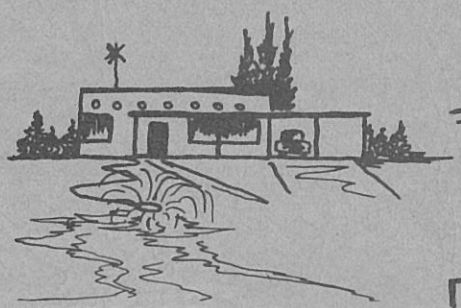
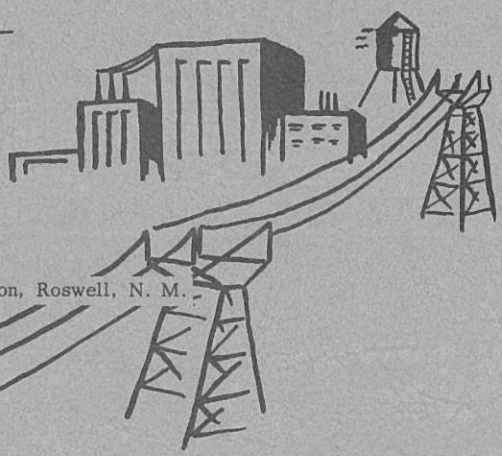
SECOND ANNUAL

WATER CONFERENCE

NEW MEXICO A&M COLLEGE

NOVEMBER 7&8, 1957





AGRICULTURAL EXPERIMENT STATION

AGRICULTURAL EXTENSION SERVICE

with the cooperation of Southspring Foundation, Roswell, N. M.

Committee on Arrangements for Conference

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K. A. Valentine	Robert Guice
John Gaume	H. R. Stucky - Chairman

Southsprings Foundation, Roswell, New Mexico, through Mr. Rogers Aston, representing the Foundation, gave valuable assistance in financing the publication of this report.

FOREWORD

Water is the life-blood upon which the agricultural and industrial development of New Mexico is founded. As our New Mexico population increases and as agricultural production is intensified, water will become increasingly important. Recognizing these facts, an annual state-wide Water Conference was instituted in 1956 by the New Mexico College of Agriculture and Mechanic Arts. These conferences are open to every interested person and are designed to permit and encourage a free and constructive consideration of New Mexico's water problems. The first two conferences were held in Milton Hall on the A and M Campus in early November of 1956 and 1957. The Third Annual Conference is planned to be held at the College in the fall of 1958.

The Conferences are attended by leaders in business, agriculture and government from many areas of New Mexico. The exchange of ideas and the bringing together of the papers presented at each Conference into a report such as this one, has helped focus the attention of all people of the state to the need for a definite program of water development and conservation. New Mexico is becoming more aware that water is one of its most valuable and scarce resources and that conservation and beneficial use of our limited water is vital to all of the people of the State.

The papers appearing in this publication are in the order in which they were presented. The program which follows this statement will serve as an index to the papers.

The Conference was sponsored by New Mexico College of Agriculture and Mechanic Arts through the Agricultural Experiment Station, the Agricultural Extension Service and the Agricultural Research Service, U.S.D.A.

Appreciation is extended to the Southspring Foundation of Roswell, New Mexico, for financial assistance in publishing this report.

A limited number of copies of the Conference Report are being processed for distribution primarily for reference purposes.

H. R. Stucky

H. R. Stucky, Head
Department of Agricultural Economics
and General Chairman of New Mexico
Water Conference

NEW MEXICO WATER CONFERENCE PROGRAM

New Mexico College of Agriculture and Mechanic Arts
State College, New Mexico

November 7 - 8, 1957

Milton Hall (Student Union Building)
New Mexico College of Agriculture and Mechanic Arts Campus

Theme of Conference

"WATER FOR NEW MEXICO - YOUR PROBLEM AND MINE

Thursday Morning - November 7

8:00 Registration - Milton Hall

General Conference Chairman - H. R. Stucky

9:30 Invocation - Rev. Jack DeVore
First Baptist Church, Las Cruces, New Mexico

Open Meeting and Introductions Page Number

9:45 - 10:00 Welcome and Comments on New Mexico A&M's Interest in the State Water Problems

Dr. Robert H. Black - - - - - - - - - - - - - - - - - - - 5
Dean & Director of Agriculture
New Mexico A & M
Chairman of Morning Program

10:00 - 10:30 Public Recognition of the Nation's Water Problems

Charles C. Butler - - - - - - - - - - - - - - - - - - - 7
Director of Land and Water Use
Farm Bureau Federation
Washington, D. C.

