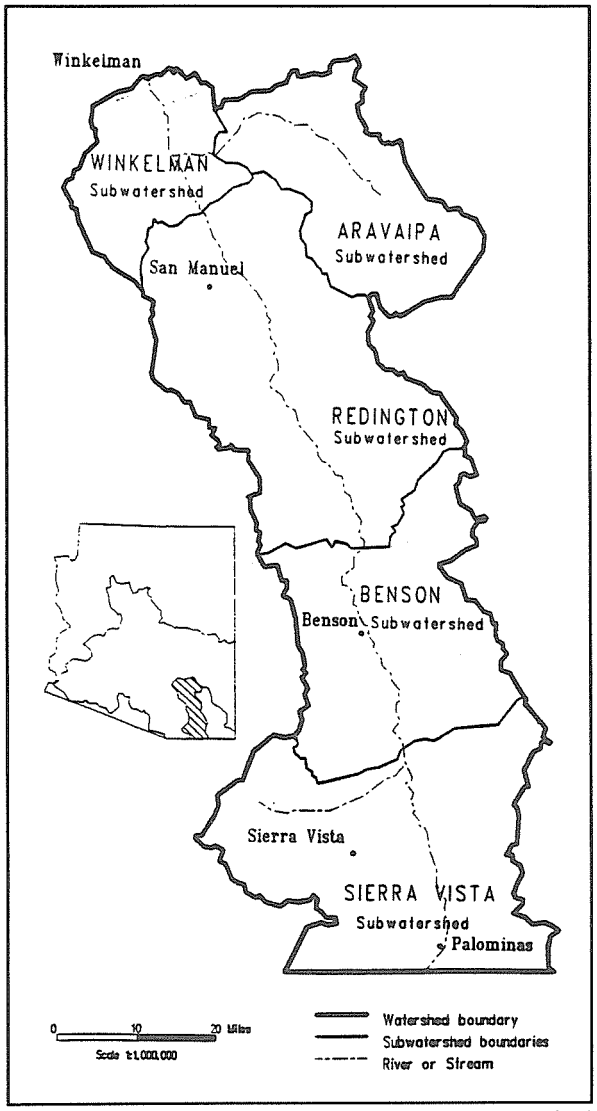


Figure 1. Map showing the San Pedro River watershed and subwatersheds.

SETTLEMENT CONFERENCES TO RESOLVE OBJECTIONS

Traditional Discovery Devices Inadequate

Rather than attempt typical discovery techniques which had already been streamlined by the Rules for Proceedings Before the Special Master, the parties decided to attempt a series of settlement conferences to see if major objections could be resolved. Aside from the landowners, the parties to the conferences included the major objectors:

- Salt River Project
- City of Phoenix
- United States on behalf of the Bureau of Land Management and Forest Service
- Gila River Indian Community
- San Carlos Apache Tribe, Tonto Apache Tribe, Yavapai-Apache Indian Community and the Camp Verde Reservation

The parties initially tried to discover why the Indian tribes had objected to nearly every single water right filed. Apparently the tribes had merely computerized all of the filings and had objected every time there was an inconsistency with respect to priority date, capacity-quantity, diversion point, place of use, ownership, and source.

The parties then proceeded to prepare a template for each reported "potential water right" (PWR) listing all of the attributes of each PWR:

- landowner/lessee
- priority date
- name of spring, etc.
- capacity-quantity
- location
- water source

At the settlement conferences, each PWR was reviewed to resolve as many objections as possible. The fact that the landowner was there was significant in terms of his ability to explain each different stockpond or stockwater use. In many cases every priority date was accepted after an explanation by the landowner or lessee of the circumstances involving the historical use of the water right.

WHY WAS THE PROCESS SUCCESSFUL?

- All parties were present with the authority to withdraw objections.
- The candidness of the landowners or lessees was quite evident.
- Many objections were based on factors which were explained away depending on each individual water use.
- Litigation costs of proving many elements of each water right in a subsequent trial was clearly too expensive and time consuming.

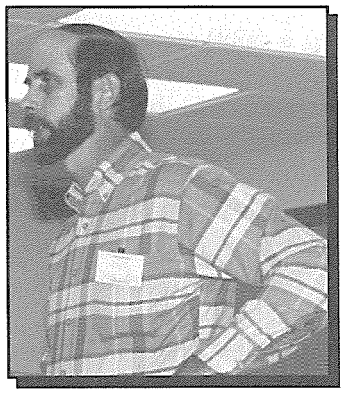
THE FRUITS OF COMPROMISE

I estimate that we will be able to resolve as many as 80 percent of the objections. We also have been able to agree on the majority of attributes surrounding domestic, stockwatering and stockpond use which will be adopted by the Special Master. We have been unable to resolve the ownership issue with the United States on federal land waters put to beneficial use by lessees. This issue will be litigated. We have made significant inroads to resolving ownership and compensation issues with the Arizona State Land Department on waters arising on or used on state land involving lessees.

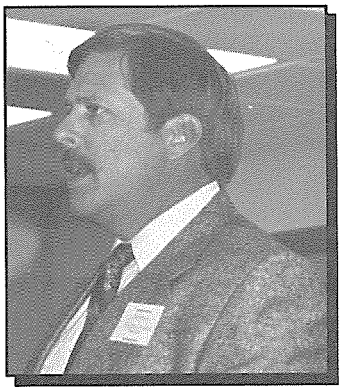
CONCLUSION

The advantage of using a process similar to EDR in a stream adjudication setting has been of immense value. When a case management approach is used, the time and money saved on subsequent hearings is tremendous and well worth the effort to try and establish an early dialogue.

***Howard Hutchinson** is a writer and chairman of the Catron County Water Advisory Board. He serves as Media Liaison for the Arizona/New Mexico Coalition of Counties and is a member of the Catron County Land Planning Committee. Howard was co-owner, publisher, and editor of the Catron County Firestarter for 11 years.*



***Jim Paxon** is the district ranger of the Black Range Ranger District, Gila National Forest, in Truth of Consequences, NM. He has served with the USDA Forest Service for 24 years, and has been a district ranger in Colorado or New Mexico during the past 12 years.*



THE CATRON COUNTY EXPERIENCE: REACHING A MEMORANDUM OF UNDERSTANDING

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THE CATRON COUNTY PERSPECTIVE
Howard Hutchinson

Resolving a conflict can be a trying experience. Those embarking on such an undertaking must realize there will be frustrations. Catron County and the Forest Service have had and continue to have knock-down drag-out conflicts. These conflicts are not short-term problems and all parties entering such battles should from the onset prepare for spirited debate.

Our presentations will address the conflict, factors that prevented resolution, how we got to the negotiation table, and what we did when we got there.

The Conflict

Catron County has initiated a focus on federal actions adversely affecting local governments and their citizens. Catron County's actions now are being copied by counties throughout the United States as this conflict and its resolution have national implications.

Factors Preventing Resolution

The primary factors preventing resolution are fear of the unknown and playing out the "tragedy of the commons," where no one interest is satisfied. The US Forest Service has many special interests to satisfy in their decision-making process, and these conflicting interests create a situation where satisfying one interest conflicts with another.

Without communication, fear and distrust develop. The county and the Forest Service feared and distrusted each other. The county had not been communicating their concerns to the Forest Service. The Forest Service had not been effectively communicating proposed actions to the county.

How We Got to the Table

Both the Forest Service and the county were forced to the table by escalating animosity. The county felt that decisions were being made without proper consideration of the effects on the physical, social and economic environments. Catron County enacted a land plan and policy and several ordinances that Forest Service personnel perceived as threatening. Forest Service staff felt the county was trying to dictate forest planning outside its jurisdiction. It was mutually agreed that a Memorandum of Understanding (MOU) could serve as a vehicle to increase communication and establish a planning process.

What We Did When We Got There

The National Environmental Policy Act (NEPA) implementing regulations have provisions for local governments to participate in preparing federal agency Environmental Analysis and Environmental Impact statements. Catron County has enacted an environmental planning ordinance that utilizes the NEPA process. This ordinance increases the level of participation for local governments.

The first step in preparing an MOU was to draft a statement of purpose. That statement, which follows, has remained intact throughout the process.

> "The purpose of the Memorandum of Understanding (MOU) is to establish a mutually harmonious and productive relationship between the County and the Forest. This MOU will address how and when each agency will jointly participate in Forest and County planning processes. This MOU shall not be construed to affect the jurisdiction of Federal, State, County, or City Governments, or any agency thereof, over any lands owned or managed by any of these agencies."

We feel confident that the MOU will help relieve many of the tensions between the county and the Forest Service. There will continue to be conflicts but with the increased level of communication they will be easier to resolve.

One added point to the NEPA process—the goal of the process is not to get a better document but to get better decisions. Adding local government participation to the process provides all federal agencies better information for better decisions.

THE GILA NATIONAL FOREST PERSPECTIVE

James E. Paxon, Jr.

Howard Hutchinson presented the Catron County perspective on how the Memorandum of Understanding between Catron County and the National Forest developed. I represent the Gila National Forest Supervisor, Maynard Rost, and hope to give you some insights into the Forest Service view of these developments.

My grandaddy was an irrigated and dryland farmer in west Texas. Water was the key to life and he was very much into conserving that which made his living. He also was a homespun philosopher who used homilies to make his points and give "shadows" like me and my cousin things to remember. I can't use the graphic language he used before this polite audience, but I would like to relate his thoughts on "skunks." Poppa would tell me quite often that "you never wanted to get in a `close quarter discussion' with a skunk! The reason is not so much that you might get bit, but rather that everyone in the room would assume the same aroma." There are lots of times when the Forest Service has been the "skunk" to our detractors and to those who find fault with our management. At times those with whom we have had acrimonious relations have been the "skunk." But does it really matter who started the fight and who is at fault if we all end up smelling the same? Now, what does this have to do with the Gila National Forest and Catron County and is there a skunk in this scenario?

The relationship between the Gila National Forest and Catron County, New Mexico is in an embryonic stage concerning environmental planning and cooperation. We are developing a formal Memorandum of Understanding wherein each entity will detail and agree upon how we will interact in the planning and documentation of projects under the National Environmental Policy Act and the New Mexico Joint Powers Agreement Act. We believe what we do in this regard will be copied many times over as Catron County is a member of the Coalition of Counties and the National Association of County Governments. We now have a very good working relationship and are moving forward as partners, but it was not always so.

Conflict can be disruptive, emotional, divisional and cause deep-seated and long-lasting animosity. It also can bring about a recognition of change, foster initiatives to deal with the changing conditions, and help spur a new direction for two governmental entities with overlapping responsibilities. The Gila National Forest and Catron County have chosen to become partners in the future management of National Forest lands within Catron County.

Dr. Kai Lee, the author of *Compass and Gyroscope* is a professor at the University of Maine and for five years was environmental consultant to the Northwest Power Plan Council. His views are very applicable to our situation. He refers to the pure application of science as "the compass" and the operation of our social democracy over time as the "gyroscope." Dr. Lee is familiar with social turmoil and views "...conflict is then necessary to detect error and force corrections in the course of the management of ecosystems and social systems." He also defined "unbounded conflict" as pure anarchy and counterproductive to any ecosystem or social system whereas "bounded conflict" was action causing change and reaction to that change working within a set of rules. We are in an era of "Adaptive Management" wherein we experiment continuously with a new course, learn what it does, change course a little, evaluate and change a little more. It seems that both navigational aids are required in our current quest of environmental and societal stability and the sustainability of National Forest lands.

Let's review the history of environmental legislation:

- 1891-Forestry Reserve Act signed by President Benjamin Harrison allowed for reserving lands from the public domain for the perpetuation of forests (timber, grass and water).
- 1897-Organic Administration Act gave actual management practices to the Forest Reserves and allowed for the regulation of use.

- 1905-The Transfer Act whereby Teddy Roosevelt moved the Forest Reserves from the Department of Interior to the Department of Agriculture and formed the Forest Service. Gifford Pinchot was appointed the first chief and was the founder of the Forest Service Movement. He wrote the transfer letter..."You will see to it that the water, wood and forage of the reserves are conserved and wisely used..." "Local questions are to be decided on local grounds." "Conflicting questions must be resolved deciding for the greatest good for the greatest number in the long run!" Then from the *Use Book of 1907*—"Where interests conflict, first one and then the other must yield a little to make things work. In the end, all will profit from it...."
- 1969-National Environmental Policy Act (NEPA) mandated the Forest Service to examine the impacts and effects of proposed actions. Coordination and cooperation with state and local governments also was mandated. Where jurisdictions overlap and to avoid duplicating effort and reduce paperwork, joint studies can be initiated. Decisions remain unique and autonomous according to jurisdiction.
- 1973-Endangered Species Act provides for the protection, management and preservation of wildlife species, threatened with extinction.
- 1974-Forest and Rangeland Renewable Resources Planning Act (RPA) provides for the resources of the National Forests and other lands to be managed for the perpetuation of the resources with use and management.
- 1976-National Forest Management Act (NFMA) from which Forest Land and Resource Management Plans have been written for each National Forest. To date, 156 plans have been produced.

As Howard Hutchinson told you earlier, Catron County passed an Environmental Planning and Land Use Ordinance in 1992. The ordinance dealt with the maintenance and preservation of the "...customs, culture and economic viability of the citizenry of Catron County." Catron County and many other small western counties have seen the management of the lands they call home passed from their control, or even involvement or influence, to urban and environmental groups through process legislation. Feeling threatened, Catron County reacted by passing an ordinance that gives them the same standing as urban, environmental, and other groups. Applying Dr. Lee's terminology, our compass is spinning and the gyroscope has gone into orbit.

Catron County's ordinance also gave the county the ability to enforce their policies. Anyone who violated the terms of the ordinance could be subject to arrest and prosecution. In the most extreme situation, if a District Ranger or Forest Supervisor makes a decision viewed as counter to Catron County's ordinance, would he or she be subject to arrest? It is often necessary to make managerial decisions for the best use of the resource based on fact and analysis even though the impact of that decision may not directly benefit the users of the National Forest. An example is a rancher who resides in Catron County with a grazing allotment on the Gila National Forest. If that allotment were to be reduced due to an analysis that showed the resource was over-committed for the number of cattle, a decision could be made to reduce the permitted cattle by 50 percent. Consequently, the rancher would lose potential income from the sale of as much as one-half of the number of calves he was able to sell in the past. The county would also lose a part of their tax base due to fewer mature cows out on the range. Those changes could be considered significant impacts on the "...custom, culture and economic stability..." of Catron County. Under a cloud of the threat of arrest for doing the job required, and because some individuals in the county wanted to have a hand in making management decisions concerning the National Forest, relations were very strained between the county and the Gila National Forest at the end of 1992.

The County Commissioners and the Forest Supervisor recognized the need to get back on track and attempt to work with each other. In

April 1993, a committee of several folks from Catron County and several from the Gila National Forest, including three District Rangers, took off their skunk suits, sat down at a common table and began searching for those areas where both sides could agree. Our charge was to produce a Memorandum of Understanding (MOU) that would define how the county and the Forest Service would interact, cooperate, and coordinate efforts on environmental planning. The areas of common ground include:

- Land is important to us all for our history, our economic welfare, and our future.
  Nearly 2.3 million acres of Catron County are Gila or Cibola national forest, approximately 53 percent of the total land base. Catron County contains six Ranger Districts on the Gila and one on the Cibola. Mining, ranching, logging, outfitting/guiding, are some of the major economic activities conducted by locals on the National Forest.
- We all want to be here tomorrow; Dr. Kai Lee's "quest of sustainability."
- No one agency nor individual enjoys working under a threat to their security.
- NEPA mandates local involvement and cooperation.
- The Forest Service has decision-making authority over management of the national forest lands that cannot be abrogated.
- Catron County has the responsibility of governing use of private lands and helping the Forest Service with input and cooperation in the management of national forest lands within the county. The county governs under state laws and the "powers not reserved" in the US Constitution. It is responsible for protecting the customs, culture and economic viability of its citizens. The county also is responsible for informing the Forest Service how a proposal would affect their customs, culture and economic viability.
- Each entity recognizes the other's authority.
- Neither entity will try to interfere or usurp the powers and authority of the other.
- Basic communication is required to accomplish anything effectively.

Where are we now? We have met once or twice each month since April and now have a Draft Memorandum of Understanding that we believe is ready to be reviewed by the County Commissioners and by the Gila Supervisor and the Forest Service legal advisors. If all agree that we are acting properly and legally, the County Commissioners and the Forest Supervisor will sign the agreement and we will begin implementation. We realize that management practices of other agencies, laws passed by Congress, judicial appeals, and litigations by outside parties may alter our management practices. The key to our success is that we are talking and working toward solutions. The MOU will give us and our successors a formal process to keep that communication open.

EPILOGUE

When Catron County and the Gila National Forest representatives made their presentations in October, both negotiating teams felt they were on the verge of realizing a completed Memorandum of Understanding. On October 28th, the negotiations came to an impasse. Catron County withdrew from the negotiations with a request to the Forest Service Region 3 Office that a facilitator be recruited to assist in the discussions.

In late November, Shipley Associates was contacted to be the facilitator. Shipley submitted a proposal to the Coalition of Arizona/New Mexico Counties (Coalition) and Region 3 to conduct a National Environmental Policy Act (NEPA) training session and to facilitate the MOU negotiation.

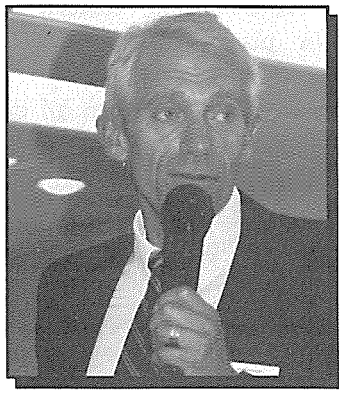
From January 24-26th, 40 county and Region 3 Forest Service representatives attended a three-day training session in Albuquerque. Region 3 encompasses both Arizona and New Mexico forests and the Coalition has member counties from both states. On the January 27th and 28th, Catron County and the Gila National Forest resumed negotiations with Shipley Associates as facilitator.

After the week-long session, participants realized that there were three levels of participation being discussed by the two teams.

- The NEPA implementing regulations create several types of participation.
- Integrated Resource Management (IRM) is a 13-step process used to arrive at a decision. All 13 steps are part of the NEPA process but only 5 were used in the National Forest Management Act of 1976.
- Ecosystem Planning is Forest Service policy established under the NFMA and is unique to the Forest Service.

The MOU describes these levels of participation and the responsibilities of each party to coordinate their planning processes.

Acting Forest Supervisor Carl Pense and the Catron County Commission signed the MOU on February 15th. Both negotiating teams feel they now are speaking the same language and have laid the foundation for increased communication. The lesson learned through this exercise is that when negotiations stall, it is helpful to seek an outside party with facilitation skills and knowledge of the subject in conflict. WRRI's conference on conflict resolution contributed to successful negotiations between Catron County and Gila National Forest Service.



Joe Borgerding has been the water production director for the Sierra Pacific Power Company since 1989. He is responsible for supply, treatment, and distribution of water for the Reno/Sparks area, which has a population of 200,000. Joe has held previous positions in California involving water supply and waste management. He is a registered professional engineer in both California and Nevada and holds B.S. and M.S. degrees in civil engineering. A member of the American Academy of Environmental Engineers, Society of Civil Engineers, and American Water Works Association, he has published technical papers in a variety of society and association journals.

THE TRUCKEE-CARSON/PYRAMID LAKE WATER RIGHTS SETTLEMENT

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The Truckee-Carson/Pyramid Lake water rights settlement is not a done deal. The settlement involves changing existing laws to meet modern needs. The Truckee and Carson rivers have been fought over in the courts for the last 80 years and operated on the basis of former court adjudications. This settlement attempts to change the way the rivers are operated through new legislation.

The Truckee and the Carson rivers originate on the Sierra Nevada along the California/Nevada border. A substantial portion of water supply comes from these two rivers; the Truckee River alone averages about 550,000 acre-feet annually. River uses started during the Gold Rush in the 1840s and 1850s when the Truckee and the Carson rivers were the two original westward routes. Immigrants discovered that the Truckee Meadows was a nice place to settle and agricultural irrigation began around 1860. That is when the conflict really began.

At first, water was plentiful. Over time many water uses developed in the Truckee Meadows and Fallon area, the site of the Bureau of Reclamation's first reclamation project, the 1908 Newlands Reclamation Project. Unfortunately, at the time, the Bureau did not have the agronomists and hydrologists to estimate accurately what was necessary to make the project successful. The result was a growing number of users on the Truckee and Carson rivers with only a limited water supply, and an inconsistent supply at that.

I would like to talk about the culmination of 80 years of legislation and how we have tried to change the laws so that the river can be better managed. It is not a success story in which every party achieved what they wanted, and although most parties got what they wanted, there still are some people who are not too happy.

A major player in the Truckee-Carson/Pyramid Lake Settlement Act is the Sierra Pacific Power Company, an investor-owned utility pro-

viding municipal water and natural gas to Reno and Sparks and electricity to most of northern and central Nevada and eastern California. Another major player is the Washoe County Water Conservation District, the public agency that originally supplied water to all the agricultural irrigators, which 80 years ago included most of the users in the area. Today, like many places in New Mexico, as the area is becoming more urban, water use is changing from agricultural use to urban use.

A third major player is the Truckee-Carson Irrigation District, the public agency responsible for the Newlands Project. The fourth player is the Pyramid Lake Paiute Tribe. The Newlands Project built the Derby Dam which resulted in the Pyramid Lake Pauite Tribe loosing most of its water supply to Pyramid Lake. It also signaled the loss of habitat in Pyramid Lake. The settlement process began in the early 1980s in an attempt to resolve some of these conflicts on the Truckee and Carson rivers.

The local power company, most of the municipal users, and the agricultural users in the Truckee Meadows anticipated that the water from Stampede Reservoir built around 1960 would be available for years to come. But the Endangered Species Act passed in 1973 changed that. By judicial decree, the area's users could no long rely on the Stampede Reservoir for their water needs. The water was to be reserved exclusively for endangered species preservation. The species in question was the cui-ui, a huge carp-type fish that grows up to 20 pounds and historically has existed in this river. The change of the Stampede Reservoir from municipal and industrial uses to the strict preservation of endangered species forced water users to consider future water supply alternatives. That was the impetus for the Truckee-Carson/Pyramid Lake water rights settlement.

The settlement uses a concept called credit storage to make more efficient use of existing reservoirs for drought and fishery enhancement. The Pyramid Lake Paiute Tribe now has exclusive use of Stampede Reservoir, although they have no water to put into it. The power company and the agricultural irrigators in the area did not have the right to use Stampede Reservoir but they possessed all the water rights. However, this could be a "win-win" situation if you get beyond the politics and the legal decrees of the last 80 years. The settlement involves an agreement between the Pyramid Lake Paiute Tribe and the Sierra Pacific Power Company for the use of the Tribe's reservoir in exchange for some of the power company's water rights. The settlement process began in the early to mid-1980s and required extensive dialogue between the chief executive officer of the Sierra Pacific Power Company and the Pyramid Lake Paiute Tribal leader. It took a couple years for the two to actually get to know each other, trust each other, and start to talk about how to meet each other's needs.

After a series of exchanges, it was agreed that during wet years, the power company would store surplus water rights, while in dry years those rights would be used for municipal and industrial supply. The Truckee and Carson rivers experience drought approximately once or twice every ten years. Most of the time, there is ample water. It is during those low-supply years when things become critical. We are just coming out of a six-year period of very severe drought. If our agreement had been in place before the drought, we would not have had the problems that we did.

The agreement insures that water can be stored for drought reserves, which also helps us deal with one of the biggest issues in our area, water meters. Until four years ago, it was illegal to put a water meter in place in Reno or Sparks. If you wanted to get into a good fight at a Sunday afternoon barbecue ten years ago, you would start talking about water meters. Many were adamantly opposed to water meters but that has changed. Through an educational process, people finally realized that without water meters the small users, that is, most people, essentially are subsidizing the large users. That information had to be communicated. Finally in 1988, as part of the settlement, legislation was passed that removed the meter prohibition.

According to the settlement, if a water conservation plan for municipal and industrial use is implemented, conserved water can be

saved and stored in Stampede Reservoir. This was an additional catalyst for arriving at a settlement.

The settlement also allows us to re-time the method by which the water is released from the upstream reservoirs like Lake Tahoe and Stampede Reservoir. Reservoir releases are dictated by legislation. A curious aspect about the Truckee-Carson system, especially the Truckee River, is the legal mandate dating back to 1915 that requires a specific flow rate be maintained in the river until the reservoirs are dry. For example, 1992 was the worst drought year on record and water had to be released from those reservoirs to maintain a flow of 500 cubic feet per second in the river. This flow continued until early June when all the water was used and no water remained for the coming summer. The settlement allows us to correct this problem.

The legislation also brought California and Nevada together for negotiations. California will eventually sign off on this agreement, although there has never been an interstate compact allocating water use between California and Nevada. Agreements have always been gentlemen agreements, governor-to-governor agreements.

I want to stress the factors that made the settlement possible. Let me go back a bit in history concerning some archaic laws that had to be changed in order for this settlement to go forward. It all began with the first Bureau of Reclamation project, the Newlands Reclamation Project. After the project commenced, the government started encouraging landholders to establish irrigated agriculture in the Fallon area. The government soon realized there simply was not enough water to supply all the acreage they had set aside. The Bureau of Reclamation started looking for sources of additional water. They found it at Lake Tahoe around 1908 and that began this whole process.

The government erected a sign above Tahoe Dam stating that the government was going to appropriate the dam's water. The dam was condemned through a friendly condemnation and as mentioned earlier, in 1915 a decree stipulated that a particular flow rate must be maintained in the river until the reservoirs are dry. However, that still did not provide enough water. By the early 1920s there was such a mish-mash of water rights that the federal government filed the Orr Ditch suit against all irrigators in the Truckee and Carson rivers in an attempt to codify water rights. The suit was litigated for nearly 20 years and finally settled in 1944. People now know what water rights they have.

During the time that the Orr Ditch suit was being litigated, diversions from the Truckee River continually dried up Pyramid Lake. Pyramid Lake Fishery was actually lost in the 1940s and the cutthroat and cui-ui fish vanished from Pyramid Lake. While irrigation in the Fallon area was drying up Pyramid Lake, a large wetlands in the Stillwater marsh was being developed, which increased duck habitat. Conflict escalated as fish were being lost and wildlife were being promoted. By the 1970s, essentially we were in a gridlock situation. We knew water uses were expanding but we had no where to go to obtain additional water.

The settlement attempted to involve all players, including all individual irrigators. You can imagine the negotiation difficulties when you have a room full of about 100 people. People were very rigid, wanting things to stay the way they were, and refusing to look ahead to future needs.

Four points should be stressed in terms of managing this particular water conflict. The Sierra Pacific Power Company wanted to recognize change before the change started to manage us. We knew we were going to get managed if we did not do something preemptive. We wanted to devise and implement a strategy for dealing with change.

First, we began with outdated, sacred-cow legal agreements. People were not willing to talk about change. You will recall that the 1915 legal agreements required a certain river flow rate. It was evident that we could make changes since we did not need to run the Truckee River for hydropower anymore. Fifty years ago the river provided a lot of power but now meets less than one percent of our power needs. The 1915 agreements discouraged conservation. There existed no conservation ethic. People could use

as much water as they wanted without regard to the reservoirs running dry. There was no recognition of endangered species. Today, endangered species cannot be ignored.

And times are changing. When the Truckee-Carson rivers projects originated, there was no consideration of the environment. Environmental considerations are at the forefront today; America is turning green and Nevada is turning green. It became evident early on that building another dam was not going to solve our problems. The Bureau of Reclamation had studies available if the people of the Truckee Meadows wanted to build another dam, but there was no public support. We were looking for nonstructural solutions, not simply pouring concrete, but trying to influence legislation.

Secondly, we analyzed the problem. We tried to develop opportunities and keep risks minimal. One big risk was trying to propose a solution on our own which would satisfy all concerns. We wanted to develop a win-win situation between ourselves, the Sierra Pacific Power Company, and the Pyramid Lake Paiute Tribe. That was the key to the agreement. If those two parties could actually agree, along with the United States government, then most of the problems were solved, though not all. Although we could not get all the players together to agree on everything the first time around, we got the major players to start moving toward a decision.

A third key factor was to be innovative and access the available tools. One tool we used over and over was the computer model of the Truckee River. The Bureau of Reclamation developed the model years ago, which we refined and used during many negotiating meetings when people asked, "Well, what if we did this?" and "What if you change the flow out of that reservoir?" We would have the answers quickly. Instead of concerns, people would have answers.

We tried to develop solutions which integrated environmental, economic, technical, legal, and political aspects. For example, we did not want a political solution that would not work because there was no technical merit to it. Also, we tried to break the problem into manageable pieces. One manageable piece was attempting to limit the number of initial negotiators. We knew that if the Sierra Pacific Power Company and the Pyramid Lake Paiute Tribe could sit and talk, others would follow. We did not want to use a shotgun approach in which a hundred people try to negotiate and nobody can make a decision. Again, we wanted to limit the risks and take advantage of the opportunities. We were careful to review our strategy often and revise it when necessary.

One of the actions we took was to empower people. We did not try to negotiate by committee. A major advantage of being an investor-owned utility is that everything does not have to be approved by a governing board. Once the company's chief executive officer made a decision, the legal staff would proceed, and they had a lot of freedom to act. We also were facilitated by State Senator Reed who had a particular interest in this issue. He and his administrative assistant used a carrot/stick approach. For example, when the federal legislation finally got underway, funds for economic development were made available to the Pyramid Lake Paiute Tribe.

Communication became the fourth key factor. We did a lot of work in Washington as well as on the local front. Working locally was really important. I mentioned the fact that people hated water meters - that was just one part of the problem. We put out a lot of publicity up front. In fact, although in our company, water contributes to only about 10 percent of our communication budget, we spend about 90 percent of that budget communicating water issues. You must inform the community and get their support. Without community support, we would not have been able to get support from Washington. We have helped develop grassroots local organizations that strengthen the settlement. Environmentalists are supportive because the settlement is actually an environmental solution and a water supply solution. We also never forgot to say thank you to people.

I would like to expand a bit on the importance of local support. We conducted several surveys to ascertain public opinion throughout the negotiation process. We tried to educate the public on what the settlement would mean to

them. For example, the settlement will provide up to 39,000 acre-feet of water per year for use during a drought. Eventually 88 percent of the people were in favor of the settlement.

The settlement actually requires adoption of a plan to save 10 percent of the water during a drought. This is a change from the ethic that existed in the 1970s. During the 1970s, Reno/Sparks residents insisted on using an incredible amount of water. Now people really understand the need for conservation. This settlement also provides water to help preserve the Stillwater Wildlife Refuge, a real environmental benefit.

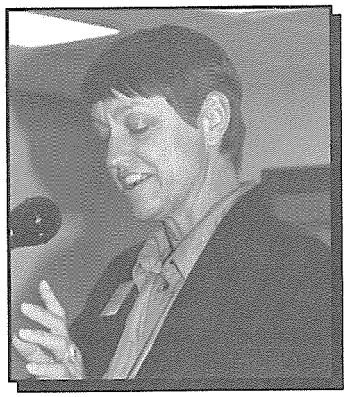
What is the status of this agreement? I mentioned that it's not over by any means. This preliminary agreement between the Pyramid Lake Paiute Tribe and the Sierra Pacific Power Company was started in the early to mid-1980s. The initial agreement in which we agreed that Sierra Company would give the Tribe water in exchange for use of the Tribe's reservoir was signed in 1988. A long uphill battle ensued between 1988 and 1990. We had to obtain federal backing because the upstream reservoirs are federal reservoirs. Also, the U.S. Fish and Wildlife Service is trying to comply with the Endangered Species Act in the area. There also was an economic incentive for the Pyramid Lake Paiute Tribe to settle and that required federal legislation.

Extensive lobbying in Washington was required between 1988 and 1990. We wish, of course, that we had 100 percent support of all parties involved, but the irrigators in the Newlands Project felt they would be shorted water, and they were right. They would be shorted but not by very much, a few thousand acre-feet out of almost 300,000. Consequently we faced a lot of opposition in Washington from the irrigators, but we did have public support on a local level. Overwhelming public support resulted in the legislation finally getting passed in the fall of 1990. While federal legislation was being completed, we worked on getting state legislation passed to eliminate the water meter prohibition.

Let me describe where we are currently. Public Law 101-618 is fairly lengthy legislation prescribing a wide range of laws. One key requirement is the development of an operating agreement. Reservoirs must be operated upstream differently than in the past. Reservoirs will not be operated at 500 cubic feet per second until the river is empty. Conservation programs are being developed for drought events.

At this stage, the agreement is drafted, and we have verbal approval from most parties. We want signatures on this agreement from the states of California and Nevada, Sierra Pacific Power Company, the Pyramid Lake Paiute Tribe and the federal government. We would like to have others sign the agreement, for example, the Truckee-Carson Irrigation District and other cities as well.

So the agreement is largely done. The Bureau of Reclamation is preparing the environmental impact review which will take approximately two years. Simultaneously we are going to develop a financing plan for water meters, although it has not been determined who will pay for the program. Hopefully by late 1995 or early 1996 the environmental impact statements will be done, the water meter financing plan will be complete and all standing lawsuits will be dismissed. We have about two more years to go. The bulk of the work is done and the most difficult work is done. A possible setback could emerge if we discover an environmental problem we had not anticipated. Actually, by re-regulating the river we are finding some environmental benefits rather than detriments. But we knew this would be a long-term project and it is not over yet.



Lisa Robert is a free-lance writer with a special interest in water resources issues in the Rio Grande valley. She served as editor of the Watermark, a newsletter for ratepayers of the Middle Rio Grande Conservancy District from 1987-1992, and is currently president of the Assessment Payers' Association, an MRGCD constituency organization. She is the author of Profiles of Water Management in Middle Rio Grande and Estancia/Sandia Basin Communities, a case study of regional water planning in Sandoval, Bernalillo, Valencia, Torrance and lower Santa Fe counties.

Aaron Rael holds a master's degree in Human Resource Development, and has been working with the Regional Water Planning Dialogue for over a year. Prior experience includes work as a project coordinator for the Water Information Network, and as a park ranger at the Wild Rivers Recreation Area in Taos. Aaron served as conference coordinator for the New Mexico Citizens' Water Quality Conference in Albuquerque several years ago which was a grassroots conference on water quality problems affecting low-income and minority communities.

Richard Pacheco recently completed a degree in Environmental Management. He worked with the Española-Pojoaque Valley Regional Water Planning Committee and will do a guest-editorship for La Corriente, the newsletter of the Rio Grande/Rio Bravo Sustainable Development Initiative. Richard was a real estate broker in Española for a number of years.

ADDRESSING CONFLICT THROUGH THE DIALOGUE PROCESS OR DON'T KILL THE MESSENGER

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THE REGIONAL WATER PLANNING DIALOGUE

The Regional Water Planning Dialogue is a Ford Foundation funded project to support community self-determination through regional water planning in New Mexico. Organized by Western Network and the Natural Resources Center at UNM, the Dialogue brings local and regional water planners together to reflect on what they have accomplished, how the process could be enhanced or facilitated, and what they have learned that might help other regions in developing their own plans. To date, case studies of water planning efforts in the Pecos Basin, Taos County, the Pojoaque/Española Valley, the Middle Rio Grande, and Socorro/Sierra counties have been carried out by the Dialogue staff, and roundtables have been held to bring water managers and other regional constituents together to talk about grassroots planning.

THE FIVE "C's" OF COMMUNICATION

Lisa Robert

I'm the Pollyana of the Dialogue group—instead of seeing the glass half empty, I tend to see it half full. When I think about the Dialogue process, I keep coming back to this: ideally it begins not with "conflict," but with common ground—not with what separates us, but with what brings us together.

The other night, my sister phoned, long distance, to ask if I knew what the five "C's" were. "I don't mean oceans," she said. A friend had asked her the same question. It was his eighth-grade son's homework assignment: name the five "C's." Neither of us had a clue. Then her friend called again. He had jokingly posed the question to his seven-year-old daughter. "Oh that's easy," she told him, "It's the code of the classroom: caring, courtesy, consideration, common sense and cooperation."

The Dialogue work requires that same list. We come to this real life classroom from diverse backgrounds, combinations of self-confidence and anxiety, each with our personal load of emotional ties and bete noires, and that infamous teacher known as experience suddenly expects us to communicate with each other! We need those five "C's."

This year, I interviewed perhaps sixty people about their role in the water planning process. They were busy folks: community administrators, county commissioners, public works department heads, agency representatives, and local water system managers, and most of them had never heard of the Regional Water Planning Dialogue. Over and over I found myself explaining who I was and why I wanted to take up their time.

I couldn't have done it without the first "C." Dialogues begin because we **care** about something. I discovered that a "messenger" asking questions from behind a shield of distant neutrality earns only answers that are distant and neutral. Neither of us invests anything. It is **caring** which breaks the ice. Not to say I need give up my objectivity and align myself with any "side," but I can express what interests me, what fuels my desire to communicate.

In doing that, I open a door, inviting the other person to do the same. Now we must engage in the second "C" which is **courtesy**. The job is to hear what's being said. This is no one-sided business, but an exchange in which to prove trustworthy. I have to signal when I don't understand, respect confidence, and recognize as a gift whatever is offered. Courtesy can be the most difficult of those "C" words, but it promises the greatest reward because it paves the way for all the rest, beginning with consideration.

Consideration means taking my partner-in-dialogue seriously; I may not agree with what is said, but I give it credence and treat it charitably, realizing every opinion is a piece of the larger design. It is crucial to remember, too, that what I reflect back and the spirit in which I present it can color the self-perception of the person to whom it refers. I learned this firsthand in submitting case study drafts to those I interviewed. I'll share with you my favorite example:

> "I read your profile about our community water planning efforts to the town council members," one respondent told me. "We looked around at each other and said, `Wow! Did we do all that?'"

Of course it isn't always so gratifying or easy. Misunderstandings happen and it's work to unravel them. But I commit to getting it right and the other individual begins to see the value in having the story told. Little by little, we are moving toward the next "C" which is a kind of **common sense**: we know very well that real communication makes us vulnerable, but at the same time, we are stronger for having shared it and certainly we are encouraged to try again.

Now the possibility exists for bringing all the players together, to hear each other's story and discover their regional commonality. The Dialogue's roundtable discussions are expansions of one-on-one communication: with a fortified sense of who they are and what they have to offer to the planning process, the stakeholders can begin the final "C" which is **cooperation.** How they relate to each other and the beneficial coalitions they may someday build are made possible by those first halting efforts at dialogue. There are still conflicts to resolve, but now there is a precedent for approaching them together, because communication is a path: the more often it gets used, the clearer and easier it becomes.

THE CODE OF CONFRONTATION

Aaron E. Rael

As we have seen, a good communicator uses the five "C's" of the Code of Communication to produce effectively a model of inclusive dialogue. However, this model is not always used to its fullest potential.

Often we are faced with the fear of communication. Frequently consultants, project directors, or even planners are not willing to bring people with different points of view together for fear of confrontation. We might even say that there is a philosophy out there that preaches, "don't let adversaries talk." We do have to admit that there are risks in bringing people together. There are the risks of other agendas, personal grudges, and even sabotage. But, a greater risk exists in not encouraging dialogue between opposing parties.

Water issues often cannot be separated from concerns, such as long-use planning or economic development, and at some point these other agendas can be incorporated into the process. As for personal grudges, participants are not asked to like each other, just to work together. And as facilitators of communication, are we not the one sabotaging the process by not allowing for true dialogue?

Frustrated facilitators have stated that they have tried the Code of Communication in working with opposing parties, and yet this dialogue

process does not work. The Code of Communication is implemented, but it is executed on a one-to-one basis. Instead of facilitating dialogue among various parties, communication is carried on between the facilitator and each respective party. Facilitators act as messengers. They in fact become intermediaries. The message is not separated from the messenger. When the dialogue process does not work, the messenger becomes the focus of the anger, the exasperation, and the alienation. By circumventing contention, legitimate communication becomes sidestepped.

This avoidance of communication leads to an entirely different set of five "C's." These can be called The Code of Confrontation: **conflict, contempt, confusion, controversy**, and **chaos**. In attempting to avert conflict, the Code of Confrontation, is in fact reinforced.

There is nothing wrong with conflict—it is a natural part of dialogue—what is important is how conflict is addressed. One method by which the Regional Water Planning Dialogue has successfully addressed conflict in the inter-regional roundtable workshops is by producing and disseminating case studies prior to the meeting date. Each case study reflects issues and concerns of a respective region. While key individuals are interviewed in compiling the data, direct quotations are never attributed to a particular person. Participants review and revise drafts of the document before final drafts are sent out to participants in other regions. Participants are able to become familiar with other regions' concerns in a safe and non-threatening manner. When the Roundtable Dialogues happen, there is an explicit understanding of various points of view, since participants have already correlated their concerns with the concerns of other regions. When a position needs to be defended, it is with an awareness that there is a common vested interest in the dialogue process.

In bringing persons with different viewpoints together through the Roundtable Dialogue, a forum is provided for seeking out commonalities. Providing an arena for listening to each other leads to a willingness to come together again. The result is a step-by-step disarmament. All stakeholders should be included early in the process, yet the dialogue should be inclusive enough to bring in other newly identified parties. Through the incorporation of other interests, new alliances are formed. An example of this process can be found in the Pojoaque/Española valleys, where parties came together to discuss water **quality** issues, even though these parties were involved in a water **quantity** dispute.

In a process-oriented approach, the means defines the outcome. The Regional Water Planning Dialogue has found this method useful in creating a vehicle for interested individuals and parties to claim ownership in a bottom-up approach to water planning. Participants no longer focus their anger on the messenger, instead they ask why this process was not started sooner.

THE FIVE "C's" OF CONCURRENCE

Richard L. Pacheco

The Pojoaque/Española Wastewater Steering Committee consists of members from north of Santa Fe, south of Velarde and south of Abiquiu Dam including six Indian pueblos, three counties, the cities of Santa Fe, Española and Los Alamos, various villages and federal, state and tribal agencies. The committee also has representatives from the Chama River and the Rio Grande Valleys, along with the valleys of Chimayo, Nambe, Pojoaque, and Tesuque. The group was formed due to concerns over potential groundwater contamination created primarily by rapid residential development and high septic tank use, illegal dumping of septage in irrigation ditches and arroyos, and the lack of a wastewater management plan for the area.

For any group to agree on anything, the group must first have a clear understanding of what it has in common and agreement on the group's objectives. Concurrence is a coming together, in agreement with others, in opinion and in action. Similar to the five "C's" of Communication and Confrontation, Concurrence has its own five "C's."

The first "C" in concurrence is **constituency**. A constituency is the people served by an organization or an institution. The Pojoaque/Española

Wastewater Steering Committee is a group of several interested community leaders, coming forward as one organization to identify the region's wastewater problems and to provide a forum in which they can mutually address these problems with constructive and unified solutions.

Together they have taken action in a Public Education Program for their constituency. This program allowed the Committee's leadership to take some responsibility for their constituents becoming informed, and for obtaining their support. A water testing program assisted in revealing to their constituents the conditions of water quality and water quantity. A survey study helped them to identify their specific interests and the concerns of the entire regional population.

The second "C" in concurrence is **connection**. A connection happens when one person is connected with others by common interests, and when an arrangement to advance their interests exists. Four years ago the Steering Committee's work resulted in a Master Plan, which allows for the cooperative management of the region's wastewater. The plan connects the entire membership in a formal plan of action to confront their common problems with workable solutions. The plan of action has become the foundation in which Indian and non-Indian communities have bridged the gap of their differences, uniting them in a common effort and connecting them into a family of communities.