10:30 - 12:15 Public Recognition of New Mexico's Water Problems

Introduction of Governor Mechem

Senator Jesse U. Richardson
Chairman Board of Regents
New Mexico College of A & M A

State Government Recognition

Governor Edwin L. Mechem - - - - - - - - - - - - - - - - 18

2:15 - 2:35	Water Compacts - Experience and Mechanics	Page Number
	J. D. Weir, Attorney - 56 Las Cruces, New Mexico	
2:35 - 2:55	1. Transfer of Water Rights - underground or surface - between farmers, from farmers to Municipalities and Industry. 2. Implications of the term "Beneficial Use" of water.	
	Charles D. Harris - 65 Special Ass't. Attorney General, New Mexico Roswell, New Mexico	
2:55 - 3:15	Recess	
3:15 - 5:00	Open discussion: Administrative, Legislative, and Judicial Aspects of Water Laws in New Mexico	
	Moderator: Robert E. Clark, Professor of Law, University of New Mexico	
7:30 p.m.	Banquet - Milton Hall	
	Chairman: Lloyd C. Calhoun Member N. M. Economic Development Comm. Hobbs, New Mexico	
	Speaker: D. D. Monroe Clayton, New Mexico	

Friday Morning - November 8

	Chairman: A. W. Langenegger Hagerman, New Mexico	
	Management of Irrigation Water	
8:30 - 9:15	Present and Future Methods for Efficient Irrigation	
	Dr. Vaughn E. Hansen - - - - - - - - - - - - - - - - - - - 72 Professor of Irrigation Utah State University Logan, Utah	
9:15 - 10:00	Water Application and Requirements for Crops in New Mexico	
	Dr. C. H. Diebold - 78 Staff Soil Specialist Soil Conservation Service Albuquerque, New Mexico	

10:00 - 10:15 Recess

Page Number

10:15 - 11:15 Panel Subject - How to Get the Most Efficient Use of Water - (about 12 minutes each)

Sprinkler Irrigation

Lined Ditches

Underground Pipe

Land Management to Minimize and Utilize Waste Water

11:15 - 12:10 Discussion

12:15 Lunch

Afternoon

Chairman: A. G. Triviz, Associate Director,
New Mexico Extension Service

1:15 - 3:00 Panel On Income Producing Value of Water When Used by Different Industries Including Agriculture and in the Various Areas of New Mexico.

NEW MEXICO A & M'S INTEREST IN THE STATE WATER PROBLEMS

Dr. Robert H. Black*

Figuratively speaking, water is the symbol of purification and regeneration. We cannot live without water; we could live better if we knew more about it. Each year we become increasingly aware of its value. In essence, water is life. It is well that we consider its sources in order that we might become more aware of our need to use it more efficiently. Ninety-seven per cent of the available water exists in 300 million cubic miles of sea. This is salt water, and as yet no cheap means for its utilization has been devised. This leaves three per cent of the water which could be classified as fresh. Two per cent of the total water, or two-thirds of the fresh water, is locked up in the polar cap, which leaves only one per cent of the total water which can be used for human consumption, for livestock, and crops. Simply stated, it means that only one gallon out of every hundred gallons is usable. This usable water goes into many activities. Today each American uses more than 12 hundred gallons daily for human consumption, growing crops, cooking, sewage, manufacturing, air conditioning, etc. Our population has reached 170 million people who use more than 200 billion gallons of water daily. It has been estimated that this need will be doubled by 1975.

Much must be done to increase the efficiency of water usage. At the present time we retain and use only about one gallon out of every twenty three gallons of rain. Thomas Fuller once said, "We never miss the water 'till the well runs dry." It is wise for us to take stock of our available water sources and do everything within our power to use it wisely. It is amazing to consider the amounts of water that may be used in manufacturing processes. In a recent report, it was stated that 5 million pounds of water are needed to make a ton of synthetic rubber; 2 million pounds of water are necessary to make a ton of rayon; 40 million pounds of water are necessary to make a ton of bromine.

Irrigation is one of the largest users of water and a very important one for the production of food and fiber. A fourth of a ton of water is needed to grow a pound of grain; one-half ton of water is needed to grow a pound of cotton. Irrigation is highly important to the agriculture of New Mexico. Therefore, New Mexico A & M College has taken a strong interest in the State's water problems. In 1955 in the United States, some 91 million-acre feet of water was used to irrigate 34 million acres of crops. Seventy per cent of this water was surface water, while 30 per cent of it was ground water. The number of wells in New Mexico have increased considerably, and by 1955 there were already more than 75 hundred wells in this State.