Collaboration is the third "C." Collaboration is to work jointly with others in an intellectual endeavor toward a common objective. The Pojoaque/Española Wastewater Steering Committee includes over 16 different entities. What makes this group unique is that six of these entities are Pueblo Tribes. This project provides a forum, with an opportunity for dialogue, between Tribal and non-Tribal governments, allowing them to come together as neighbors and partners to solve their common problems. Pojoaque Pueblo and the county of Santa Fe now have a joint powers agreement for the management of a Regional Septage Facility. This document can serve as a model for other joint projects within the area. San Juan Pueblo and villages of Chamita and Alcalde might now address their common problem of groundwater contamination due to high septic tank use. Santa Clara Pueblo and the City of Española may be able to work together on wastewater management issues for the areas where they share common boundaries.

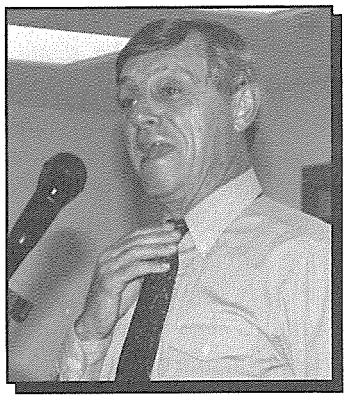
The next "C" is **compassion**: a sympathetic consciousness for the distress of others exists together with a desire to alleviate it. This region is a multicultural and ethnically diverse area where people of all types must live and work together as one unified community. The Steering Committee's success is due in part to the respect and trust shared by everyone for each other's culture, values, religion and way of life.

The fifth "C" of concurrence is **community**: a group of people with a history of common social, economic and political interests, living together within a larger society. The Steering Committee consists of residents from the city and county of Santa Fe, the city of Española and the lower part of Rio Arriba County, the community and county of Los Alamos along with the Los Alamos National Laboratory. In addition there are the pueblos of Pojoaque, Tesuque, Nambe, San Ildefonso, Santa Clara and San Juan. Land grant and acequia associations also are included.

These communities now have the chance to work together in a spirit of cooperation and with objectivity. For example, the Los Alamos National Laboratory, in the interest of better public relations, has generously donated to the Steering Committee expensive water testing equipment. In doing so, they have taken the occasion to repair what in the past has been a bad reputation as a disinterested neighbor. LANL has seized an opportunity for improving their public image.

To have concurrence within communities, groups must collaborate with each other connecting with respect and trust—working together as neighbors and friends for the betterment of their constituents. Like a committee member recently said, "It is nice to know that someone else in the community stays awake at night worrying about **my** problems."

***Richard Collins** is a professor of Urban and Environmental Planning at University of Virginia's School of Architecture and director of the Institute for Environmental Negotiation which he founded in 1981. The Institute has been active in legislation, regulations and site-specific negotiations which include water policy, wetlands, landmark laws, land use and zoning, instream flow legislation, coal mining, hazardous waste and natural resources including national forest plans. Rich has worked with a variety of agencies including the EPA, Corps of Engineers, the Chesapeake Bay Commission, and the Virginia Water Control Board among others.*



SHARING THE PAIN: MEDIATING INSTREAM FLOW IN VIRGINIA

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I am going to supplement with these remarks the article I have written entitled, *Sharing the Pain: Instream Flow Legislation in Virginia* that describes the process which led Virginia to adopt new instream flow laws, and which is reproduced here following this paper.

The article describes the environmental mediation which assisted in developing the consensus draft of instream flow legislation which the Virginia General Assembly adopted and which substantially changed Virginia water law.

My remarks to you today are based on my experience as an environmental mediator, but I must confess that my teaching and academic propensity also will be apparent. Since 1980 I have served as Director of the Institute for Environmental Negotiation (IEN) at the University of Virginia. I am also a professor of urban and environmental planning in the School of Architecture.

In my life, at least, the classroom and the negotiation table are not that separated. Both the classroom and negotiations involve learning, argumentation, discussion, searching for answers, and both absolutely depend upon some level of mutual trust. There are obviously some differences in the two realms. Perhaps, the most notable difference is that in the classroom I get to set most of the rules and provide the evaluations; in negotiations the parties establish the rules, and determine the outcomes.

I know that you have convened because you are concerned with water resource issues. And, this year you are focusing on conflict resolution in water resource matters. Virginia's water climate, water resources and water law are all very different from New Mexico's. Our political institutions and political alignments also are quite different. So, one concern I had in preparing these remarks was to find some elements of the experience the IEN had in a recent mediation in

Virginia that would transfer usefully to your quite different setting.

The new instream flow legislation in Virginia is, at least in part, the result of a consensus-building process that overcame 10 years of frustration by a specially constituted Virginia Water Commission that was empanelled to make recommendations for changes in Virginia's riparian doctrine. The riparian doctrine, as distinct from the prior appropriation doctrine, which characterizes most western states, stems from the initial understanding that there was enough water for everyone's reasonable use. Even 50 years ago that assumption made a certain amount of sense. It makes less sense every year.

The *Sharing the Pain* article describes in some detail how the negotiations were initiated, the techniques that were used, and the process by which the group consensus was transformed into legislative enactments. Now, the legislation is being implemented by rules and regulations which refine the statute, or take the steps necessary before the law is applied in particular settings.

The Virginia water law revisions which emerged from the mediation process statutorily declare that instream flow is a beneficial use. Prior to the adoption of these revisions, offstream uses were the only statutorily established beneficial uses.

This change in the law is of more than symbolic value, but even the symbolic value is considerable. It is valuable because Virginia's streams and rivers may, particularly in periods of low rainfall, be drained by offstream uses, leaving bodies of water, or stretches of water, without any instream flow. The new instream flow rules requires the state to set limits on the offstream withdrawals to protect the ecological and recreational uses of the stream. This, of course, affects the demands that can be made upon the water by traditional offstream users.

Virginia's population is increasing. Agricultural, urban and industrial uses of water are increasing. Citizens are concerned that these growing demands upon the waters of Virginia are environmentally harmful and are limiting instream uses such as recreational fishing and boating. The water law revisions, in effect, acknowledge a new scarcity of water, at least in some streams at some times.

Scarcity, and particularly scarcity when it arises after historical periods of little perceived scarcity, generates increased economic competition and political conflict. This is one of the key aspects of environmental conflict and why some innovations in resolving environmental conflicts are developing.

The riparian doctrine and the historical methods for resolving water conflicts in Virginia presupposes sufficient water for all and therefore little conflict among users. Where conflict arises it can be settled by litigation and judicial decree based on previous judicial precedent.

As you know much better than I, the prior appropriation doctrine was developed under the assumption of scarcity and the need for determining legal rights in the face of that scarcity. We, in Virginia, are now confronting issues that are similar to those faced earlier by states in the more arid West.

But in a greater sense the entire nation is experiencing more conflict, and heightened conflict over resource issues. Much of this, as in Virginia's experience with instream flow, is the result of environmental concerns that were not historically viewed as major problems. But as the pressure of numbers of people and of demands of the economy on our natural resources grow, we will have to address our basic orientations toward resources as well as toward our institutional means of resolving conflicts. I will return to this theme in a moment.

Virginia's Instream Flow Legislation

The water law revisions which Virginia adopted in 1991, as I have already noted, establishes instream flow as a beneficial use. Additionally changes were made in the criteria and goals of the Virginia Water Control Board's (VWCB) decision-making on projects that required approval under the federal Clean Water Act.

Projects that under federal law require a 404 permit also require a state certification that the project or activity does not conflict with state

water law. This review conducted by the state is issued in a 401 certification. Both permits are required under the Clean Water Act before a project can proceed.

The statutory changes in Virginia water law made explicit the legislature's desire that VWCB evaluate water **quantity** impacts as well as water **quality** impacts in conducting 401 reviews.

Prior to this legislation, the water agency demurred from such assessments because the administrators were not certain that the legislature actually wanted them to review the water quantity (instream flow) issues. Consequently, the agency had confined its water quantity analysis on 401 reviews to whether the stream flow was sufficient to meet pollution-dilution standards rather than to other instream flow values.

The 401 review was required by federal law; the Virginia General Assembly gave this 401 review a concurrent status in Virginia law. The 401 review and permit is also the state instream flow permit. The effect is to generate an instream flow evaluation of all activities that require a 404 permit. There are some constitutional and legal issues that might arise if a FERC permit receives a 404 permit, but the state denies it on the basis of an insufficient instream flow, but that discussion is for another time. It is sufficient to note that the question of jurisdiction was addressed and the legislature acted.

A third legislative change was the establishment of a permit system which required water users in designated areas to limit their withdrawals in time of low flow. These districts are called Surface Water Management Areas (SWMAs). Currently there are three rivers which are developing allocation rules for these rivers.

The law allows the users within the established districts to negotiate among themselves for fair and equitable water reductions of water usage during these periods of low flow. The VWCB has the authority to approve or disapprove such negotiated settlements based upon its sense of what the public interest may require. One would expect that in most instances the negotiated sharing the pain outcomes would be consistent with the public interest as well.

As you might imagine, limiting the permit system only to those locations and to those times when there was a conflict between instream uses and offstream demands made the law acceptable to both opponents of a state permit system for water withdrawals at all times and all places, and to those who maintain that the riparian doctrine is obsolete, inefficient, and even, environmentally harmful.

The concept of sharing the pain ethic is the foundation for the entire set of changes. The law does not abolish the riparian doctrine nor does it establish a statewide water planning and permitting system. It is both a compromise and a creative alternative. Would this compromise and creativity have resulted in legislation without the process described in my article? No one can answer that with certainty, but I think most informed observers of the previous efforts think that the mediation process was a critical element in the process of water law changes.

There were other changes in the riparian doctrine that were important to Virginians, but which are of less interest to you. Some exemptions on reporting the amounts of water withdrawals made by agricultural users were removed from the law, and the Virginia Attorney General was authorized, indeed encouraged, to enter into water suits among private parties to articulate the state's instream flow interests.

Let me, once again, encourage you to read *Sharing the Pain* if you are interested in getting a fuller account of the mediation process and the water law changes made.

Rather than merely repeat what is written in *Sharing the Pain* let me provoke you with some concepts that I have been playing with that are relevant, I think, to finding more effective and less costly ways to resolve environmental conflicts.

Water, air and land, the three critical environmental spheres are cultural as well as natural, physical media. They are cultural in the sense that their natural characteristics are imbued with meaning through interaction with human values and attitudes. The human values and attitudes, of course, are influenced by historical experience

and also are enshrined in law which crystallizes values and attitudes of the people.

There are three concepts that I think are particularly critical to attitudes about natural things or the environmental media of land, water and air in the United States. These same concepts are present in some way in other cultures and nations as well. These three concepts are those of the commons, of resources, and of property.

All three of those concepts are present, or should be present, in any sensible evaluation of air, land, and water. I happen to believe that by considering these concepts and their utility in examining the environmental media, we might overcome the "hardening of the categories" that I think dominates our national thinking.

Americans pretty much still view air as a commons, water as a resource, and land as property. In everyday practical terms we need to think and rethink these three environmental media in terms of these concepts in order to appreciate the character of environmental conflicts. I maintain that water, better than land or air is surrounded by historical attitudes that make it particularly suitable for experimenting with new forms of environmental conflict resolution. Natural things can be viewed as something that belongs to all of the people and to be used commonly by all the people. Gifts of nature and of God are different than personal property or fabricated goods which require human labor, ingenuity, and investment. Land is in some ways the same as air and water. Henry George, the author of the American classic, *Progress and Poverty*, has had more influence on the people and nations that have a more restricted or confined land base than we do, but his thinking on the land as different from capital, or if you prefer, from other forms of capital, is more relevant today than it was in his own time. At some time and in some way land, air and water are a natural gift that humans inherit from one generation to the next. If only in the generational sense, we have some responsibility for understanding all three of the environmental media as a commons.

Historically a commons has referred to common land that is possessed by the community rather than individuals for the common use of the people. In England, or in parts of New England in the 18th century, a commons was available for grazing by cattle owned by individuals.

Today, air and the regulation of air quality is perceived and treated as an existing commons. People believe that air belongs to us commonly primarily because we recognize that it is essential to life, but also because historically it has not been priced or privately owned.

In conflicts over air quality, there is an underlying assumption that no private party has the right to appropriate its use—that is to make it an environmental sink—if it hurts the community. To be sure, there are conflicts over whether air quality changes will hurt the community's health or welfare, but generally speaking, the "polluter" does not have a presumption of the right to use air as one might use land. Sometimes this view of air as a commons can keep us from creatively dealing with issues of pollution control that are likely to respond to the realities of pollution as well as to the realities of economics.

Water is predominantly viewed as a resource. This may be because, unlike air, it has always had an obvious, productive use and some scarcity. And unlike land, water, or at least rivers, flow and hence permits human transportation which has public characteristics. We say "water resources" where we don't often say land resources.

Water is recognized as being critical to life which is limited and which must somehow be allocated among different uses. The political nature of that allocation is taken more or less for granted. Unlike air which has only recently become regulated, or land which is more often viewed as property, water controversies are characterized by disputes over allocation and the benefits of one allocation over another allocation. Now I recognize that the prior appropriation doctrine creates property rights, as does the riparian doctrine, but the property rights are not so adorned with the rights orientation that is associated with landed property.

Land, as I have already said, is viewed in the U.S. today mainly as property and only secondarily as a resource, and hardly at all as a

commons. Land policies and conflicts are heavily influenced by attitudes about private ownership and the rights of ownership.

One of the characteristic features of negotiations surrounding land is the heavy emphasis on the use of the "rights." The language of rights when it is used in more than a trivial sense, is that it connotes a sort of "trump" in the dialogue game. Or, put another way, a party might argue that the use of landed property would be harmful to the community. The other party might say, yes, but it is my right to do it. This is what I mean by a "trump" argument. In other words you have made a good, even a correct point, but the correctness of your resource argument does not win.

Property rights are different than some other rights. The right of free speech cannot be abridged by the community even if the community is willing to pay for it. The use of the term rights in property rights, means that the owner's control cannot be limited by the community without compensation for its economic value.

One characteristic of environmental conflicts in our time is the challenge made to the dominant attitudes and understandings about natural things or environmental media rather than to resolving the conflict by the application of the existing rules or attitudes.

Water issues are generally understood as resource issues as well as property or commons issues. That resources partake of both the commons and the property perspectives makes them especially suitable for alternative dispute resolution (ADR) or to use my term, supplemental policy dialogue (SPD). The first acronym is now well established in the legal profession to encompass forms of dispute resolution that diverge from the practices and forms of a judicial trial. The latter acronym is of my own making and not in general use, but which I believe more accurately depicts what is needed and what is happening in resource and environmental conflicts.

SPD around water issues is likely to bring to the conflict resolution table the diversity of interests, and the public attitudes which are necessary to produce better outcomes. Stakeholders, in the jargon of environmental dispute resolution, are likely to be representative of the diverse interests that constitute the interested community. Their interests may be property-like, but these interests will also concede the resource characteristic. Water conflicts bring to the table an interest that they want to articulate but also a willingness to consider alternatives other than pure and simple compensation.

An SPD or mediation, like the one described in *Sharing the Pain* uses a third party, called a facilitator or mediator, whose major role is to help create the climate for dialogue. The mediator establishes a place, time, and manner for the dialogue with the cooperation of the group, but the most important contribution is to provide a climate, the setting, and the material for mutual education and communication.

Communication is essential to any type of dispute resolution. Roberts Rules of Order, for example, is a set of communication rules. The cross-examination of witnesses in a trial proceeds under certain communication rules.

The mediated dialogue also is largely a communication process. The dialogue is a process that encourages communication that is more open, flexible, and informal. In short, mediated dialogue has very different rules for what is "relevant" than a trial. Relevance includes exploration of concepts and ideas that may be quite remote from an immediate fix of the conflict. From the standpoint of determining the "truth" or getting to the real issues, a mediated dialogue follows different rules. These different rules are based on the idea that the boundaries of technical or legal discourse are sometimes too constraining to a resolution of categorical issues.

A few comments on the use of the word "negotiation" may be helpful to you. Negotiation as it is practiced in dispute resolution is quite different than the type of negotiations one employs in setting a price on a used car, or even resolving a lawsuit on the courthouse steps. Negotiation is, or can be, more than "positional bargaining." Positional bargaining assumes at least two stated beginning positions that compete with each other.

Principled negotiation, as it is called by Fisher and Ury in their book, *Getting To Yes,* is designed to explore alternative interests, and this in turn generates ideas. Interests can be realized by several alternative positions. Thus focusing on interests, rather than positions, encourages a search for mutual satisfaction through exploring options that might permit joint gains, or win-win outcomes.

"Principled negotiation" is what a mediator encourages the parties, or stakeholders, to establish and exploit. Ultimately, compromise may occur, or creative alternatives may be developed, but it is through a process that encourages widening and deepening of conversation rather than the narrowing and winnowing and artificiality of a cross-examination.

Principled negotiation encourages creative thinking and boundary-expanding searches for outcomes. This type of climate, setting and dialogue is difficult to achieve in traditional settings whether they are legislative hearings, administrative rulemakings, technically based decision-making or litigation in courtrooms. The key point is that SPD is not so much an alternative to the other settings and institutions, it supplements and where successful assists them in performing better their responsibilities.

I think that is what happened in Virginia in the instream flow mediation. The setting, process, and interest representation led to agreements that needed further political and legal testing, but these initial agreements provided a positive basis for further action; action that might not have been possible without this supplementation.

I have used the concepts of commons, resources, and property and applied them to land, air and water. My purpose is to encourage you to play just a little bit with your own positions and even your interests. Viewing water, air and land from the perspectives of a commons, a resource, or property can produce special insights into your own attitudes, values and positions; it can also lead to common ground with other individuals and interests who without this exercise would appear incomprehensible, strange, unrealistic, or worse.

I suggest that those of you who live in New Mexico might want to experiment with processes similar to that which are described in *Sharing the Pain.* It could supplement your existing water institutions but, might also provide the impetus for developing water law inventions that will better serve your future need.

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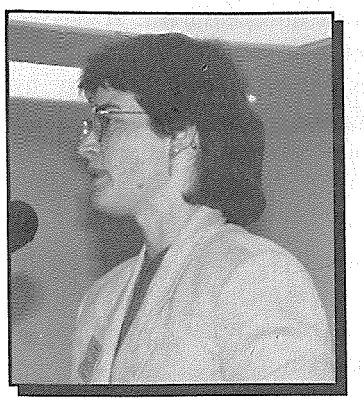

APPROACHES TO INDIAN WATER RIGHTS SETTLEMENT

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I am a person who looks for positive omens, signs of the future. For instance, not spilling my coffee and getting all green traffic lights is an omen that I will have a great day at work.

So I was struck by the incredibly positive omen the world witnessed in the simple handshake between the leader of the Palestine Liberation Organization, Arafat, and the leader of Israel, Rabin. In a simple handshake we saw two peoples, divided for centuries by culture and religion, agree to try to live together in peace. It portends a willingness to set aside cultural and religious differences so that both sides may benefit from a new relationship. In that handshake, there is a recognition that Arab and Jew are in an inter-connected world; a recognition that they must learn to co-exist if they each are going to continue to exist at all.

As I was trying to figure out how this positive omen fits into my work, I received a letter from an old friend who was recalling the life of an author who died this summer. My friend quoted a piece written by Freya Stark in 1929 about her travels in the Middle East in a piece called "Baghdad Sketches":

> I suppose that, after the passion of love, water rights have caused more trouble than anything else to the human species. Our word for rival, or rivalry, comes from the Latin *riva*—the banks or margin of a stream—and the justice of the derivation is proved at any rate in Iraq.

I verified in the *Oxford English Dictionary* the derivation of the word "rival." In common usage today it means "one who is in pursuit of the same object as another; one who strains to equal or outdo another in any respect." But, as Freya Stark correctly wrote, in Latin it meant "one living on the opposite bank of a stream from another."

What an incredible status water controversies have in history, that the very word for stream or life on opposites sides of a stream in the English language should come to be the word for not only competition for water but competition for

anything. Obviously, we who work in the water field, work with a natural resource that is much desired, much competed for. It has become the limiting factor of survival of cultures.

So I looked for a way to utilize the positive spirit evidenced in the handshake and my new understanding of water rivalry and I recalled yet another Middle East connection. In February 1991, at the height of the Persian Gulf War, I wrote a column for the Tucson paper that suggested several principles the U.S. should use to guide our activities in the world. I went back and read my article and was struck at how closely the principles I suggested apply to both international affairs and our own water disputes between Indian and non-Indians in the American West. They're sort of the "everything-I-need-to-know-I-learned-in-kindergarten" version of how to negotiate:

- respect each other as fellow human beings;
- recognize as legitimate, each other's forms and philosophies of government, religion, and society, even if we don't understand them and would not choose them for ourselves;
- treat others as we would want to be treated;
- listen to each other and try to understand the need of others;
- use only a fair share of the resources and work with each other to conserve or stretch the resources to meet all needs;
- think long-term, even if it means that some benefits will be non-immediate;
- do not focus on enemies because once we cast someone as an enemy it prevents us from recognizing joint problems and joint solutions;
- strive to resolve conflicts by non-violent means; and finally,
- act with the realization that the world is inter-related, and what happens in one area impacts all other areas.

Promotion of these principles requires education to a new way of thinking: to a thinking that promotes the benefits of cultural diversity, to a thinking that recognizes that my future is in your hands and your future is in mine.

In the natural resources arena our conflicts result in further destruction of the water, air, land and plant and animal life on which we all depend.

Nowhere is the destructive nature of conflict (or rivalry) more clearly visible than in the State of Washington. In the remainder of my talk, I will discuss two models for Indian water rights settlement, the Washington State model and the Arizona model.

I worked for the Attorney General and Governor's Office in Washington in the 1980s. It was a period of transition. For many years, Indian and non-Indian battled violently, physically and in the courts, over the tribal right to fish. People were jailed, buildings were occupied, boats were seized.

The federal court in *Boldt I* finally awarded to the Indians a right to harvest 50 percent of available salmon. There were, of course, many issues still to be argued over, but by then it was realized the salmon resource was in trouble.

The new governor wanted to get beyond court battles. His new agency heads forged alliances with the tribes to co-manage the resources. The few years of cooperative management (1986-1989) set the stage for dealing with *Boldt II*.

While the *Boldt I* decision gave the tribes the right to take 50 percent of harvestable fish, the *Boldt II* issue concerned whether the harvest rights give the tribe the right to demand habitat protection necessary for fish production. Habitat protection is primarily instream flows necessary for salmon migration. Rather than litigate the *Boldt II* issue, Washington State and tribes were in a position to use the new way of thinking about cooperative resource management. To facilitate cooperative resource management, in 1989 the governor signed a proclamation that the state would deal with tribes government-to-government and agency staff were sent to cultural diversity classes. A facilitation organization, Northwest Renewable Resources Center, was hired to facilitate discussions among state/tribe/local/government/utilities/agriculture/environmental groups to develop a statewide water planning process that involved the tribes.

I doubt that all those parties would have gotten together for hours and days and weekends if they hadn't realized that the fate of all of them hung in the resolution of water use. They knew they could either fight in the courts for years and delay development and environmental protection or become equal partners in a water planning process.

The result, the "Chelan Agreement" avoids quantification of rights and emphasizes planning and needs. These divergent interests have agreed to respect each other's interests on economic and population growth issues. They will listen and understand needs. They will deal as co-managers of resources for joint solutions to joint problems. This alliance is especially important as thePacific Northwest battles the decline of the salmon resource. It has allowed for cooperation over the Endangered Species listing.

In Arizona, the emphasis in settlements of Indian water right claims has been on quantification of rights; finding the water budget to fill the right; and gaining congressional approval and money. In Arizona there are 19 Indian reservations with 20 million acres or 28 percent of state land base. Indian water claims easily surpass state surface water supply, most of which is presently used by other non-Indian parties. In Arizona there is a realization that for both Indian and non-Indian communities to proceed with economic planning, some certainty in water supply is needed.

Arizona's settlements have taken on the nature of contracts between Indian/non-Indian/ federal government for water delivery, exchange and storage. Of five congressionally approved settlements, there are nine common elements:

1. There is need for **certainty.** Negotiations are litigation and adjudication driven.
2. **Importation of Colorado River water (Central Arizona Project water or other)** is a primary source of the settlement water budget. The earlier the settlement, the easier to fulfill the water budget. With CAP's current financial problems, CAP may not be affordable for future settlement. This depends on how the CAP cost repayment is restructured and how much of CAP costs the federal government will cover.
3. **Leasing** of CAP water by tribes off-reservation has been authorized within a 3-county area.
4. Use of **reclaimed water** is encouraged.
5. **Storage agreements** are utilized.
6. **Information exchanges** between state and tribe are promoted.
7. **Groundwater pumping is capped** in an effort to coordinate tribal use with the state's comprehensive groundwater management law.
8. **Tribal water-management plans** for on-reservation use are authorized.
9. Efforts are made to **coordinate tribal groundwater plans** with the state's groundwater plans.

In the settlement process, the Department of Water Resources' role has been limited to that needed to gain state appropriations and Congressional approval and that needed to alert parties to the state's water laws and policies.

Generally the federal government, tribes and non-Indians negotiate water budgets and storage agreements. The federal negotiating policy includes criteria for local cost sharing, partial and total settlement, and federal negotiating teams.

The parties go to Congress for approval and money. The parties then negotiate a detailed agreement to be signed by all parties to implement the congressionally approved settlement. The settlement is entered into the General Stream Adjudication for incorporation into a final decree. A court approval process is guided by the Supreme Court's Special Procedural Order For The Approval of Federal Water Rights Settlements.

Finally, the parties seek state funds. The benefits to the state include money savings by reducing or eliminating hydrologic survey reports for the adjudications; and court system costs and litigation expenses. State benefits may also include goodwill between the state and the tribes; achievement of a workable and enforceable solution; and access to federal monies.

There has not been an effort to bring Indians formally into a statewide planning process, other than to realize that quantification and satisfaction of Indian claims with the security of finality is in

the best interest for economic planning of both Indian and non-Indian.

For details about individual Arizona Indian settlements, I strongly recommend *Indian Water Rights, Negotiating the Future* by Bonnie Colby and Elizabeth Checchio.

Arizona and Washington experiences show that there has to be an effort to share water resources with tribes and to bring tribes into state water management programs. Groundwater and surface water have to be managed cooperatively for the benefit of all citizens of the state.

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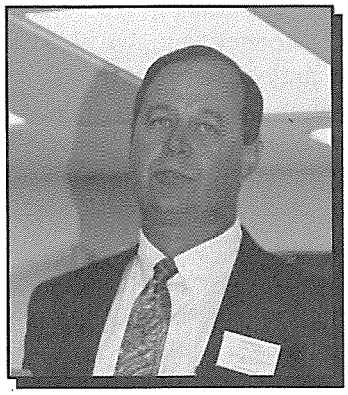

JOINING FORCES: THE PECOS RIVER NATIVE RIPARIAN ORGANIZATION

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Conflict resolution, building consensus, and forging partnerships are as old as mankind. In the last 100 years, we have made tremendous technological advances in communications, transportation, and manufacturing, but I do not know whether we have ever made any significant gains in managing human conflict. There may be nothing new to say about human beings sitting down and resolving conflicts. Our predecessors probably agonized over the same stumbling blocks we have today in dealing with one another and working out our common problems. Keep in mind that you are dealing with people's values when sitting down to resolve conflicts and build consensus. Dealing with people's values and ideals is more delicate than dealing with their money or homes. Wars are fought over differences in values and ideals.

People can become very emotional when dealing with water issues. Oftentimes the most vocal parties, the most interested, and the most difficult to deal with, are the parties least affected, live the farthest away, and do not have a direct stake in the issue. But because we are tinkering with people's ideals, they become very committed and vocal although they are the least affected. In the future, maybe through genetic engineering, we could implant a gene in people that would enable them to work out conflict and build consensus. That may never be possible, but it seems some people have the genetic ability to be mean spirited, negative, and have a natural ability to evoke conflict and chaos. I have met a few of those people.

We have a project in Carlsbad along the Pecos River in which I have been involved for about three years. The Pecos River Native

Riparian Project is proceeding well although it is sometimes frustrating and slow. We have learned much from this project that we certainly did not know at its inception and we will continue to learn as the project unfolds. I am not going to tell you anything new or revolutionary today but I may put a different twist on many of the things you have heard here already.

The Pecos River has a long history of floods, water shortages and high salt concentrations. In 1942, the National Resource Planning Board, which I assume is the forerunner of this administration's new National Biological Survey Department within the Department of Interior, made this observation:

> For its size the Pecos River presents a greater aggregation of problems associated with land and water use than any other irrigated basin in the western United States.

That has not changed since 1942. In fact, the Pecos' problems are more complicated today than ever before because of additional players with their own values tied into managing the river. Further complicating the situation are the many laws influencing how the river is managed. That means there are more conflicts and more meetings with more individuals attempting to build consensus and forge ahead while trying to protect the Pecos River basin.

Many current problems are the result of the U.S. Supreme Court ruling in Texas v. New Mexico. The Supreme Court amended the 1947 compact and placed stringent requirements on the state of New Mexico to deliver water to Texas. The new Texas water commissioner is here today and that is evidence of how both states have become more interested in learning about the other. For years, I have gone to meetings such as this and have never seen the Texas commissioner present.

I will describe briefly the Pecos River Native Riparian Project and give you some principles that we have discovered as we have struggled along with this project. The Pecos River in New Mexico is over-appropriated because the flow is not constant; it is either dry or flooding. The river is so undependable that it is impossible to predict the yield from one year to the next.

Since the early 1940s, salt cedar has been a water user on the Pecos River. It is a phreatophyte that lives in the river basins, uses a tremendous amount of water that could be used beneficially in some other manner, crowds out all other vegetation and eventually becomes 100 percent stands. Much time and effort has been spent concerning this unappropriated water use since the early days of the Pecos River compact, and little progress has been made. A federal project in the Pecos River Basin began in the mid-1960s and was aimed at eradicating the plants using mechanical means. However, at the end of the project, there remained tens of thousands of acres of salt cedar in the basin.

The Pecos River Native Riparian Organization believes that by controlling this plant and re-establishing native vegetation, we not only will bring back the native vegetation and wildlife, but we will free-up some water in the basin which will benefit New Mexico, the residents of the basin, and Texas. These projects normally are conducted by federal or state agencies. In the last 40 years we have become dependent on the federal or state government doing things for us. In this case, we are taking a different approach. Our group of impassioned volunteers have organized to resolve this issue. Initially, we were not funded, which is unusual for this type of project. We also had no experience in lobbying or fund-raising, but we felt we needed to do something. We enlisted some very good people and formed a nonprofit corporation to carry out a demonstration project to control salt cedar and re-establish native vegetation.

The project area is located directly along the west side of the river, south and east of Artesia and comprises six-thousand acres of private land. To control the salt cedar, we will use an integrated program of mechanical means and herbicides. We will re-establish the native riparian vegetation and monitor any water yielded from controlling the salt cedar and the effects on wildlife.

The nonprofit organization is made up of four soil and water conservation districts; Carlsbad Soil and Water Conservation District, Central Valley Soil and Water Conservation District, Peñasco Soil and Water Conservation District, and Dexter/Hagerman Soil and Water Conservation District. The Pecos Valley Artesian Conservation District and Carlsbad Irrigation District also are members. Each entity has a representative on the board of directors, and I am chairman.

As time passes I think we are becoming more astute. Next to the Waste Isolation Pilot Plant, I do not know of a project that has more built-in conflicts and problems than we have encountered here. It certainly seems like an insurmountable task sometimes.

We are looking for a state-of-the-art, economical, effective, efficient method to control salt cedar. Two new-age herbicides have been developed that do the job very satisfactorily. However, some people have strong sentiments opposing the use of herbicides to control the salt cedar. They are able to construct roadblocks in different ways to hinder the project. Our group has learned to do several things. We have attempted to solicit participation from all concerned parties, not just affected parties. It is easy to find affected parties, but finding all concerned parties, especially those who may provide the strongest opposition, is more difficult. Those parties may have inherent values and concerns about the project even though they might be the least affected or not affected personally at all.

Once you locate all parties, it is best to obtain their input from the very beginning. I think we have done a tremendous job in including everyone, and it has not been easy. One recommendation I have is that you do not confront initially big conflicts such as the use of herbicides for controlling salt cedar. Do not start a dialogue by arguing that issue. First try to find common ground, interests, and goals. Discover that on which everyone agrees and build from that commonality. Reinforce those agreements and goals, and establish some basic principles, such as in our case, controlling the salt cedar.

I have not found anyone who disagrees that salt cedar is a problem given the vast densities we have in our area. Everyone seems to agree salt cedar is a problem and it would be better if native vegetation and wildlife lived in our area in the density and numbers that once existed and if the water table would return to previous levels.

Those are basic issues that everyone agrees on, therefore it would seem as if it would be relatively easy to carry out this project, but not so. We tried to build consensus slowly on mutually agreeable topics like revegetation and monitoring the effects of the control program. We will leave the biggest hurdle until last, although throughout the process the herbicide issue has been discussed.

During the process, we continued to stress the safety of the herbicides we are considering for the project. Herbicide company representatives have disseminated information concerning herbicide labels and testing procedures. We have tried to be as up-front as possible because we know the final debate on the use of herbicides is looming ahead. It is a fact that the project could come to a complete stop because of disagreement over herbicides use. We are not out of the woods on this yet.

Another issue we have had to confront is people's fears. Whether the fear is real or perceived, to the person perceiving the problem, it is as real as if it were a fact. You must keep that in mind. You may have to deal with someone whose concerns seem utterly ridiculous with no basis, but in their mind these concerns are as real as if they were based in fact. Again, we are dealing with people's ideals and values, and you can not expect people to change these overnight. Sometimes you just learn how to work around their concerns by building consensus.

Throughout this process, we had to focus on our objectives, learn to communicate, educate, persuade, recruit, and to be flexible and positive. We learned to listen and continuously recruited people to reinforce our passions. If you do not have a passion for a project such as this, it is easy to get discouraged, and you must project your fervor in order to promote the project to others.

It is important, then, to expand your contacts, build a support base and recruit high quality people. Keep the commitment level high, although often it is hard to sustain. Our members do not get paid so it is their passion for the project that gets things accomplished. Also you can bet that your opposition feels every bit as impassioned and committed as you do.

At the onset, we did not know much about fund raising or public relations. We have learned that you must work on public relations by building grassroots public support. We are out beating the drum continuously to maintain and win new support. Grassroots public support converts to political support. Political support converts to funding support. We are not funded adequately, but we are making progress. Simultaneously, we have tried to build consensus with interested groups or individuals. If interested groups are not at least partially committed, they can derail the funding process very quickly. Even with grassroots support, some opposing organizations are very adept at lobbying politicians, and we have found that these organizations can very easily stifle your funding efforts. I think we are going to have our project adequately funded within another year.

A few rules have emerged from our experiences on this project.

- Always maintain credibility.
- Keep your commitment level high.
- Stay focused on your objectives, yet keep an open mind to new ideas.
- Sit down with and listen to other groups' perspectives. Much can be adapted from others' positions particularly if it helps win their support.
- Build common ground by emphasizing common gains to be derived from the project.
- Deal with conflicting issues one at a time.
- Respect the ideas and concerns of those with whom you are trying to reach consensus. If treated with disrespect, you will not receive any commitment from them.
- Avoid contempt and confusion and try to promote understanding—working toward some resolution.

Water is probably one of the most emotionally charged issues we deal with in New Mexico and throughout the West. When considering any water-related issue, we are dealing with people's emotions. Emotions must be controlled to some extent during these meetings because much headway can be lost by just one uncontrollable, emotional outburst. You must keep your cool and stay focused on your long-term goals.

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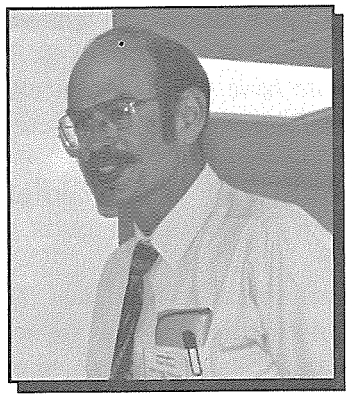

CONFLICT RESOLUTION ON THE PECOS: THE PECOS RIVER COMPACT

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From an engineering perspective, the history of the Pecos may be viewed in two parallel parts: 1) the development of irrigated agriculture and of engineering facilities to harness the river to these uses, and 2) the development of a system of apportioning the river's waters. This paper will address the relationship between these subjects over time, and trace the successes and failures of the relationship between New Mexico and Texas.

Large-scale irrigated agricultural water use on the Pecos in both New Mexico and Texas began concurrently in the late 1880s. Thereafter, water shortages occurred in both states, primarily due to the irregular nature of the river's flow and lack of surface water storage facilities. From the turn of the century, New Mexico and Texas water users actively opposed federal funding for reservoir construction benefitting the other party.

In the early 1920s, partly as a result of the Colorado River Compact's success, the use of interstate compacts to apportion water between states was viewed favorably. In 1923, New Mexico and Texas enacted legislation to create jointly the Pecos River Compact Commission. The Commission met in El Paso in December 1924 and signed a compact in February 1925.

Articles of Agreement in the 1925 Compact provided:

1. The purpose of the Compact was to provide for the equitable division of unappropriated flood waters in the river system.
2. Existing rights to beneficial uses in both states were to be unimpaired.

3. No construction permits for storage in upper basin (above Fort Sumner) in excess of 10,000 acre-feet would be granted by New Mexico prior to January 1, 1940. This provision would have delayed replacement of the Carlsbad Project's McMillan Reservoir until after 1940.
4. New Mexico had rights to irrigate 76,000 acres from surface or storage in the middle basin.
5. Texas had a right to build Red Bluff Reservoir. Red Bluff provides a major on-stream storage for Texas, and is located on the New Mexico-Texas border.
6. Surplus waters above requirements for 76,000 acres in the middle basin and 40,000 acres in the lower basin (in Texas) would be divided equally between states.

For compact administration purposes, the upper basin is defined as the reach of the river above Fort Sumner, New Mexico. The middle basin is defined as the reach between Fort Sumner and the state line, and the lower basin is the reach between the state line and Girvin, Texas, approximately 200 river miles to the south. The river, its basins and its principal features are presented in Figure 1.

At the time of the 1925 Compact, the extent of water use on the Pecos was minor in relation to its development potential. Only two of the present six mainstream reservoirs had been completed. Therefore, the 1925 compacting process was comparatively simple because, given adequate financial resources for ultimate development, the Pecos could supply far more water than was being used at the time. The agreement failed because the two states focused on the status quo of the water supply as it existed in 1925, failing to recognize the river's potential. This failure resulted in reducing the interstate water relationship to the level of political strife which lasted through the next 15 years.

The New Mexico and Texas legislatures promptly ratified the Compact, but it was vetoed by the New Mexico governor. The veto was in part based on the fact that it was silent on replacement storage for Carlsbad. Texas continued to appeal to New Mexico for ratification of the 1925 Compact until 1931, when the Texas legislature repealed its ratification of the agreement.

The lack of a workable agreement, however, did not solve the pressing need for additional surface storage to ensure a stable water supply in both states. In 1926, the Congress authorized $2 million to construct Red Bluff and rehabilitate irrigation works in Texas. The Act appeared to protect New Mexico's interests by providing that Texas should not have claim to any water used above Avalon Dam in New Mexico, then or in the future. However, the project was not immediately funded, since the Reclamation Fund was depleted. Ultimately, construction of Red Bluff was funded in 1933 and begun in 1934.

In 1935, the Bureau of Reclamation proposed construction of Alamogordo Dam, located above Fort Sumner, to replace storage lost in Lake McMillan. Texas opposed the project, fearing it would reduce the supply to Red Bluff. New Mexico countered by opposing funding to complete Red Bluff.

Negotiations mediated by the Secretary of the Interior to resolve this impasse led to the 1935 Alamogordo Agreement, which contained the following principal provisions:

1. Texas agreed to withdraw opposition to the construction of Alamogordo Reservoir.
2. New Mexico agreed not to deprive Texas of its share of flood waters originating above Avalon Dam over the past 20 years. This was apparently the first formulation of the principle of apportioning the river's waters based on flood flows.
3. New Mexico agreed to limit irrigation to a maximum of 76,000 acres in the middle basin, from either surface supply or storage.
4. Most importantly, the agreement committed the two states to negotiate a compact.

Red Bluff was completed in 1936, and Alamogordo Dam was completed in 1937. These two structures and a wet 1937 season solved the two states' immediate water supply needs.

In 1938, the Texas legislature passed a bill ratifying the Alamogordo Agreement as a compact, which was signed by the Texas governor. New Mexico however, refused to ratify, and con-

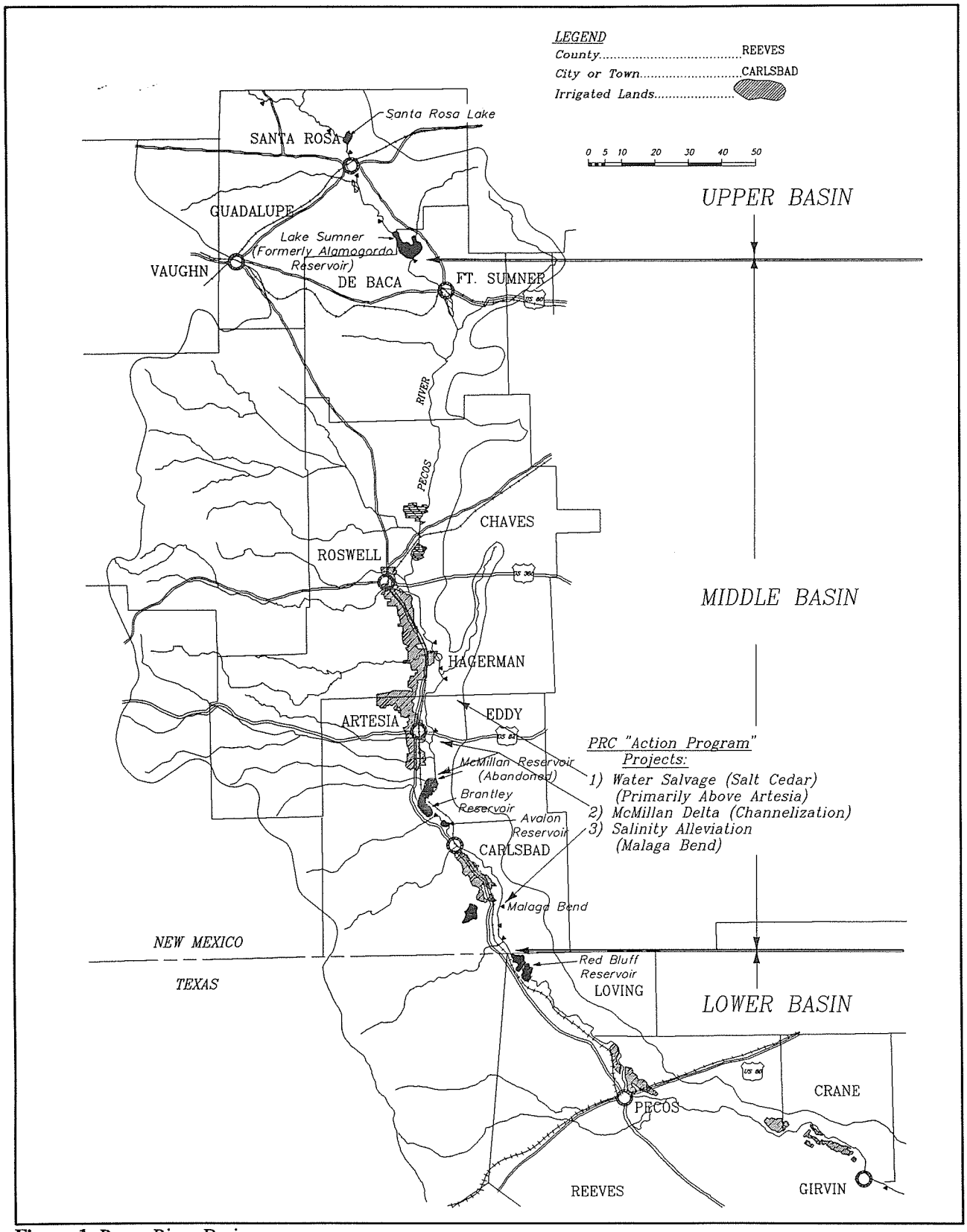

Figure 1. Pecos River Basin.

sidered the agreement an interim step toward a compact.