*Dean and Director of Agriculture, New Mexico College of A & M A

The Experiment Station at New Mexico A & M is carrying on research with crops and water. There are a variety of studies being carried on at the present time. Our Agricultural Engineering Department has two projects--one, cotton irrigation on sandy land, and another, studying alfalfa irrigation. Our Department in Agricultural Economics is pursuing research dealing with the economics of water laws, economic uses of San Juan water, costs of irrigation production, and pump-irrigation economics. Our Agronomy Department is studying the practices of irrigating pastures. The Dairy Department is conducting an experiment on water hardness and its use in cleaning dairy equipment. At our Middle Rio Grande Substation at Los Lunas, we are carrying on research on the irrigation and nutrition of chile. Our Northeastern Substation at Tucumcari is doing research on fertilization of cotton and irrigation. We are cooperating with the Great Plains Program to assist in every way possible to encourage more surveys of the available water and to encourage its efficient usage.

Water is vital for irrigation, industry, manufacturing, municipalities, rural homes and livestock, power, recreation, wildlife, and we could name many many more. This conference should move us another step closer to an understanding of our water problems in New Mexico. We welcome you to the campus of the New Mexico College of Agriculture and Mechanic Arts. This is your landgrant college. We sincerely hope that your stay is a pleasant and profitable one. If we can be of service to you, either during your stay on the campus or later, we are pleased to offer our assistance.

PUBLIC RECOGNITION OF THE NATION'S WATER PROBLEMS

Charles C. Butler*

It is indeed a real privilege to be your opening speaker at the Second Annual New Mexico Water Conference.

I am delighted with this opportunity for a number of reasons. First, I am happy to participate in a program in the State of New Mexico. This is one of the few states in the United States in which I have never before taken part in a meeting, and I have looked forward to attending this conference with much interest. I am always glad to participate in water meetings because water and water resource development are my favorite subjects. The privilege of participating in a meeting with your Conference Chairman, Dr. H. R. Stucky is always appreciated. Over a decade ago we started attending meetings together in another of the great western states - the State of Montana.

Before proceeding further, I wish to congratulate those responsible for the annual water meetings in your state. They are progressive citizens who realize that water is a real problem and who desire to provide a means of public discussion and recognition of this ever-increasing problem. The theme of your conference is most appropriate, "Water For New Mexico - Your Problem and Mine." From the subject which has been assigned to me, I am sure you will not object if I broaden that theme for purposes of my presentation to, "Water For America - Your Problem and Mine."

Water is fast becoming of serious concern to every individual in America. Without fear of contradiction it can be said that water is now the number one resource problem of our country. It is becoming critical at such an accelerated pace that possibly it may crowd crop surplus from the front page within the next two decades.

Water has been a number one problem in New Mexico and other western states ever since the arrival of the first settlers. In many other parts of the nation water has been so plentiful that it has been taken for granted until recent years. Now it is of serious concern over the entire country. In fact within the past 12 months over a thousand cities and towns from coast to coast have been complelled to curtail the use of water. Ground water tables have fallen in many sections of the country in recent years, and in many areas water is now being pumped from such depths that its cost is almost prohibitative. At the present rate of water table decline, many areas will go out of production in the forseeable future. All over the country streams no longer provide adequate supplies of usable water during critical drought periods.

What is so important about water to warrant all this attention? Why are we so concerned? It is simply because water is the most basic material known to the world. Where there is life there must be water. There is no

*Director of Land and Water Use, American Farm Bureau Federation, Washington, D. C.

organism of any kind, plant or animal, which is not highly dependent on it. A seed cannot sprout without it and even the lowest forms of desert life must have some water. It is basic in formation of the protein molecule, the fundamental material in all living matter. For every pound of dry material in a plant from 300 to 1000 pounds of water is required for its production. Animal body tissues are 70 to 90 percent water and a loss of 10 percent will result in death.

Water serve the consumptive life needs of every plant, animal and human on the earth. And it goes far beyond the simple requirements of life - it becomes the very heart of our agriculture, industry, commerce and other aspects of our highly organized economic life. Only where water supplies have been adequate and assured has civilization flourished - where it has been deficient or irregular, growth has been forestalled or entirely prevented.

Let me repeat - water has become the number one resource problem of our nation. I relaize that this is a strong statement, but I believe it to be true, because water is a controlling factor in the development of our national economy, whether it be in the North, South, East or West. Without adequate water supplies our nation cannot continue to grow.

What we do about our water supplies in the future can cap our national economy near its present level, or it can serve as a gusher toward higher levels of economic growth and development. The problem is with us now and will become even more serious in future years. Experts tell us that our water demands will have doubled by 1975, a period of 18 short years.