In 1941, Texas repealed its approval of the agreement "in order that the Texas Attorney General may bring suit ... " This ended the efforts to settle politically the differences between the states. Coincidentally, 1941 was the wettest year in the Pecos Basin on record, with an annual precipitation total having a recurrence interval of several hundred years.

Pursuant to the 1935 Agreement to negotiate a compact, the Pecos River Joint Investigation (PRJI) was initiated in 1939. This massive joint state and federal investigation initiated a level of engineering and hydrologic studies previously unequalled on the river. A disproportionately high level of engineering effort continues to be expended through the present time. The PRJI investigations proceeded for two years until the spring of 1941. These investigations developed much of the data and engineering methodology on which the 1949 Compact's apportionment provisions were based.

In May 1947, the Commission appointed an Engineering Advisory Committee with instructions to formulate engineering data to be used in compact negotiations, including an inflow-outflow formula to apportion river flows.

In 1948 the Engineering Advisory Committee completed its engineering analysis of the water supply and produced a report which was the basis of the "nine points" around which the compact was written. The principal element of controversy within the Compact was the fundamental apportionment provision (Article III(a)), which read:

> New Mexico shall not deplete by man's activities the flow of the Pecos River at the New Mexico-Texas state line below an amount which will give to Texas a quantity of water equivalent to that available to Texas under the 1947 Condition.

In retrospect, it is evident that the final compact negotiations were conducted at a pace which was something more than "all due haste." In addition, it is clear that the final understandings of the two parties resulting from these negotiations were far from identical. The primary misunderstandings concerned the computation of New Mexico's delivery obligation and the question of whose rights were protected.

The most famous story regarding these negotiations concerns the penultimate negotiating session which was held in Austin from November 8-13, 1948. The New Mexico contingent was located on the top floor of the Driscoll Hotel, with the Texas contingent on the first floor. The level of misunderstanding was so pronounced that all negotiation was carried out by Royce Tipton, the federal representative, who shuttled from the top to the bottom floor until an agreement was reached.

None of the negotiators are alive today, but it is surmised that Tipton allowed the two parties to understand different meanings of the final language. Considering Tipton's reputation for fairness, it is not suggested here that the misdirection was deliberate. Specifically, Texas apparently understood that Article III(a) meant that the level of flows in the river existing in 1947 would be protected. New Mexico apparently understood that water uses existing in New Mexico as of December 31, 1947 would be protected. At minimum, we know that this interpretation of the Compact was presented to the New Mexico legislature during hearings to ratify the Compact. Morgan Nelson, who continues to farm in East Grand Plains at the present time, was a legislator during those hearings, and has related this understanding.

The Compact was signed on December 3, 1948 and was promptly ratified and signed into law by President Truman on June 9, 1949.

The status of the Pecos River at the time of the 1949 Compact was essentially a fully appropriated stream system. The compact divided the river based on development existing in 1947. All components of surface and related groundwater flows up to and including unappropriated flood waters were studied, quantified, and included in the river's division. By comparison with the 1925 Compact, no surplus waters, nor waters potentially developable in the future remained, either

physically in the river itself or outside the understandings of the compacting states.

A key element of the Compact was the division of flood inflows between the states. The Pecos River Compact is the only Compact in New Mexico in which an accounting of flood waters is used to divide the river, as opposed to a division of the river as a whole. The Compact and the later Supreme Court decree provide that New Mexico shall deliver an amount of water to Texas equal to approximately 45 percent of the sum of flows past Alamogordo Dam plus flood inflows between Alamogordo Reservoir and the state line.

Flood inflows are defined as flows resulting from rainfall events. Flood inflows are a major component of the Pecos water supply, but are inherently highly variable and unpredictable, and intrinsically difficult to estimate. Under this arrangement, New Mexico receives the beneficial use of base inflows to the river.

Basically, flood inflows may be determined either by gaging tributaries or as a residual in a water balance for a specific reach of stream. Gaging tributaries provides a reliable measurement, and is used in the Artesia to Carlsbad reach, but is too expensive to use throughout the river. The computation of flood inflow as a residual in a water balance is an imprecise method heavily influenced by the methodology and precision of the estimates of all other water balance elements.

The problem is illustrated with a schematic of a typical river reach in Figure 2. Flood inflows are obtained by subtracting the sum of the known inflows from the sum of the outflows. In this example, it may be particularly difficult to estimate base inflow and channel loss. Base inflow typically appears as hundreds of small seeps feeding the river in the reach, and thus is not susceptible to direct measurement. Engineers might estimate this base inflow based on a corre-

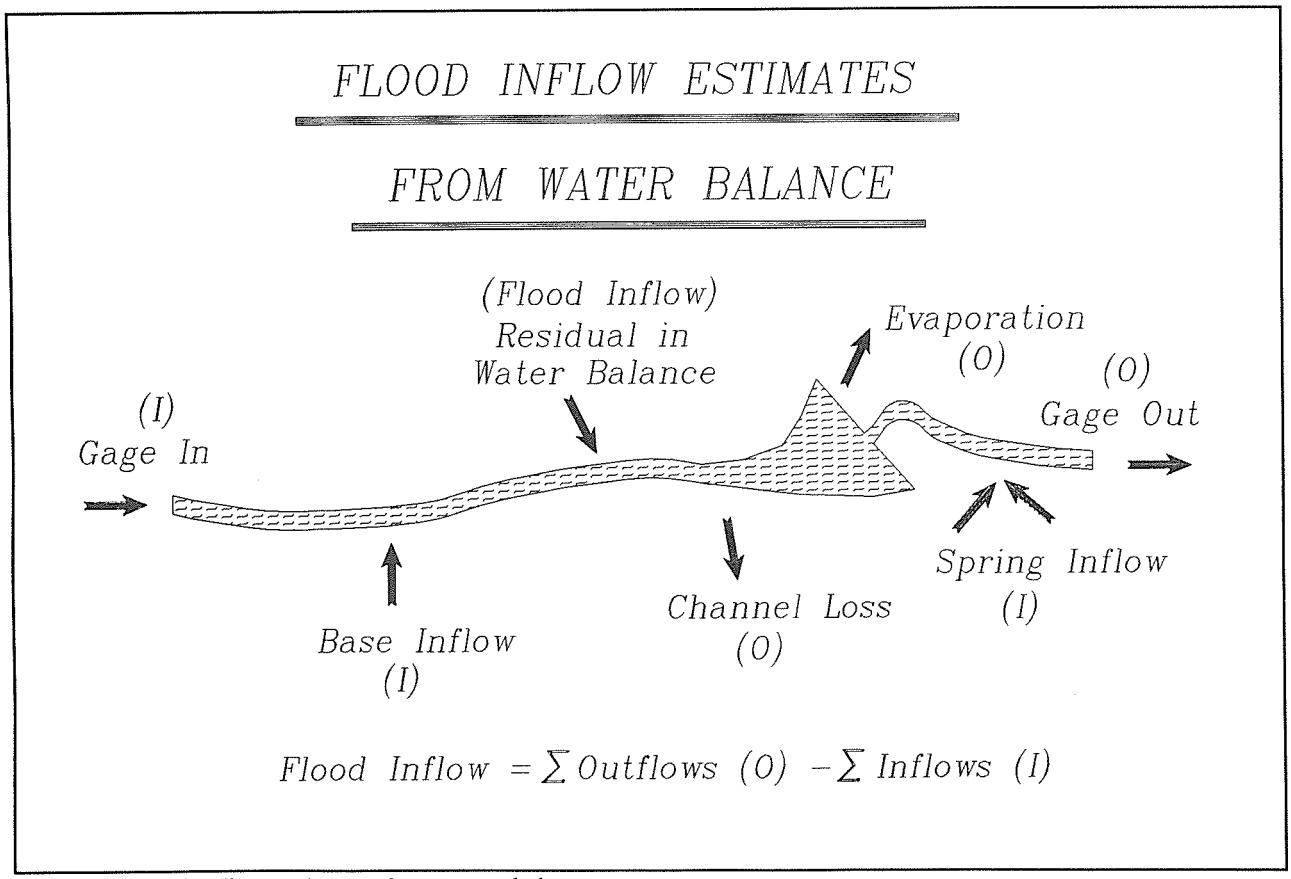

Figure 2. Flood inflow estimates from water balance.

lation with precipitation, or a correlation with groundwater levels, or hydrograph scalping. Because of the nature of the water balance, any error in selecting the method of base inflow estimation (or in making the computation) is reflected in the computed flood inflow, which is in turn reflected in the computation of New Mexico's delivery obligation.

The difficulty in making these extremely crucial determinations has necessitated the expenditure of many man-years of work, and has dictated the pattern of reliance of Compact Commissioners on the professional expertise and judgements of their engineer advisors, both in defining the methods to quantify flood inflows and in making the annual estimates.

The concept of the Compact originally was that the Commission had full authority to change the method or perfect the technique of evaluating deliveries and the 1947 condition, as long as the result was directed at determining the 1947 condition embodied in Article III(a). It was understood by the engineer advisors to the Pecos River Compact Commission that elements of the 1948 studies needed refinement. Items of concern included errors, extremely limited data sets, and necessary improvements to methods of data analysis.

During the period from 1952 through 1957, Texas' engineers on the inflow-outflow subcommittee recognized and approved corrections to errors in the computation of flood inflows, but maintained that the original Compact curve which defined the 1947 inflow-outflow relation was not subject to revision. New Mexico's engineers understood that each change in the method of computation of annual flood inflows required a recomputation of flood inflows for each year prior to 1947, and thus a change in the plotting of the inflow-outflow relationship itself. The original inflow-outflow curve is presented as Figure 3.

In July 1957, the Commission authorized a restudy of the 1947 condition relationship by a "Subcommittee on the Review of Basic Data." It did so following the Commission's legal committee's report suggesting the Commission had the authority to modify the terms of the 1947 inflow-outflow relationship. The stated purpose of the study was to determine whether the relationships depicted by the original inflow-outflow curves should be modified.

This subcommittee produced a "Report on Review of Basic Data" (RBD) which was adopted by the Commission on January 31, 1961. Using methods and data in this report, the subcommittee completed compact accounting computations for the 1949 through 1961 period. At the November 9, 1962 meeting the Commission approved the revised computation of a negative 5,300 acre-foot departure through 1961. During the three-year period in which this subcommittee developed the RBD, a remarkable level of cooperation and consensus existed between the New Mexico and Texas engineers. Although the Review of Basic Data was never completed, it represented a second independent development of the data and methods to be used to evaluate the 1947 Condition and to estimate New Mexico's delivery obligation.

The Pecos River Compact is unique in that in addition to apportioning the waters of the river it provided that the compacting states would act cooperatively to improve water quality, and salvage wasted water to improve the limited, diminishing supply. In 1953 the Commission approved an "Action Program" developed by the Engineer Advisors which was designed to:

1. Rechannel the river between Artesia and McMillan Dam. This reach of the river suffered large carriage losses as it crossed the delta created by McMillan Reservoir. A low-flow channel and floodway were proposed to reduce these losses.
2. Reduce brine inflow at Malaga Bend. Malaga Bend, located several miles above the Texas-New Mexico state line, contributes large volumes of salt to the river through saline springs which adversely impact agricultural uses of Pecos waters in Texas. It was proposed to intercept these brines in a well and pump them to a dry lakebed, where the water would evaporate.
3. Eradicate salt cedars in the Middle Basin. Salt cedar acreage had expanded greatly through the 1950s. Salvage of water through

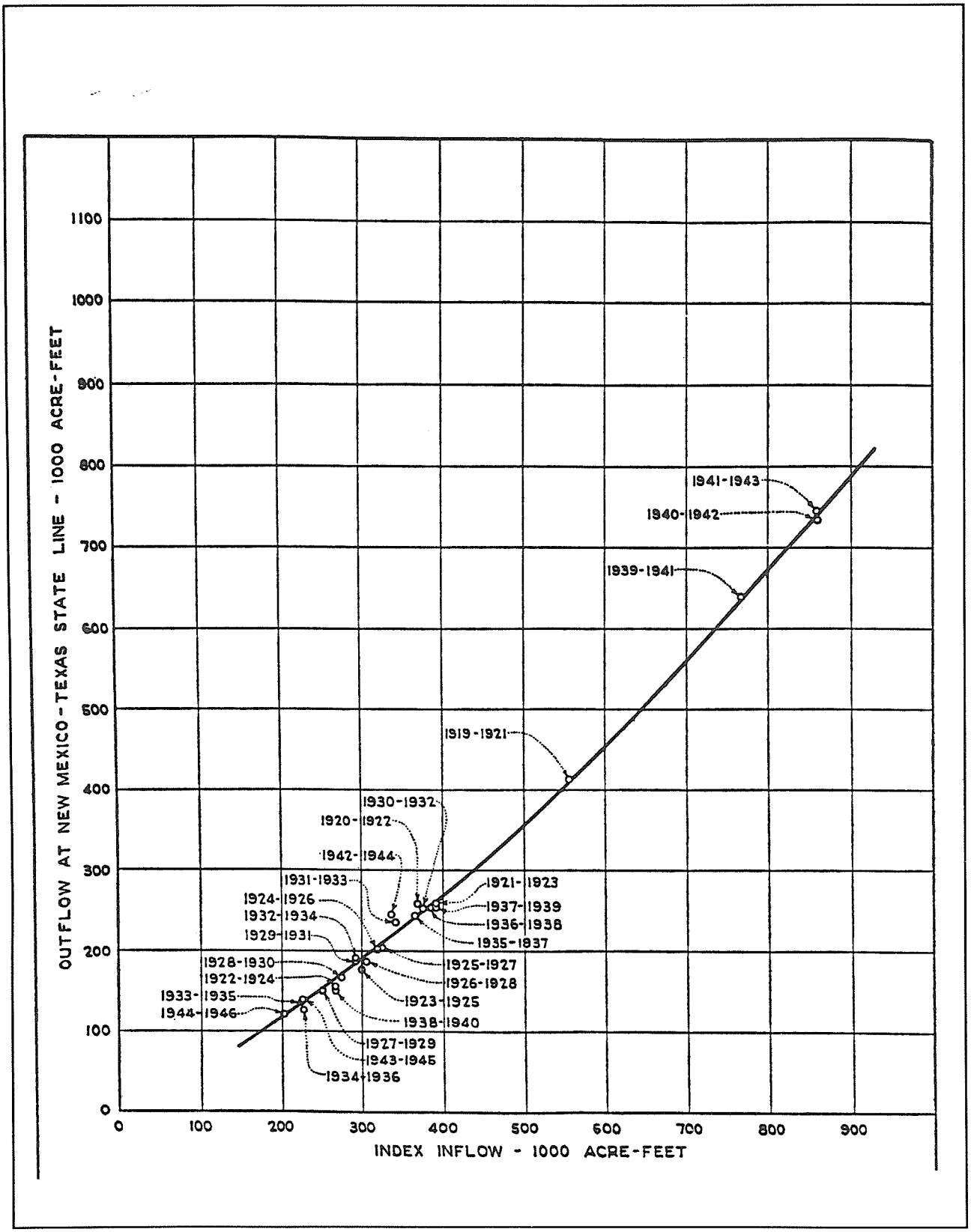

Figure 3. Flood inflow-outflow curve from Alamogordo Dam to New Mexico—Texas state line (Pecos River Compact).

eradication of salt cedar was viewed as a major source of "new" water for the river.

The Commission retained Robert Lingle as director of the "Action Program." Lingle was the program's administrator as well as its promoter and lobbyist in Washington. In 1958, Public Law 85-333 was enacted to channelize the river in the McMillan delta and for salinity alleviation. In 1963 Public Law 88-594 was enacted to clear phreatophytes. Both the salt cedar eradication project and the salinity alleviation project at Malaga Bend were ultimately funded and constructed. The improvements in water supply resulting from the successful implementation of these engineering projects during the 1955-1975 period by the Commission represented a high point in the Texas/New Mexico relationship.

During the period after 1962, little progress was made to complete the definition of the 1947 inflow-outflow relationship. In July 1970, the new Texas Commissioner demanded that the Commission account for delivery of Pecos waters on the basis of the original Compact inflow-outflow engineering analysis. By January 1971, the Texas Engineer Advisors produced a report using the original formulation that determined New Mexico's deliveries to be delinquent in the amount of 1,100,000 acre-feet since the inception of the Compact. This equaled an average annual deficit of 57,000 acre-feet per year.

At the Commission's meeting of February 1974, the Texas commissioner formally announced Texas' "repudiation of the Review of Basic Data and all prior agreements and actions by the Commission" because, in his view, the Review of Basic Data had operated to deprive Texas of water.

Fourteen years of litigation followed. The case was argued before three Special Masters appointed by the Supreme Court. Key rulings in this case included the following:

1. Texas' position that the 1947 Condition as defined by the original inflow-outflow relationship could not be changed, was rejected. Special Master Breitenstein ruled that neither state was bound by the errors in the original 1947 studies.
2. New Mexico's position that the Compact protected all water uses existing in New Mexico as of December 31, 1947 was rejected. Judge Breitenstein ruled that "If all New Mexico uses are protected, all of the inadequate supply of the inconstant stream in times of drought could be consumed in New Mexico in complete disregard of Texas rights. Texas is entitled to its equitable share." In addition, Judge Breitenstein concluded that the 1947 condition refers to the river's status as of the beginning of 1947.

Regarding the central issue of the division of the river's waters, the disputed issues of the most appropriate methodologies to be used in deriving flood inflows were argued a third time before the Special Master. The result was the third definition of the 1947 condition inflow-outflow curve and a determination that New Mexico had undelivered to Texas at an average rate of 10,000 acre-feet per year for the 34-year period from 1950 through 1983. The revised curve and methodology were incorporated into a River Master's Manual under which the river is now administered.

New Mexico responded to the Supreme Court Decree by undertaking a comprehensive program of water-use management in the Pecos Stream System. The centerpiece of this project is a $40 million program to purchase and retire approximately 18,000 acres of irrigated land, sufficient to increase state line flows in the Pecos by 15,000 acre-feet annually. At present, this program has been funded a total of $20.8 million, and has purchased approximately 32 percent of the required water supply.

Much of the constructive work product of the two states during the 1949-1970 period, as embodied in the Review of Basic Data and the Commission's "Action Program" has now either been superseded by the 1988 Supreme Court Decree or has lapsed into non-use. The decree has resolved the primary dispute between the states by establishing an inflow-outflow curve and by defining the method for computing flood inflows for use with that curve. By its appointment of a Pecos River Master, the court provided an arbiter of future disputes concerning methods

and calculations of New Mexico's delivery obligations. In the future, the Commission may look forward to a new "Action Program" to assist in solutions of water quantity and quality problems on the river. Two possible elements of a new program could be a revival of the Malaga Bend salinity alleviation project and cooperation between the states to deal with the new challenges posed by environmental concerns and endangered species issues on the Pecos River.

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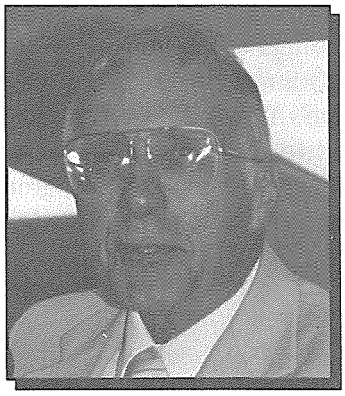

TRANSBOUNDARY PERSPECTIVES

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We could talk about transboundary water resources and conflict resolution on almost every river in New Mexico. We have had major transboundary conflicts on the Rio Grande, Vermejo, San Juan, Gila, Pecos and Canadian rivers. Water is a precious resource and we fight over it. As somebody said, "Whiskey is for drinking but water is for fighting." We know that story well here in New Mexico.

Today I will talk about the international dimension, specifically, the U.S.-Mexico relationship. Every one of the rivers I have mentioned is part of an international river or has an international dimension. The San Juan River is part of the Colorado River flowing into the Gulf of California; the Vermejo and Canadian rivers are transboundary but not international, and flow ultimately into the Gulf of Mexico; the Pecos River is part of the Rio Grande drainage basin and therefore part of an international river; the Rio Grande is an international river; and the Gila eventually flows into the Colorado, an international river and the source of conflict between Arizona and the rest of the Colorado River basin states. Arizona could never agree to the Colorado River compact because it did not want the Gila considered as part of the Colorado. Arizona considers the Gila "their" river.

When we consider the international transboundary dimension there is good news and bad news. The good news for New Mexico is that the allocation of the main international rivers that we share with Mexico has been settled between Mexico and the United States by amicable agreement. We have had our international obligations on the major rivers settled through peaceful dispute resolution. We have two separate treaties on the Rio Grande and one on the Colorado. At the international level, we have settled the disputes with Mexico so at least in New Mexico, we do not have to worry about international claims

coming in and trumping all our disputes on the Pecos, the Rio Grande, or the Colorado.

The 1944 Rio Grande treaty governs and divides the waters between Mexico and the U.S. below Fort Quitman, Texas. The treaty divides the main stem's flow roughly fifty-fifty, fifty for Mexico and fifty for us, which seems like a fair deal. However, Mexico tends to grumble a bit from time to time because two-thirds of the Rio Grande's flow below Fort Quitman comes from Mexico. They supply the lion's share of the water so they feel that a fifty-fifty split isn't so good. However, nobody wants to reconsider that treaty and nobody will because it is too difficult to reach agreement on all the issues that would be raised.

We have a 1906 treaty on the upper Rio Grande that allocates 60,000 acre-feet every year to Mexico to be delivered to Juarez just north of El Paso in the main channel. Similarly, on the Colorado River, the U.S. has an obligation to deliver 1,500,000 acre-feet to Mexico every year to be delivered to Mexico's main take-out dam, the Morales Dam, just south of the border by Yuma. That is the good news. We have been able to settle those disputes, although neither easily nor quickly. It took decades, half of the 20th century, to sign those treaties.

The bad news is not completely bad. We have not been able to reach agreement with Mexico on groundwater. We have an agreement on surface waters, which assures our water rights. Mexico does not know how much groundwater to which it is entitled and the U.S. does not know to how much it is entitled. Likewise the cities of Juarez and El Paso do not know to how much they are entitled. We have a gentlemen's agreement hoping that the other side won't hurt us too much. That kind of arrangement in New Mexico doesn't let neighbors sleep soundly at night. New Mexico was one of the first states to have an effective groundwater law; it has been in place since 1931. Texas has not been able to pass a groundwater law yet. Arizona passed its groundwater law in 1980. California's groundwater law is pretty much a mess. Colorado has an effective groundwater law. It has been difficult for states to deal with groundwater. Because groundwater is out of sight, it tends to be out of mind. That is certainly true at the international level.

The city of El Paso shares the Hueco Bolson with Juarez and both cities are growing rapidly. Other cities along the U.S.-Mexico border are in the same situation where they are dependent to a major degree on groundwater yet they have no security or ability to regulate how much water anyone can take. A group of U.S. and Mexican lawyers, economists, engineers, and geologists h ade suggestions for a groundwater treaty between the U.S. and Mexico. The treaty does not suggest anything novel, but proposes an approach similar to New Mexico's whereby the state engineer can declare critical zones in areas where withdrawals exceed recharge, or where contamination is threatening supply. In New Mexico we call a critical zone a declared basin, and a permit is required to pump groundwater in that area. The state engineer determines whether or not a well would harm or impair the neighboring wells. It is a fairly simple system that protects the well owner's investment. What are the prospects for a groundwater treaty between the U.S. and Mexico? It likely will take some kind of crisis to force the issue.

During the last legislative session, Texas enacted legislation to regulate withdrawals in the Edwards aquifer which lies below the Austin/San Antonio/San Marcos area. This wonderful limestone aquifer, where the water flows like a river, contains species living 1,000 feet below the surface that have never seen daylight. These species have been living happily there until people, like a catfish farmer, drilled a well that suddenly threatened the water supply of San Antonio and San Marcos. Everyone felt vulnerable yet no one wanted any regulation. The sentiment was that no one wanted government bureaucrats regulating what could be done on private land. But when people began to see the effect of their neighbor's well on their own water supply, attitudes changed. Six decades after New Mexico passed its groundwater legislation and after blood was spilled in the halls of the state legislature in Austin, Texas is going to establish the Edwards Aquifer Authority with the power to manage and protect the aquifer, require permits

for groundwater withdrawal, and hopefully bring about some order through regulation. It took a real crisis to get to this point.

When will Mexico and the U.S. come to terms on groundwater legislation? Possibly when we reach a further crisis in El Paso. Some think we are near that crisis in El Paso now. Although figures vary, withdrawals significantly exceed recharge. It is estimated that 20 barrels of water are withdrawn for every barrel of recharge in the Hueco Bolson. The city of El Paso projects that by about 2020, they will have depleted their potable water supply. Both Juarez' and El Paso's populations are growing quickly—Juarez has 1 million people going on 2, and El Paso's is 600,000 going on 1 million. Three million people will live in the area tomorrow depending to a major extent on groundwater availability. Maybe it will take a catfish farmer on the other side of their property to bring them into some kind of order along the U.S.-Mexico border. I hope it comes before a crisis hits and irritates our relationship too much. Up to now, the U.S. and Mexico have been able to resolve transboundary problems amicably through dispute resolution. I hope we can resolve potentially serious disputes with Mexico, not only in the El Paso area, but with other places along the border west toward California before we are at each other's jugular.

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THE WASTE-MANAGEMENT EDUCATION AND RESEARCH CONSORTIUM

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INTRODUCTION

Efficient and safe management of nuclear, hazardous and solid waste is a critical multidisciplinary issue that requires an integrated collaborative effort among multiple organizations with diverse expertise and experience. In 1990, the Department of Energy (DOE) approved a cooperative agreement for the Waste-management Education and Research Consortium (WERC), a five-year model program. The consortium includes members from New Mexico State University (NMSU), University of New Mexico, New Mexico Institute of Mining and Technology, Navajo Community College, Los Alamos National Laboratory, and Sandia National Laboratories. WERC's operational organization is presented in Figure 1.

The model program was assigned the mission of demonstrating that a university and national laboratory partnership can effectively expand the nation's capability to address the issues related to management of all types of waste via education and technology development. The program provides a national resource of education and research related to waste-management: it develops and transfers new technologies, increases human expertise and sensitivity to waste-related issues, trains future experts in environmental disciplines, creates advanced technologies and promotes their application, and encourages universities, national laboratories and private industry to work together to solve some of our nation's waste problems.

The formative years have demonstrated conclusively that the partnership of universities, national laboratories and industry developed by WERC is an effective tool for education, technology development and technology transfer, with the education process playing a critical role in technology transfer. A 1992 study by Oak Ridge Assoc. Univ./Pacific Northwest Laboratory indi-

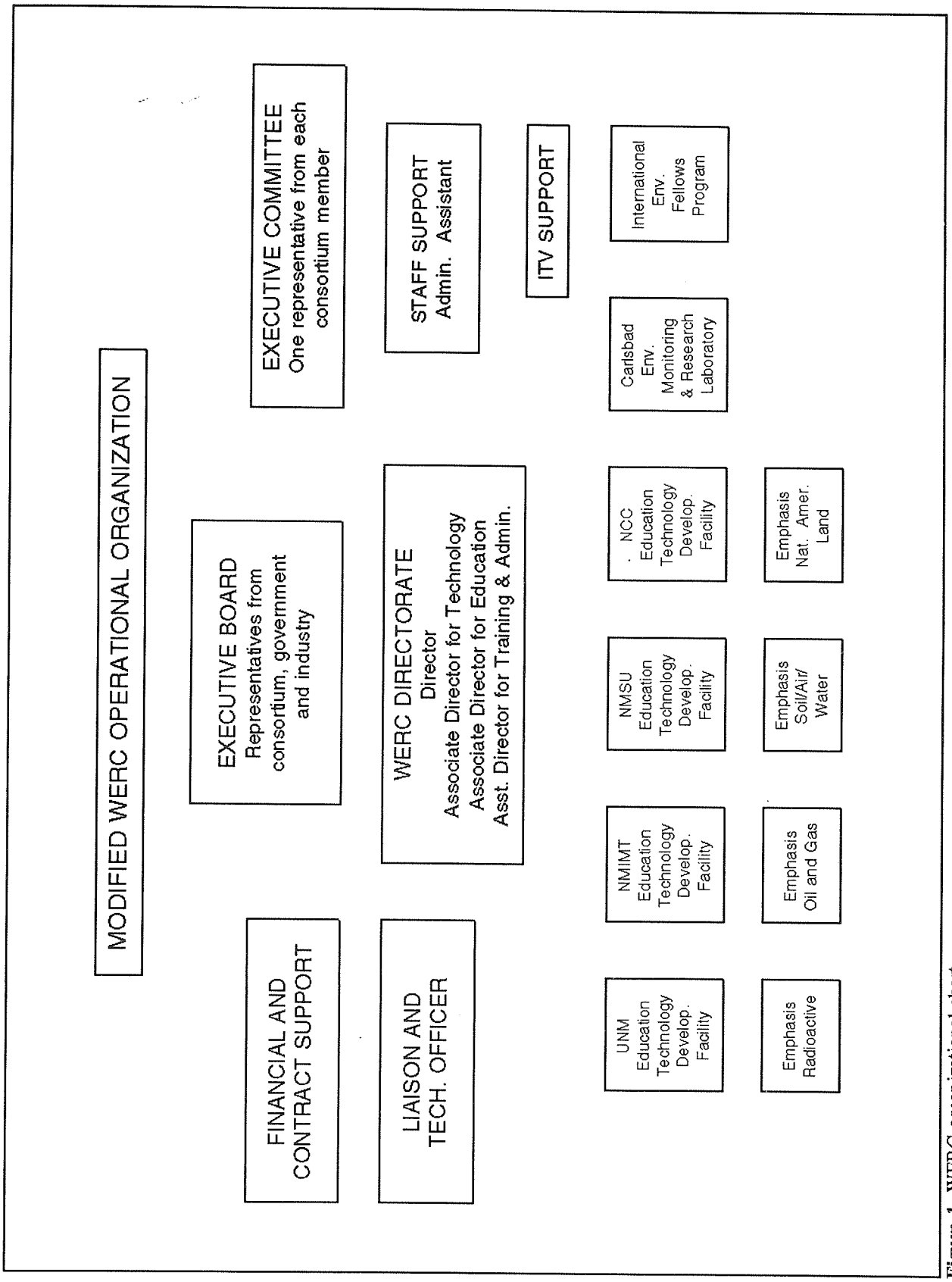

Figure 1. WERC organizational chart.

cated that there will be a 45% increase in manpower needs from 1993-1997, with a corresponding budget increase of 49%-87%. Training and education needs are at a critical level for environmentally trained engineers, project managers, technicians, hydrogeologists, environmental scientists, and risk assessment managers. There also is a critical need for students to participate in internships providing them with practical experience in their field.

The WERC program is available to over 30,000 students in academic institutions with a minority population of 25%-95%. The very high minority population of New Mexico and of the academic institutions of WERC makes the continuation of WERC a national priority.

Education

In its first years, WERC has successfully developed the infrastructure and the activities for education and retraining which are proving to be significant factors for technology transfer. Significant accomplishments have included:

- Providing undergraduate and graduate options and degrees in environmental engineering and management to over 500 students annually.
- Developing associate degree programs at Carlsbad and at the Navajo Community College especially aimed at retraining technicians working at DOE and industry sites.
- Producing an intensive state-of-the-art video conference series for retraining and technology transfer to over 8,000 professionals at national laboratories, industry, and federal agencies.
- Developing capstone courses on environmental process design with technology being transferred among universities internationally.
- Initiating educational programs aimed at making pre-college students aware of the most up-to-date technology.
- Starting an Environmental Fellows Program to provide graduate-level technology information to emerging leaders from government and industry.
- Launching a two-year Solid Waste Management degree program specifically for Native American students.

These initiatives have been critical to the technology-transfer effort, including direct state-of-the-art technology transfer as over 100 WERC graduates have entered the work force annually (Figure 2).

STUDENT PLACEMENT SUMMARY

Placement	Percent
DOE & DOE Facilities	40
Other Government Facilities	20
Industry	22
Graduate School	8
Total	**100**

Figure 2. Student placement chart.

More than 2,000 students and professionals are enrolled in WERC educational programs with over 300 students receiving scholarships (Figure 3). Figure 4 depicts student growth over the past three years, while Figure 5 shows that 464 New Mexico residents enrolled in the WERC program. Students come from cities and towns throughout the state. Undergraduate, graduate, and associate degree programs are offered through the program. An International Fellows program provides opportunities for foreign students.

The teleconference system reaches locales throughout New Mexico and the Americas. A satellite/fiber optic TV system has been established throughout New Mexico and the ITV courses are received by over 500 students at sites shown in Figure 6. The Teleconference Series presents state-of-the-art updates on environmental issues monthly and the series has participation from about 85 organizations in the U.S. as shown in Figure 7.

Technology Development

The university/national laboratory/industry partnership has resulted in unique solutions to technology issues. Within the three-year period from the program's commencement, some pro-

SCHOLARSHIPS AND ASSISTANTSHIPS

Type	Estimated Women and Minorities	Total
Undergraduate Scholarships	34	70
Native American Scholarships	110	110
Work Study Scholarships	10	30
Tech. Development Assistantships	30	75
Fellowships	15	30
High School Scholarships	5	6
Internships	12	20
Total	**216**	**341**

Figure 3. WERC scholarships and assistantships.

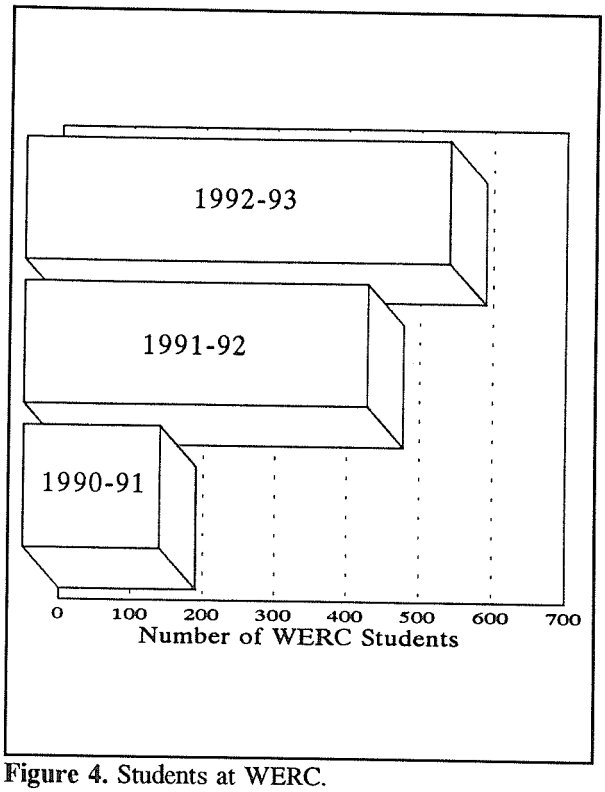

Figure 4. Students at WERC.

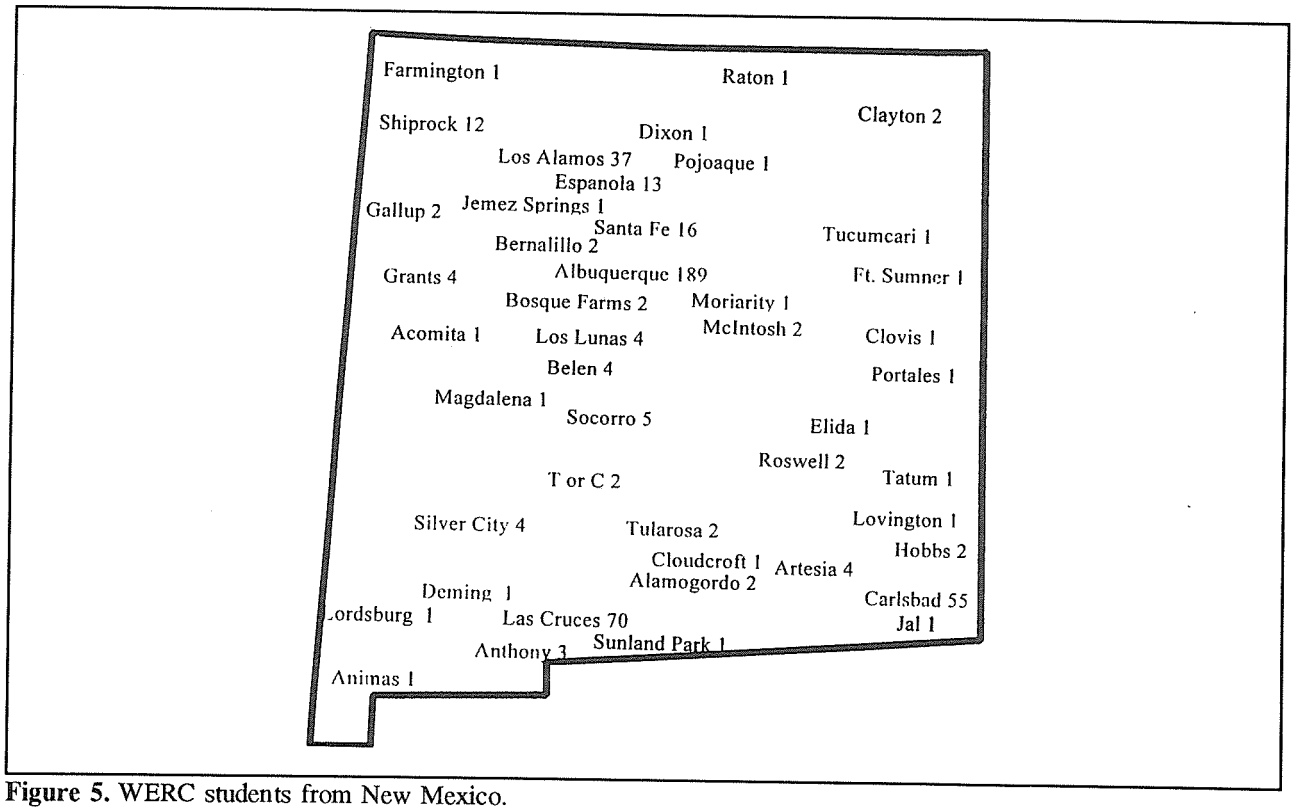

Figure 5. WERC students from New Mexico.

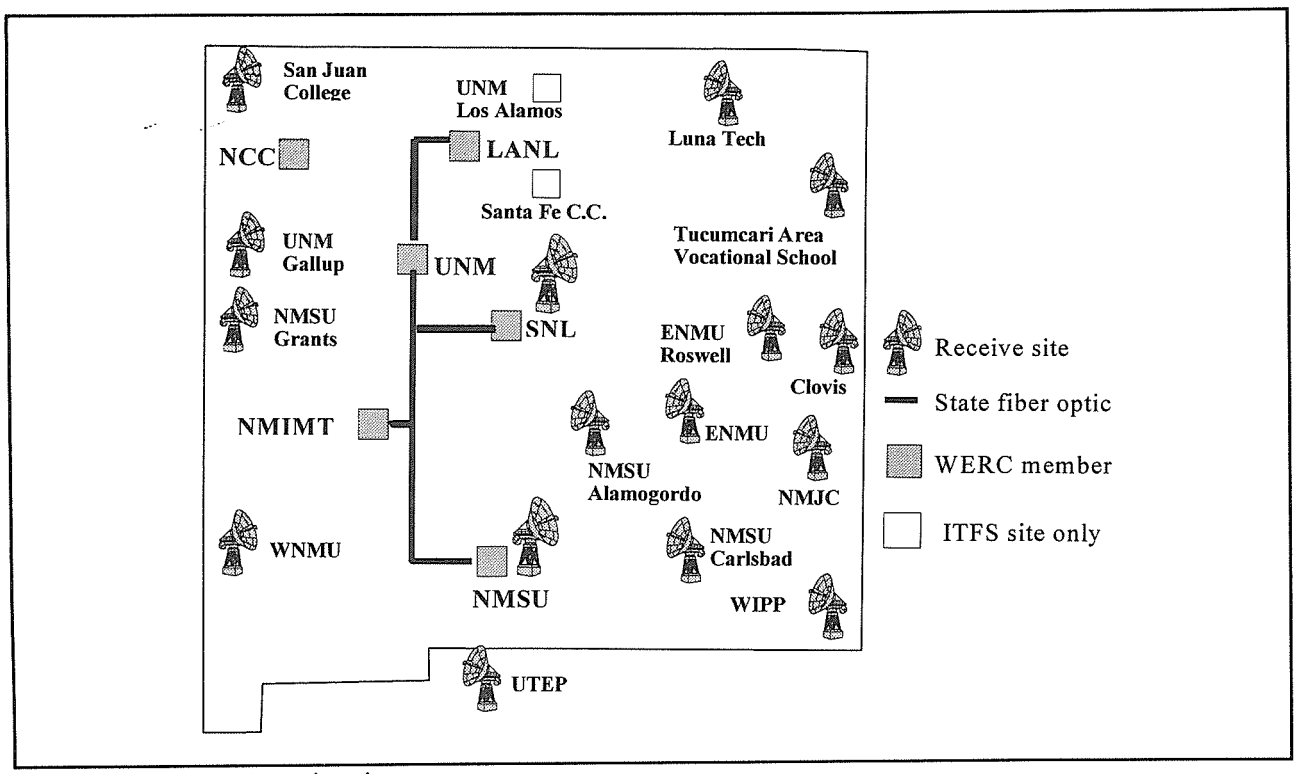

Figure 6. WERC-ITV receive sites.