What has caused our growing water shortages? The average annual precipitation over the nation as a whole is still 30 inches. It has neither decreased or increased since weather records have been kept. Our average daily precipitation is about 4,300 billion gallons, of which we use a little over 6 percent of the total. Still as a nation we are faced with a shortage of water. Why?

In the first place the distribution of precipitation over the nation ranges from 4 to 120 inches per year. This in itself creates many water problems, both surpluses and shortages. About 70 percent of the precipitation is returned to the air by evaporation or transpiration. This leaves us working with only 30 percent of the total. Terrific inroads have been made on this 30 percent, our working supply of water, in recent years, because of our rapidly increasing population and rising standards of living.

At the turn of the century our country supported a population of about 75 million people. Not long ago this number had increased to 172 million and if this accelerated growth continues we will have a population of not less than 228 million by 1975. Where each individual, personally, used a few gallons of water per day fifty years ago, each person now uses approximately 150 gallons. If we include water for all purposes, every man, woman and child now requires 1500 gallons of water daily. This all adds up to unheard of demands for good quality water in amounts that almost stagger the imagination. The cause of

our present situation is nothing more than increased per capita requirements and an ever increasing population.

Water is matter - and in accordance with the laws of nature it can neither be created or destroyed. Therefore, we cannot look forward to increasing the total supply of water. We will have adequate water supply to meet the needs of our people only by making the best possible use of the water we have. This is the problem with which we are faced. It is up to us as individuals, groups and organizations to solve this problem in a manner which will be in keeping with our traditional democratic form of government.

We have been looking at the physical side of water problem. Let us turn our attention for a moment to some of the legal aspects of this ever-changing picture. The legal problems are now becoming just as apparent as the physical problems and no doubt the future will see many changes in our former concepts regarding the law of water. This will be true over the entire nation but will be especially true in the states east of the 98th Meridian where necessity and economic needs will rewrite the water laws just as they wrote the doctrine of prior appropriation into the law of the West.

As we make the necessary legal changes we must be most cautious to achieve progress without the loss of vested rights and without further intrusion of the federal government into the affairs of our citizens.

Many former legal concepts are already being challenged and many new questions are arising as a result of the critical water problems facing our country. Let's look at some of them -

There has been an age-old conception that the owner of land owns from the center of the earth to the top of the sky, and therefore, the water under his land.

Will this concept be abandoned and the land owner required to obtain a right to the use of water under his own land?

Diffused surface water has always been considered to be the property of the land owner. Will an owner continue to have a right to store this type of water?

Will distant cities be allowed by some legal process to appropriate water from under farm land and haul it away for their use?

Will public need be sufficient to justify the diversion of a stream to another valley, thus compelling the sharing of water with other areas?

What rights accrue to the builder of a dam who impounds water on a stream? Must lower lying land owners pay him for water he releases? What if the builder was the Federal government?

If the builder of a dam inpounds water behind his dam which would otherwise be wasted, does he become the owner of the water? What may he do with

the water? May he sell it? To whom?

Who is to determine which use of water is most important and the relative ranking of water uses? Who will have authority to change this determination once it is made?

How much government control of water are we willing to agree to? Complete control of major rivers? Of the tributaries? Of the creeks that feed the tributaries? What about the small watershed reservoirs and the farm ponds which also contribute to the total water supply?

Must the public be allowed access to water impoundments on private lands.

How far up the river will we allow the "Commerce Clause" to stretch? It is moving under government control toward the top of the watershed - where and how will we stop it?

How far are we willing to go with the presently expounded theory of federal ownership of water? How can we keep this theory from being accepted?

What place does the conservation of water for recreational purposes have? Is this a beneficial use? Is the use of water for fish and wildlife more important than agricultural and industrial uses? Who is to say?

What is the appropriate legal approach to compel municipalities, public agencies or the Sovereign States themselves to perform their duty in eliminating stream pollution? (The legal problem relating to industry is not too difficult).

These are only a few of the legal questions as they relate to water that are being asked across America today by those familiar with water problems. These questions must be answered but as of today there are few firm answers to any of them.

The answers to some of these questions will have very real affects upon the future economy of our nation and upon the governmental structure of the country.

If we are inclined to wonder why many of these questions haven't been answered or why our water problems are so numerous we have only to look at our national policies and programs for water resource development. Perhaps it would be more appropriate to say, "Our lack of national water policies and our overlapping, duplicating and conflicting programs for water resource development."

Forty three federal agencies have responsibilities of one extent or another in this field. Twenty five agencies have a major concern in water resources and power and the remaining 18 are concerned to a lesser degree. Most of these agencies are in the Departments of Interior, Agriculture,

Defense and Health, Education and Welfare. In addition there are a number of independent agencies such as the Federal Power Commission and the Tennessee Valley Authority.

The major water resource agencies have been the Corps of Engineers, Bureau of Reclamation and the Soil Conservation Service. To these now have to be added the Agricultural Conservation Program Service, the Great Plains Conservation Program and the Conservation Reserve of the Soil Bank.

The Corps was established in 1824, Reclamation in 1902, Forest Service 1905 and the Soil Conservation Service in 1935, and the others in recent years.

A close look at the program of these agencies reveals a picture of inter-agency rivalry and overlapping and duplication. Conflicts between the Corps of Engineers and the Soil Conservation Service are especially prevalent at the present time as a result of the Corps serious opposition to the Watershed Protection and Flood Prevention Program.

Unfortunately, water resource development programs have become so large and so important to every Congressional District that much of the program has become a political football - a pork-barrel program. This is especially true with the program of the Corps of Engineers and to a lesser extent with the Reclamation program. With the demand for these developments by local groups, many who feel they are getting something for nothing, and with the constant support of the hundreds of agency employees who are out to sell their program, the water resource development programs have grown to their present stature in an almost completely uncoordinated manner.

The Corps of Engineers presently have authorized projects which they estimate to cost $9 billion dollars and they are pleading with Congress for approval of additional project authorizations which by their own calculations will cost approximately $1.5 billion. The history of Corps of Engineer projects shows that they eventually cost approximately 2¼ times the original estimated cost. The Corps carries on their own operation and maintenance program from appropriated funds. They estimate that over a 50-year period the operation and maintenance cost will be equal to the original cost of construction. On this basis, the projects presently authorized, plus those for which the Corps is requesting authorization, will place a future commitment on the tax payers of this country of over $40 billion. This represents a future tax of over $1000 for every family in America just to pay for the Corps of Engineers program which is presently authorized but unconstructed plus the program for which they are presently requesting authorization.

In addition to this the Bureau of Reclamation has authorized water resource projects estimated to cost over $3.3 billion.

This gives you some idea of the way certain phases of our water resources development program has gotten out of control. There is little wonder that the President's Advisory Committee on Water Resource Policy reported, "The greatest single weakness in the federal government's activities in the field of water resource development is the lack of cooperation and coordination of the federal agencies with each other and with states and local interests." Responsibility is split among many groups, each pretty much going their own way, with no agency authorized to determine the policies, make decisions and give the supervision that is, and will be, required if water resource development is to meet our nation's needs.

This situation will continue to grow even more serious unless legislative steps are taken to bring about a better coordinated program between Federal agencies, interstate organizations, state and local agencies and organizations and individuals for the development of our nation's water resources.

The American Farm Bureau Federation and a number of other national organizations have devoted a great deal of attention to possible legislative proposals that might help bring about the desired objectives in water resource development. A number of proposals have been drafted and discussed with the Administration, Congressional Committees, individual members of Congress and agency personnel. It has been found most difficult to draft legislation that would accomplish the objectives sought and still have a possible chance of becoming law.

We now have a draft of a bill, based on long standing policies of the American Farm Bureau Federation, which we hope will be introduced early in the next session of Congress. The voting delegates to our annual meeting next month could change our policies relating to water resource development and thus require changes in the proposed bill. However, since our organization has had these general policies for over a decade, significant changes are not apt to be made. The purpose of the proposal is to further cooperative action by state and federal agencies in planning the conservation, development and use of water resources in major interstate rivers and their tributaries, to establish an Interstate Rivers Commission advisory to the Congress and to authorize the establishment of Water Resource Committees for interstate rivers and their tributaries.

The proposal would establish an Interstate Rivers Commission as an independent advisory agency to the Congress. The Commission would consist of five professionally qualified persons in the field of water resource management. The Commission members would be appointed by the President with the consent of the Senate, and one member would be designated by the President as chairman and principal executive officer of the Commission. The term of office of the Commission members would be five years.

All proposed water resource projects involving federal participation, the estimated cost of which exceeded $5 million, would be transmitted to the Commission. The Commission would review such projects and

prepare reports to the Congress and to the President setting forth the Commission's recommendations relative to economic justifications and engineering feasibility, the allocation of costs, reimbursement from beneficiaries, whether or not the proposed project would be an efficient and comprehensive development of the resource in the public interest and other information provided for by Act of Congress.

In addition the proposal would provide congressional consent to an agreement between the appropriate state governments and the federal government to establish a Water Resources Committee for any interstate river and its tributaries. The President would be authorized to consult with the Governors of the states involved to further the negotiation of such agreements. Each committee would consist of a nonvoting chairman, appointed by the President with the consent of the Senate, a representative of each federal department having water resources responsibilities and a representative or representatives from each state appointed by the Governor. The number of state representatives would be at least equal to the number of representatives of federal departments.