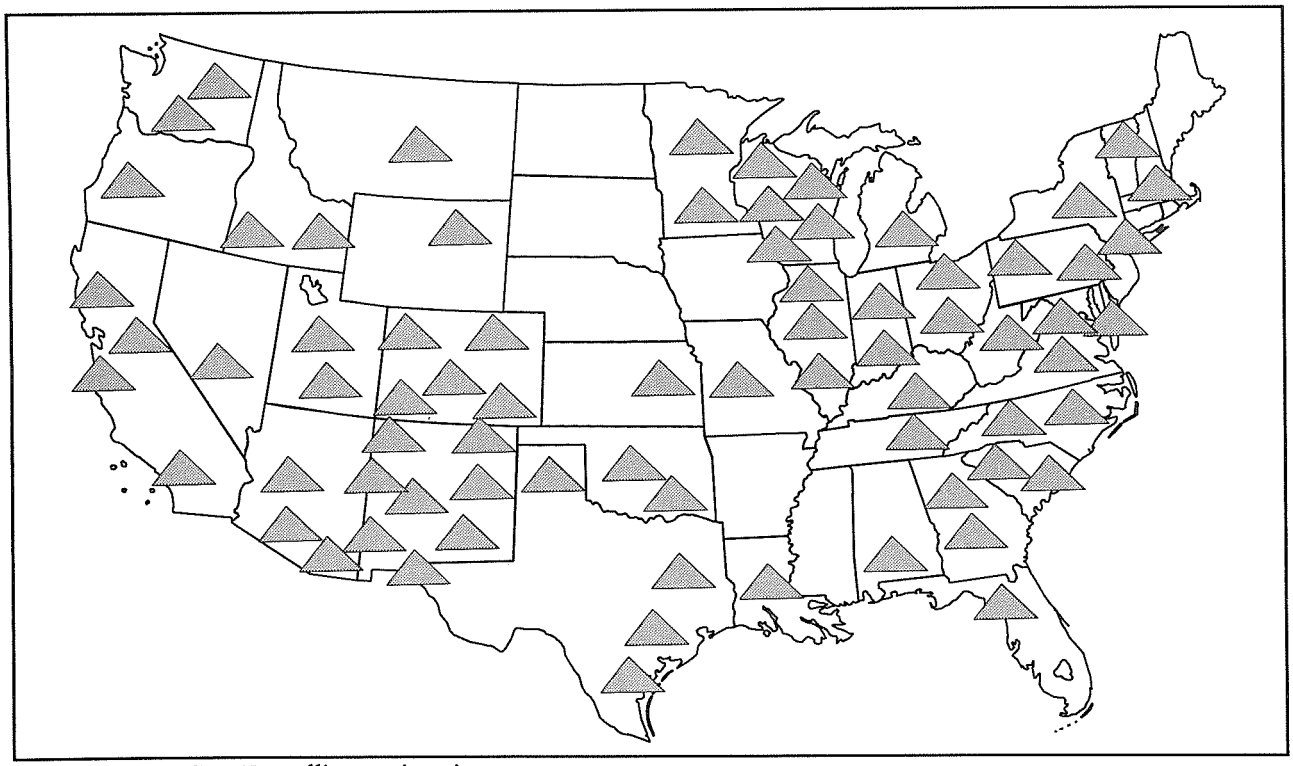

Figure 7. WERC-ITV satellite receive sites.

jects are ready for the demonstration stage to be conducted at DOE and industry sites. Further, the program has resulted in students with experience on practical development projects at the leading edge of technology, thus forming a base for technology transfer as these students flow into government and industry jobs. Several graduates occupy responsible positions and are already technology transfer agents.

The scope of the unique technologies developed through WERC are successfully demonstrated via application at national laboratories and industrial sites. Examples include:

- Remediation of soil contaminated with plutonium using a polymer capture process has been applied at a DOE waste site.
- Mapping of radioactivity in oil fields has been applied at a DOE integrated demonstration site.
- Tensiometric barrier for vadose zone waste containment has been applied at a DOE integrated demonstration site.
- A process for non-toxic building blocks from fly ash and toxic wastes has been applied to alleviate industrial problems.
- A pipeline detection system has been applied to detect leaks from storage tanks and pipelines in the oil industry.
- Remediation of soil containing heavy metals using a heap leaching process has been applied at a DOE waste site.
- Design codes for encapsulation, brine flow and ventilation for waste burial have been applied to the Waste Isolation Pilot Plant.

Another example of new technology developed through WERC involves a series of WERC supported projects that have provided subsurface mapping of waste sites. The application of analysis and software has been demonstrated at Sandia National Laboratories and will be demonstrated next at the Idaho National Engineering Laboratory. Several procedures were integrated including ground penetrating radar, magnetic sensing, Eddy current sensing, cross-borehole tomography, ultrasonic sensing, radiographic sensing, thermal sensing, and interferometric holography. Software has been developed which uses sensing data to produce a three-dimensional subsurface map to guide remediation. These projects have been instrumental in developing a non-destructive mapping technique which is safer and more cost effective than alternate methods. Two NMSU faculty, three students, and professionals from Sandia National Laboratories, Pacific Northwest Laboratory and Stoller participated in these projects.

In the next five years, applications to DOE and other sites will result from program activity. Equally important is the practical experience that about 2,000 faculty members and students have obtained from the involvement in the technology projects and in the exchange of technology between universities, the national laboratories and industry.

Four laboratory facilities have been established to assist research and education and continue to attract industry and state participation.

- Soil-Water-Air Testing Facility
- Environmental Radioactive Measurement Laboratory
- Hobbs Oil-Water Experimental Facility
- Navajo Drylands Environmental Laboratory

A major effort called the Carlsbad Environmental Monitoring and Research Center has also started environmental monitoring in the Carlsbad, New Mexico area. The center, which reports to the director of WERC, generates experimental data using state-of-the-art techniques and conducts research on monitoring techniques. A permanent laboratory building is critical to this program.

Technology Transfer

The technology transfer function of the consortium is emphasized throughout the program. An Executive Board and an Advisory Board composed of representatives from top management of government, industry, academia and environmental organizations have been formed and are functioning for the purpose of technology transfer starting at the top level of industry and government. Major technology transfer conferences and teleconferences are held annually for industry and government. Continuous contact with government and industry is

maintained to transfer the technology development results to real applications. Over 100 technical papers have been presented and published on the various aspects of this program. Additionally, a large number of WERC students are transferring information via summer internships, co-op job programs, and permanent job placements.

WERC Strategy

WERC has proven to be an invaluable resource for the DOE and others. WERC's strategy is to utilize the excellent base started by DOE and the WERC partners and strives to reach its objectives to produce the following.

- New professionals educated in economics, law, business, engineering and science for the management of nuclear, hazardous and solid waste transferring new technologies as they enter the work force. A need for specialists will exist for at least the next three decades.
- Technologists trained or retrained on the safe handling of radioactive and hazardous waste.
- A pipeline of pre-college students informed of opportunities and technological challenges offered by the environmental field.
- Faculty and students working together with national laboratories and industry personnel using state-of-the-art technology information to resolve DOE and other site remediation issues.
- Retrained professionals and management personnel in government and industry via the interactive TV and site-intensive courses. This retraining effort will be a base for technology transfer for managerial and professional resources for several decades.
- World-class environmental monitoring laboratories, including the Carlsbad Environmental Monitoring and Research Center, that serve the real needs of DOE and communities.

The WERC program has been outstanding in its achievements to date. The program annually develops unique technological solutions and transfers information to over 2,000 students and professionals. The program has graduated over 100 students and is projected to graduate at least 100 annually. The $5 million per year initial WERC program has been leveraged by new programs of over $3 million annually. New outreach programs currently in the formation stages will further increase the new program starts to $5-$10 million annually.

As noted earlier, WERC is a model for environmental education and technology transfer, especially for minorities, since New Mexico, with its very high minority population, forms a model that other states in the U.S. will reach by the year 2020.

In 20 years of operations, the program is projected to pay back over $600 million in benefits to the U.S., a return of over 300% if the investment continues for 20 years. However, all of this is contingent on WERC continuing to be funded at about $5.5 million annually.

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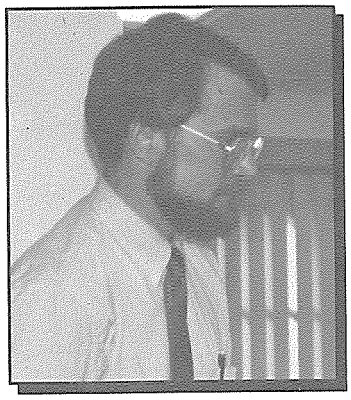

HYDROLOGIC STUDIES FOR THE WASTE ISOLATION PILOT PLANT

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INTRODUCTION

The objective of this paper is to provide a general overview of hydrologic conditions at the Waste Isolation Pilot Plant (WIPP) by describing several key hydrologic studies that have been carried out as part of the site characterization program over the last 20 years. The paper is composed of three parts: background information about general objectives of the WIPP project; information about the geologic and hydrologic setting of the facility; and information about three aspects of the hydrologic system that are important to understanding the long-term performance of the WIPP facility. For additional detailed information, the reader is referred to the references cited in the text.

BACKGROUND INFORMATION

The WIPP is located in southeastern New Mexico approximately 25 miles east of Carlsbad (Figure 1). The facility is designed for the receipt, handling and storage, and ultimately the disposal of approximately 180,000 m^3 of defense-related transuranic (TRU) waste (U.S. Department of Energy 1990). Figure 1 shows the main components of the facility. Beneath the waste handling facilities on the land surface are four shafts to the underground workings. At the north end of the workings, an experimental area has been developed where various in-situ experiments are being conducted. In the waste storage area, the repository is designed to have eight waste storage panels, with each panel consisting of seven individual disposal rooms. At this time, only the first waste storage panel has been excavated.

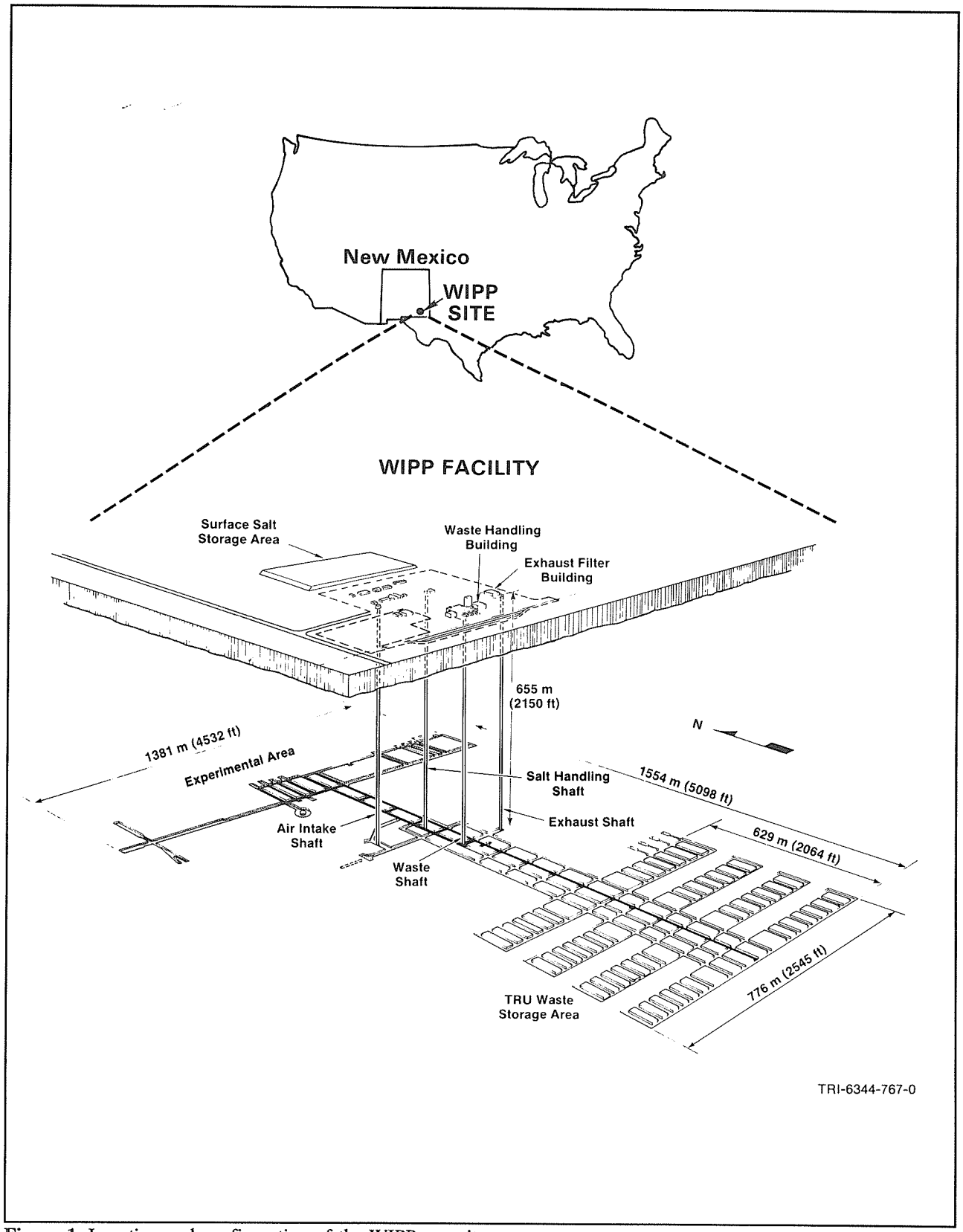

Figure 1. Location and configuration of the WIPP repository.

Waste transported to WIPP will consist of waste materials such as metal, glassware, cellulosic materials (paper and cloth), and processed sludge. These wastes have been produced as a by-product of defense-related nuclear activities and contain small quantities of plutonium or other transuranic elements and their fission products. Most of this waste is contained in 55-gallon drums, which will be placed into the disposal rooms and then backfilled with crushed salt (Lappin et al. 1989). A smaller quantity of waste, in canisters having a higher surface dose rate, will be transported in shielding casks and the canisters will be placed into large-diameter, horizontal boreholes in the walls of the disposal rooms. As a panel is filled, it will be backfilled with salt mined from the next panel. Each panel is closed off with an engineered seal once it is full.

GEOLOGIC AND HYDROLOGIC SETTING

The repository is located in the Delaware Basin, a large geologic structure with laterally continuous layers of different types of sedimentary rock (Lappin et al. 1989). Figure 2 shows the sequence of rocks in the uppermost 1200 meters of the basin. Most of these rocks were deposited over 230 million years ago. The shallowest rock unit is primarily fine-grain sandstone and siltstone. These rocks have relatively low to moderate permeability. Below this shallow unit is the Rustler Formation, which contains two thin dolomite layers. The deeper of these two layers, the Culebra Dolomite, is the most permeable, laterally continuous layer overlying the repository.

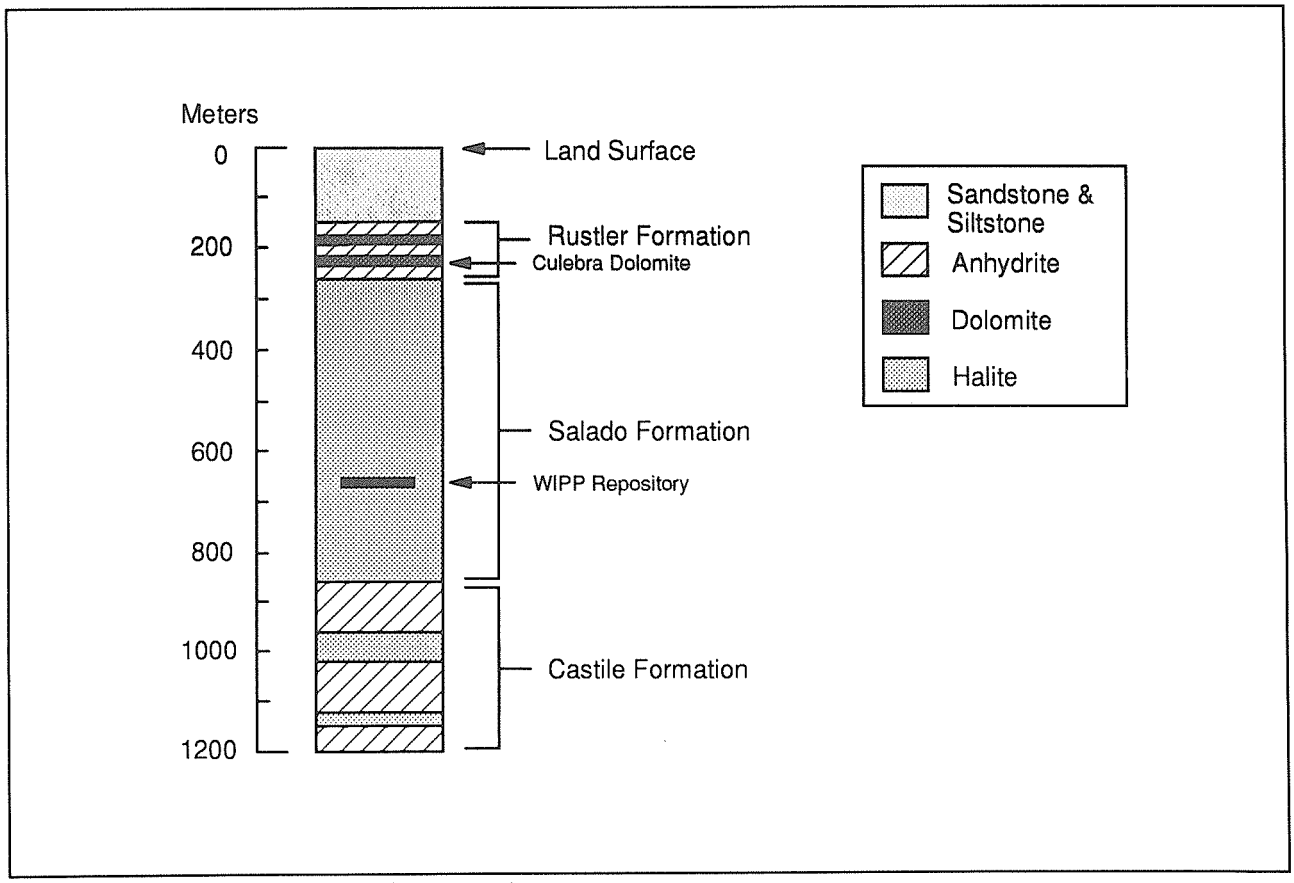

Figure 2. Stratigraphic section at the WIPP site.

The WIPP repository is located approximately 650 m below land surface in the lower part of the Salado Formation (Figure 2). The layered halite (salt) of the Salado Formation was selected as the host rock for the repository because of its extremely low permeability, which provides hydrologic isolation, and because the relatively plastic halite will eventually deform and flow, thereby encapsulating the waste. The Salado Formation also contains a number of thin layers of anhydrite, a somewhat more brittle rock. Below the Salado Formation is the Castile Formation, which is made up of thick alternating layers of halite and anhydrite.

IMPORTANT ASPECTS OF THE HYDROLOGIC SYSTEM

Over the past 20 years, extensive field and laboratory testing and analysis have been carried out to characterize the hydrologic conditions at the WIPP site. The following sections describe three aspects of the hydrologic system that play an important role in the assessment of long-term repository performance.

Pressurized Brine in the Castile Formation

Localized reservoirs of pressurized brine (water that is saturated with dissolved salt) have been encountered in the Castile Formation, occurring in the uppermost anhydrite layer of this formation. Figure 3 shows the locations where these pockets of pressurized brine have been encountered in the Castile Formation while drilling deep holes (Borns et al. 1983). Most encounters with pressurized brine have occurred in an area that has experienced moderate salt flow and associated deformation of the anhydrite within the Castile. Pressurized brine was also found in an exploration hole, WIPP-12, inside the WIPP site boundary. WIPP-12 is located about one mile north of the waste storage panels.

Figure 4 illustrates a north-south cross-section (i.e., "vertical slice") through the rock units at the WIPP site. At the WIPP-12 drillhole, where the pressurized brine was encountered at the bottom of the uppermost Castile anhydrite unit, relatively mild salt flow and deformation has occurred in the Castile Formation. There are over 200 meters of halite between this anhydrite unit and the stratigraphic horizon of the WIPP

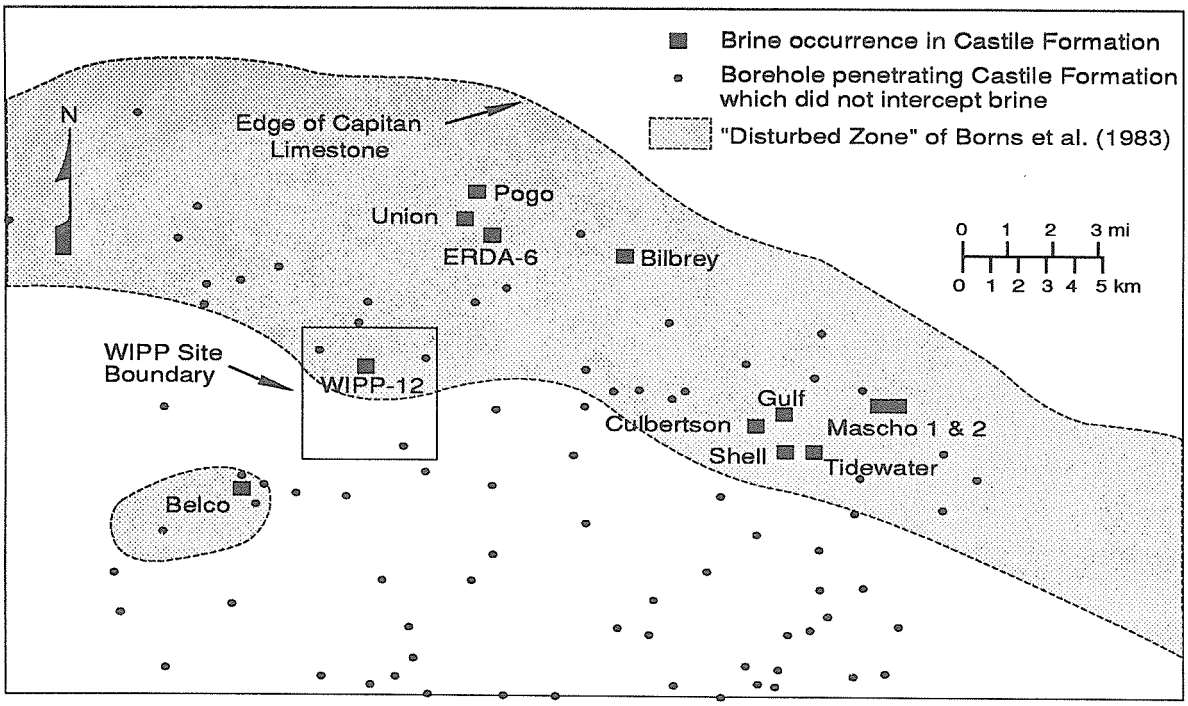

Figure 3. Map showing locations of brine occurrences in the Castile Formation. TRI-6330-112-1

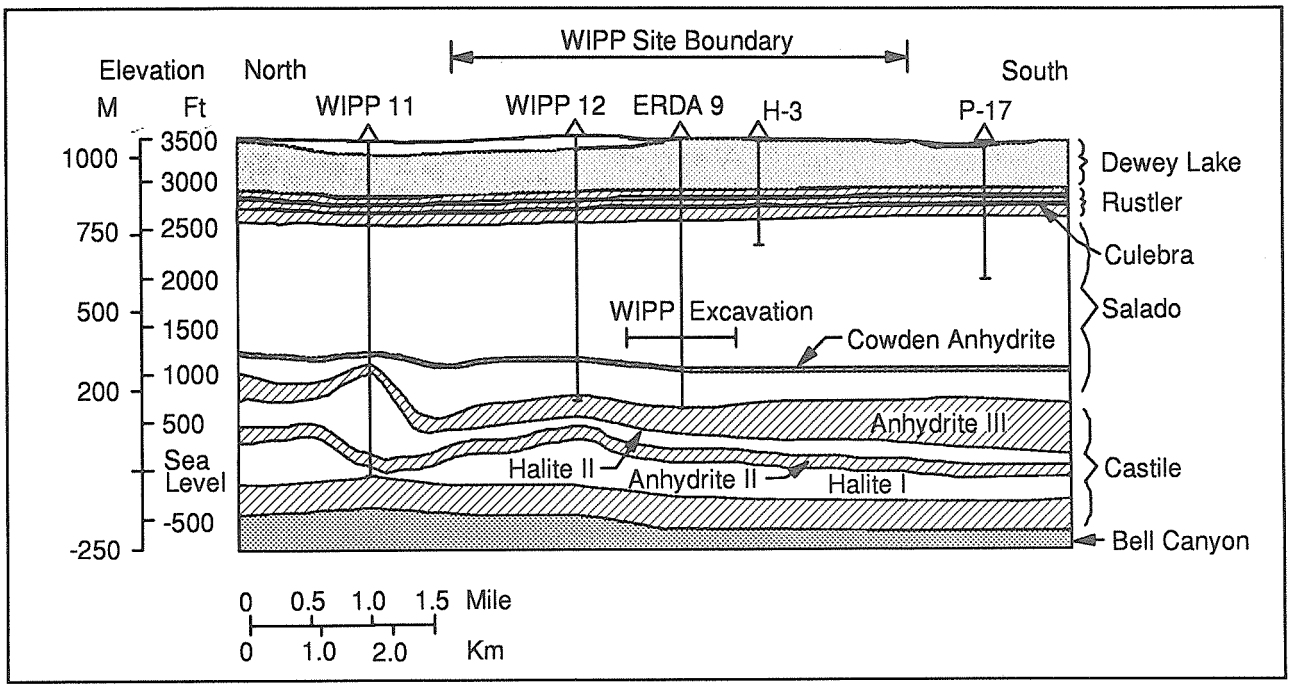

Figure 4. North-south cross-section (i.e., "vertical slice") in the WIPP region.

repository. Although more pronounced deformation is present at drillhole WIPP-11, no pressurized brine was encountered at that location. Given the presence of pressurized brine in the Castile, an important question is how might the occurrence of pressurized brine affect long-term repository performance. Two different scenarios are pertinent in addressing this question.