The agreement establishing a Water Resources Committee for an interstate river may contain provisions as follows:

1. The functions the Committee shall perform, which may include any or all of the following:

   a. To serve as the principal and continuing agency for the voluntary coordination of the activities of state and federal agencies with responsibility for water resource programs - and particularly with respect to planning and development activities.

   b. To prepare and keep up to date a plan for the development of the river and its tributaries and to publish such plan.

   c. To review and develop recommendations relative to any proposed water resource development or project on the river or its tributaries which involves a total expenditure of $1 million or more and to publish such recommendations.

   d. To prepare and publish, and submit to the President, the Congress, the Governors and legislatures of the states involved an annual report relating to the administration, conservation, development and use of the water resource of the river and its tributaries.

2. The financing of the Committee functions, the employment of personnel and related administrative matters.

The Commission and any Committee organized under this proposal would be required to refrain from any activity designed

to obtain the enactment of either state or federal legislation except that they might publish their recommendations and other material and appear before any duly constituted state or federal legislative or executive body to present their views and recommendations relating to the development and use of water resources.

The federal agencies having responsibility in the field of water resource management would be authorized and directed to cooperate with the Interstate Rivers Commission and with any Water Resources Committee. They would also consult with the Commission or Committee with respect to the administration of water resource programs and submit any project plans or major revisions thereof for review.

We are of the opinion that the enactment of this proposal would go a long way toward bringing about better coordination and cooperation between all levels of government and the public in the development of the Nation's water resources.

No doubt some would say that the proposal does not go far enough toward elimination of many of the undesirable aspects of present water resource development programs. While this may be true it probably goes as far as any legislative proposal in this regard with a chance of enactment. Powerful forces are in operation in this country to prevent the passage of legislation that would in any way slow down large federal water resources projects. The mammoth federal lobby is not the least of these forces.

Perhaps some of you are asking why the protection of water rights obtained under state law has been left entirely out of this proposal. That is a good question because the protection of individual water rights is the most important phase of needed water legislation facing our nation. It was not included in this proposal because the subject is adequately covered in Senator Barrett's S. 863 - the Western Water Rights Settlement Act Proposal.

For the benefit of those who may not be acquainted with the background leading to the introduction of this proposal in Congress and what has happened relating to this subject in recent months, let me summarize the problems that exist relative to the protection of water rights obtained under state law.

Senator Barrett's bill was introduced as a result of the controversy over the decision of the United States Supreme Court in the so-called Pelton Dam case in Oregon. For nearly a century prior to that decision it was the established rule that Western water rights were determined by state law.

Under the Desert Land Act of 1877 the Congress determined that the public lands of the western states should be patented apart from the waters located thereon and that the water would be reserved for the use of the

public under the laws of the states. As you know the economy of the public land states has been built upon that theory and policy.

The Pelton Dam decision cast grave doubts and uncertainty upon the validity of the water law principles accepted throughout the West. In this case the court held that the applicant for a license to build a power dam did not have to comply with the laws of the State of Oregon because the dam was located on reserve lands of the United States. In effect this was saying that the Western states had control over the waters on the unreserved public domain lands, but not on the reserved public lands. Naturally, there was immediate fear that the same rule could well be applied to the Forest Reserves from which comes 65 percent of all irrigated water used in the West.

This subject is even further confused by the attitude of the federal government in the litigation between Arizona and California over the distribution of the waters of the Colorado River. In this case the federal government is rather clearly contending that it is the owner and may do as it pleases with the waters of western streams regardless of the rights of the states or individuals. It argues that the United States acquired the Southwest from Mexico and that the United States therefore became the owner of that territory, including both the land and the water and that it has never transferred title of the water, so therefore still owns it. It is further argued that under Article VI, Section 3, of the Federal Constitution the federal government may make "all needful rules and regulations respecting the territory and other property belonging to the United States."

The contention is also being made by the federal government that under the "Commerce Clause" of the Constitution the waters of the Colorado are navigable, or could be made navigable by the expenditure of funds, and are therefore under exclusive jurisdiction of the federal government.

The claim is also being made that waters required for the development of now undeveloped desert public lands may proceed if the government so decides without any heed to existing rights required under the laws of the States.

It is further claimed that if the government sees fit, recreation facilities on government lands, including reserves for migratory waterfowl, by reason of government ownership of the water, may take precedence over the appropriative water rights of individuals acquired under the laws of the States.

These are extremely dangerous theories and especially when one stops to think that there is very little land area in the United States that was not once owned by the federal government. It is obvious that sustaining of any such theory is totally destructive of supposed property rights which have existed for many years.

Senator Barrett's proposal S. 863, undertakes to set at rest forever the theory and doctrine of federal ownership of water. It does so by providing that -

> "in connection with federal programs, projects or activities, no federal agency or employee of the government shall interfere with the exercise of any right to the use of water for the beneficial purposes theretofore acquired under and recognized by State custom or law, except when authorized by federal law and upon payment of just compensation therefore"

and further providing that,

> "subject to existing rights all unappropriated navigable and non-navigable ground and surface waters are preserved for appropriation and use by the public pursuant to State law."

and further providing that all federal agencies may acquire rights thereto only in conformity with the laws of the States, except under the power of eminent domain when expressly so authorized by Congress.

S. 863 has been before Congress during the past two sessions and in spite of support from practically every group with the exception of the United States Justice Department the bill has never reached the floor of either House or Senate. There are some indications at the present time that the Justice Department may possibly modify their opposition to the Western Water Rights Settlement Act proposal which may provide an opportunity for its enactment during the next session of Congress.

These are only a few aspects of the nation's many and varied water problems that are in need of public recognition. They are some of the more important phases of the problems and some that need public attention in the immediate future.

Our citizens must demand immediate action on some of the fundamental problems in the field of water resources, especially as they relate to the federalization of the waters of the United States. Until this is settled all other aspects of the nation's water problems are in vain.

You and I, as well as all other individuals and groups in this country have a tremendous stake in the future development of our nation's water resources. These resources must and will be developed for the benefit of our nation and its citizens.

I believe the most important question ahead in this regard is - How will these resources be developed? Will it be by local and state organizations and private interest? by the federal government? or by a well balanced combination of these various groups?

During the past two decades we have seen a concentration of more and more power in the hands of the federal government. It is well known that the concentration of power in a centralized government leads to loss of freedom. Once power is so concentrated it can be monopolized by those who might want to use it. When power is divided this cannot happen - just stop to think how true this could be in the field of water resources. Remember, they who control the water resources of America, control America.

I believe we can assure the control of our nation's water resource in the right hands if we keep the responsibility for the development as close to home as possible, keep the financial contribution of individuals and local, state and federal governments at a level in keeping with the benefits which each derives from the development; and if we refuse to turn over to the federal government jobs which can be done more efficiently by individuals, private organizations or local or state governments.

It has been an honor to participate on your program. My best wishes to all of you for a most successful conference.

STATE OF NEW MEXICO
EXECUTIVE OFFICE
SANTA FE

EDWIN L. MECHEM
GOVERNOR

November 25, 1957

Dr. H. Ralph Stucky
Professor of Agricultural Economics
State College, New Mexico

Dear Dr. Stucky:

It is a pleasure to have a chance to submit a resume of my remarks to the Water Conference, held at State College on November 7.

For the sake of brevity, I will not enlarge upon the main points that I tried to make, which were:

1. Adequate appropriation for the Engineer's Office to hire adequate engineers and legal talent.

2. Accelerated studies of ground water supplies, with particular attention given to migration of water.

3. Sedimentation control work, and

4. Detailed studies of conservation practices for re-use of water primarily to prevent waste and pollution.

One item should be added and that is -- a study needs to be made of our statutes on waste and the penalties prescribed therefor.

Sincerely,

E. L. Mechem

WOMEN'S VIEWPOINT ON OUR STATE WATER PROBLEMS

Thelma Immon*

When I was asked to speak to you on this subject, my first thought was that there would be very little I could say because most of my water problems have been related to ranch management. However, when I go rid of the forest, I could see the trees and realized that much can be said from the women's viewpoint.

First, let me say that we believe we do have a very good state water law even though people sometimes disagree on the administration and interpretation of the law.

We are interested, primarily, in the health and welfare of our families and since water problems are economic problems, they definitely have a direct bearing on our health and welfare. Concerning sanitation and cleanliness, I shall only say that we are glad for progress that has given us modern plumbing...but I am sure that the world is till full of little boys who wish that it weren't so convenient for mom to say, "Wash up Johnny, and be sure to get your ears clean."

Basically, there are two water problems and all the others stem from these which are, "too much" or "too little".

Let's discuss "too much" first, even though it is hard for us in arid New Mexico to visualize "too much". (You know what floods can do to any area and how detrimental they are to health, welfare and the economy of the locality as well as the country as a whole.) Last summer, a small residential area outside of Deming was flooded...along with the other problems it also contaminated the one well that serviced the area and made it unfit for human consumption for several weeks. (Undoubtedly, it is the responsibility of the states and federal government to do something about these conditions when major rivers are involved)...but is it their responsibility when areas such as the one in Deming, floods in Albuquerque and other places happen? Or should the real estate company that develops the land have the responsibility?