The first scenario considers repository performance under undisturbed conditions. Because there are over 200 meters of extremely low permeability halite between the uppermost Castile anhydrite and the repository horizon, no brine is expected to flow from the Castile into the repository. Therefore, the presence of brine (if it were to occur beneath the waste storage area) has no significant impact on undisturbed performance of the repository.

The second scenario is driven by the regulatory criteria set forth by the Environmental Protection Agency (EPA) for radioactive waste disposal (U.S. Environmental Protection Agency 1985). These criteria require that in addition to undisturbed performance, the repository must be evaluated for human intrusion in which some future society inadvertently drills through the repository (Lappin et al. 1989; Reeves et al. 1991; WIPP Performance Assessment Department 1992). In this human-intrusion scenario, a drillhole penetrates both the repository and a hypothetical pocket of brine in the Castile Formation (Figure 5). While current drilling regulations require that such drillholes be plugged, the human-intrusion scenario assumes that over time the plugs will degrade, thereby allowing pressurized brine to flow upward through the repository. It is assumed that brine flowing through the repository will pick up dissolved radionuclides and that this contaminated brine will enter the Culebra Dolomite, where it will be carried laterally to the site boundary. In order to assess the regulatory impact of this scenario, it is important to understand the flow and radionuclide transport characteristics of the Culebra Dolomite.

Flow and Transport in the Culebra Dolomite

The Culebra Dolomite is the most permeable, laterally continuous unit overlying the WIPP repository and, therefore, represents the most likely pathway for off-site radionuclide transport for the human intrusion scenario (Lappin et al. 1989). This dolomite unit is approximately seven

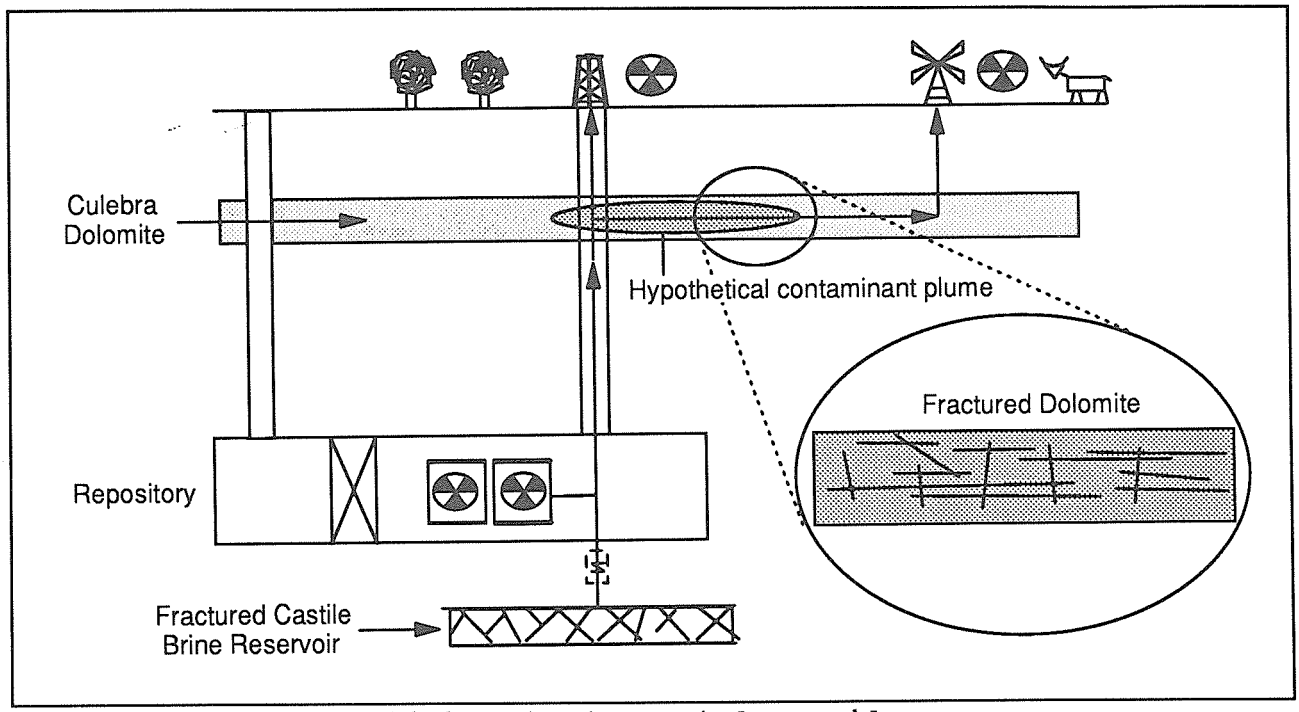

Figure 5. Schematic illustration of the human-intrusion scenario. [not to scale]

meters thick and has both horizontal and vertical fractures. Extensive hydraulic testing of the Culebra has been carried out at 41 different locations, including large-scale pumping tests centered in drillholes WIPP-13, H-3, and H-11 (Figure 6). These tests reveal the location of the more permeable portions of that Culebra Dolomite and provide important data for the analysis of water movement through this unit (LaVenue et al. 1990).

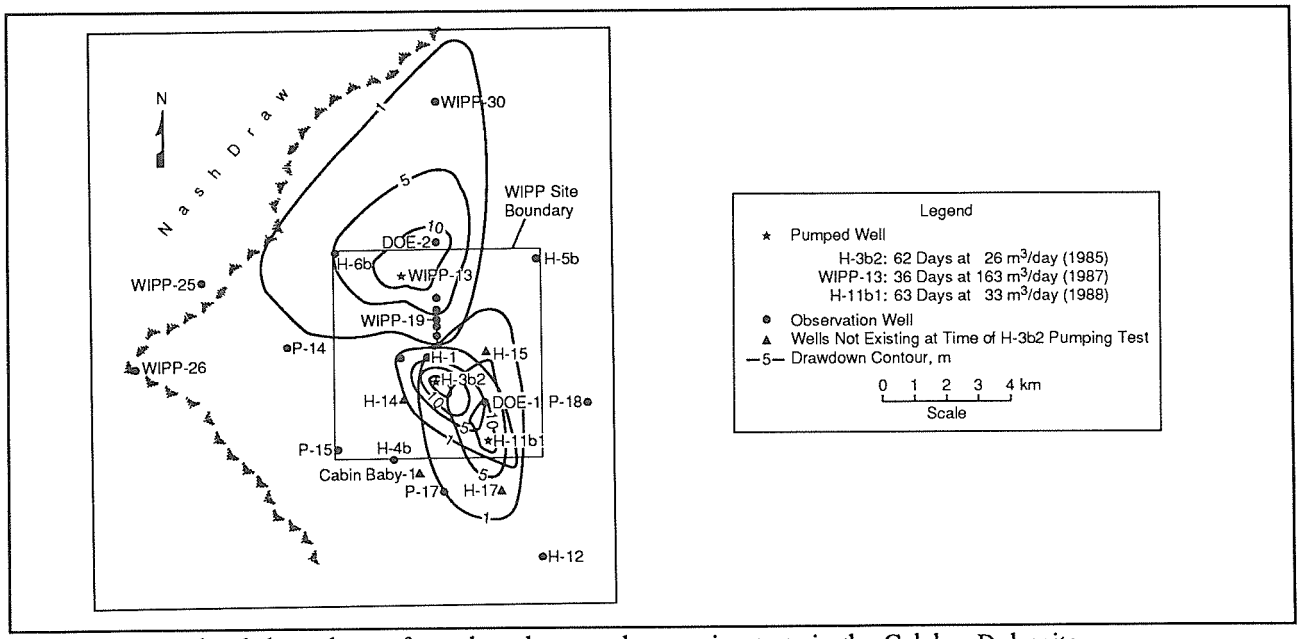

Figure 6. Water level draw downs from three large-scale pumping tests in the Culebra Dolomite.

In addition to extensive hydraulic testing to characterize groundwater flow, tracer tests have been completed at five locations to determine the transport characteristics of the Culebra (Jones et al. 1992). In these tests, nonreactive tracers are injected at as many as three wells while water is pumped from a nearby pumping well (Figure 7). Tracer concentrations in the pumped water are then measured and plotted versus time. These tracer concentration curves are then analyzed to provide important information about how contaminants such as dissolved radionuclides would move through this fractured rock unit. An important question that is being addressed by these tracer tests is to what degree, when relatively concentrated solutes flow through a fracture, do significant quantities of solute diffuse into the rock matrix adjacent to the fracture. This matrix diffusion process would significantly retard lateral transport of contaminants.

Hydraulic- and tracer-test data are used to construct computer models of groundwater flow across the site and to examine the transport for the hypothetical human intrusion scenarios (Lappin et al. 1989; Reeves et al. 1991; WIPP Performance Assessment Department 1992). These models are used to quantify the uncertainty in transport calculations due to limited knowledge of parameter values. These models are also a powerful tool to examine a variety of "what if" scenarios that provide important information about the behavior of the hydrologic system in the vicinity of the WIPP repository.

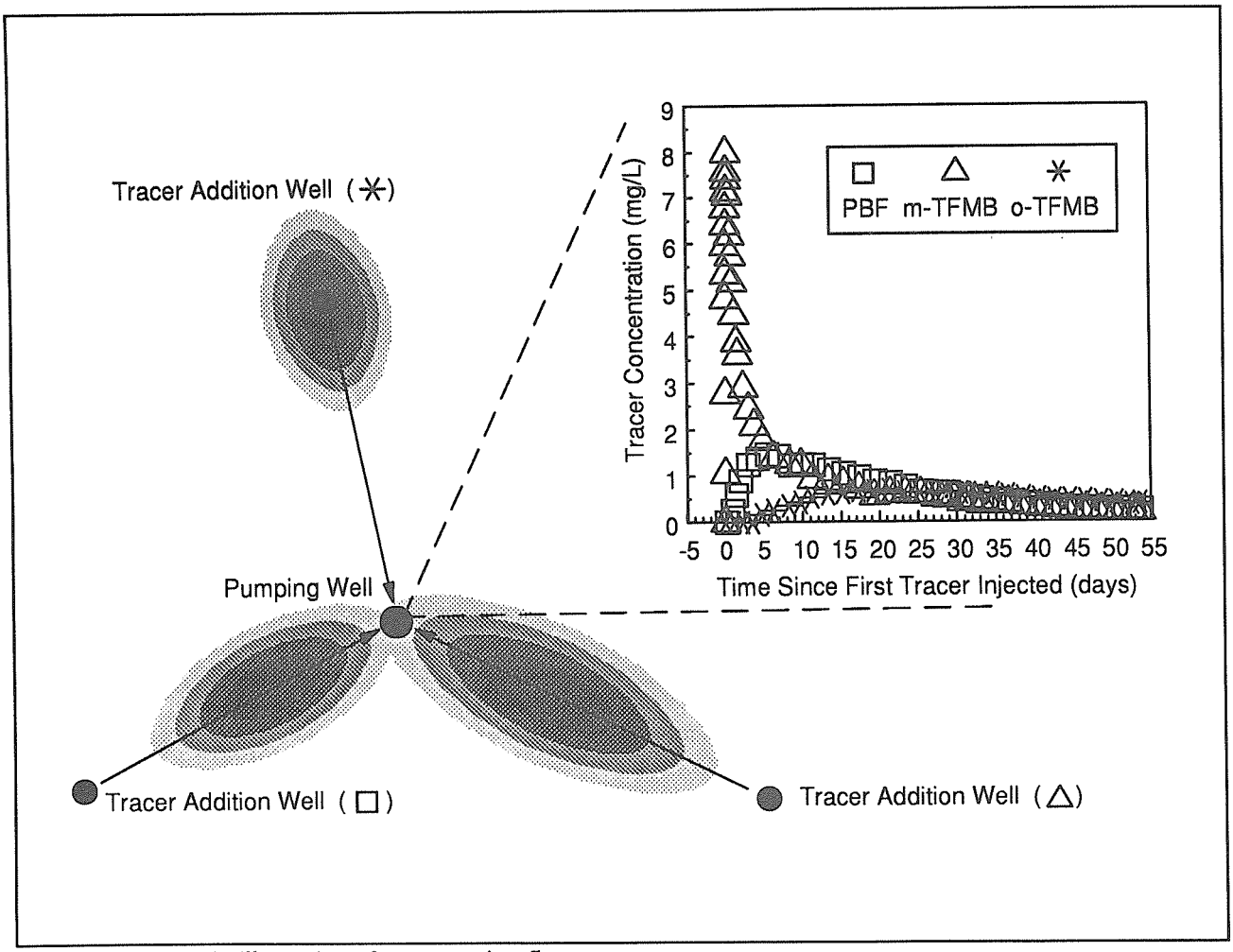

Figure 7. Schematic illustration of a converging flow tracer test.

Brine and Gas Flow at the Repository Horizon

The halite of the Salado Formation that surrounds the WIPP repository is an extremely low permeability rock. In fact, there is some question as to whether brine would flow through this rock at all. In-situ testing at the repository horizon has revealed that there is indeed a small quantity of brine that may flow through some of the impure halite and thin anhydrite layers at the very high pore-pressure gradients that exist adjacent to excavations in the salt.

Quantifying flow parameters in these very low permeability rocks is extremely difficult because the volume of flow is so small. Hydraulic tests to measure permeability have been carried out in a series of small-scale tests in different Salado layers (Beauheim et al. 1991; 1993). In addition, a 3-m-diameter, 110-m-long cylindrical room was excavated at the repository horizon to monitor the rate and volume of brine inflow under controlled conditions (Nowak 1990). Over the past four years, approximately 150 liters of brine have been collected from this experimental room. Although some brine may have been lost to evaporation or trapped in a localized fractured zone around the room, this experiment confirms that the quantity of brine that can flow though the halite is extremely small compared to most other common rock types.

Another important hydrologic issue for assessing long-term repository performance is the potential for generating gas by corrosion of the metal barrels that contain waste, metal in the waste, or by microbial degradation of cellulosic materials in the waste. Laboratory studies have shown that gas-generation rates are much higher if the waste is submerged in brine than when waste is exposed only to humid conditions (Brush et al. 1992). An important scenario being evaluated is that when the salt deforms and a disposal room starts to creep shut and encapsulate the waste, a small amount of brine flows into the room (Figure 8A). Contact of this brine with metal leads to gas generation and causes fluid pressure in the room to rise. At some point, pressure in the room may get high enough to drive brine and/or gas outward from the room (Figure 8B). The most likely pathway for brine and gas flow is the thin anhydrite layers, which have slightly higher permeability than the surrounding halite. To assess the impact of gas generation on long-term repository performance, one must understand how the presence of gas influences release of radionuclides under the human-intrusion scenario. The potential for lateral transport of volatile organic compounds from the waste within these thin, anhydrite layers also must be evaluated.

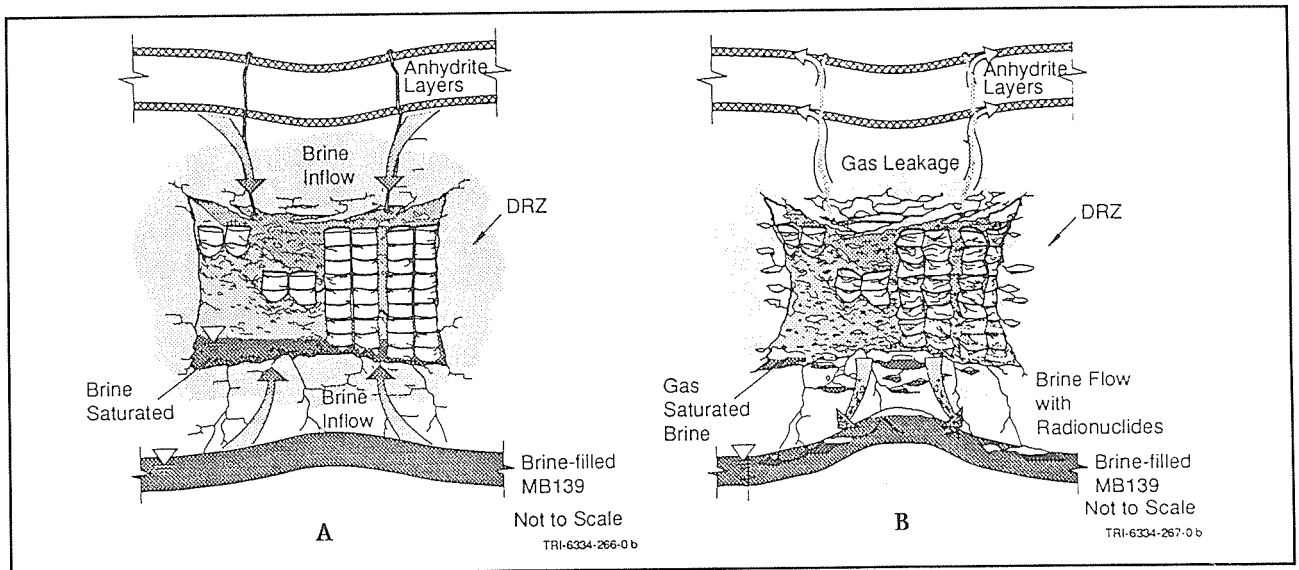

Figure 8. Schematic illustrations of room closure and brine inflow early in the post-closure time period (A) and brine and gas outflow at a later time (B) in response to gas generation by corrosion and/or microbial processes.

An important tool for evaluating these scenarios is numerical flow and transport models (Davies et al. 1992; WIPP Performance Assessment 1992). Data for these computer models are provided by both laboratory and in-situ hydraulic testing of the halite and anhydrite layers. Ongoing experimental and model-development work is focusing on reducing uncertainty and on developing a better understanding of the coupling between the hydrologic processes of brine and gas flow to and from disposal rooms, the mechanical process of room closure and consolidation, and the chemical processes that control gas generation.

CLOSING COMMENTS

A high level of confidence in flow and transport models at the WIPP is important because these models are a critical component of the analysis of long-term repository performance under a wide variety of conditions. One approach taken to develop confidence has been for the WIPP project to participate in the International Project to Study Validation of Geosphere Transport Models (INTRAVAL). The objective of INTRAVAL is to increase understanding of how various geophysical, geohydrologic, and geomechanical phenomena influence radionuclide transport and how these phenomena are described by the mathematical models that provide the basis for numerical models of system behavior. Multiple working groups from the international scientific community use information from specific laboratory and field experiments, as well as analog studies, to test both conceptual and mathematical models. Two WIPP test cases have been submitted to INTRAVAL, one on brine flow in the Salado Formation and one on flow and transport in the Culebra Dolomite. For each test case, WIPP data were submitted for evaluation and analysis (INTRAVAL 1993). Feedback from INTRAVAL participants has been extremely useful for evaluating the strengths and weaknesses of field tests and mathematical models of the hydrologic system at the WIPP.

Over the next few years, experimental work will continue to address key data needs and resolve remaining hydrologic issues. This information will then be incorporated into assessments of the long-term performance of the entire WIPP disposal system. This performance assessment will provide the technical basis for a formal Department of Energy compliance submittal to the Environmental Protection Agency.

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ACKNOWLEDGEMENTS

The author would like to thank Susan Howarth and Al Lappin for their technical reviews, and Tina Johnson and Ed Lorusso for their technical graphics and technical editing support. This work was supported by the U.S. Department of Energy under contract DE-AC04-94AL85000.

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