It might be well if the prospective homeowner would be more careful when he buys land, to purchase only in an area that is protected. This might decide the issue of "responsibility".

Then we have "too little" or the threat of "too little" available water which definitely effects the urban as well as the rural family. It seems that about the only time the urban family realizes there is a shortage of water is when they are advised to water the lawn at stated times...but their economy is directly or indirectly effected. However, it is quite different with the rural family. Heavy pumping, in conjested areas, along with prolonged drouth, may case the water table to be lowered which causes added

*State Chairman, Women's Committee, New Mexico Farm & Livestock Bureau and Deming Ranch Operator.

expense in drilling supplemental wells or deepening the old one. Along with this original expense, it means higher monthly power bills and can upset the whole economy of the farming operation...using money that might otherwise have been spent for better housing, medical or dental care or education, insurance and other items necessary to health and welfare.

We must use all available water if agriculture and industry are to be developed to their potential...this makes for better schools, better communities and happier homes...but over-use can be more harmful than under-use in an irrigated area just as drought effects the economy in non-irrigated areas. Perhaps there may be plenty of water farther down but until we get a cheaper form of energy to utilize that water, it can be economically infeasible to obtain it. Supplies can be exhausted.

Water is our most precious natural resource. Substitutes have been found for most of the others but I do not see a substitute for water in the forseeable future.

Population is increasing very rapidly in our state. Much of the increase is due to defense projects. We are concerned about "land grabs" by the federal government. We are aware that, so far, where additional water is needed for these projects, the government has purchased existing water rights...but what if a time comes when no one has any for sale and the government needs them? Can the Office of the State Engineer continue to protect our rights if the government decides water is needed more for defense than agriculture and industry? Several years ago, I spent several weeks in Newfoundland where the U. S. was in the process of building a defense plant. Federal personnel and people from other parts of Newfoundland had more than doubled the population of the small town practically overnight. Newfoundland is a backward country compared to ours and there was no central water system in the community but families were dependent on their own wells for water. Their normal rainfall is sixty inches a year but because of the added consumption of water, many wells had either gone dry or were going dry. This is food for thought when we compare our expected normal rainfall of nine to twelve inches to their sixty.

As lay-persons, we are not qualified to know all the answers to our water problems...but as citizens, we must be alert to them and be certain that we continue to have qualified people in office who can and will safeguard this most vital resource and that the responsibility for decisions is properly placed whether it belongs to the individual, state or federal government.

PUBLIC RECOGNITION OF NEW MEXICO'S WATER PROBLEMS

The County Government's Point of View

E. G. Minton, Jr.*

The United States with it's vast resources, multiple organizations for the improvement of it's citizens way of life, cannot be matched by any other country in the world. Regardless of the fact that Russia has beat us to a Sputnik, and the second satelite with it's husky dog passenger, we in America are the most fortunate race of people on earth today. The United States has always put the welfare of the American people first, and by doing so, have made tremendous strides in disease control, soil and water conservation, improvement, development, and control of crop blight for increased farm production. Made possible electricity and telephones to the rural dweller. Federal Aid highways as well as thousands of other ways to improve our every day lives including rural and small communities water systems.

The various states, in a smaller way, have followed in the footsteps of the Federal Government to try to make our living standards better. In every way, the emphasis has been on the human being, rather than on war machines for the destruction of the world and it's inhabitants. In New Mexico, the various state agencies have made tremendous strides in assisting local governments in aleviating problems or conserving our resources. The state highways are being improved continuously, our State College is making studies here and all over the State for the betterment of crop yields, improving of livestock breeds, making sheep produce more wool, making economic studies in the pumping of water, and probably most important, producing a top grade of future citizens.

The various cities, towns and communities are continuously making appeals to it's State or Federal governments for assistance of every type. Most of these appeals can be approved, some cannot. The State and Federal governments must therefore, maintain clearing houses, so to speak, staffed with experts in every field, for the purpose of studying these requests and appeals. If the request is found to be logical, probably some way is found to execute the request, if the request is found to be unsound or feasibly uneconomic, then it is denied.

As uncommon and rare as it may be, there are times when a county or community is determined to develop it's own ideas without the assistance of either the Federal or State government. It may have developed an attitude of keeping home business at home, or it may feel that under certain specific conditions, it is able to solve the various problems which arise within it's borders. Such a feeling arose in Lea County. Perhaps, it was because Lea County is fortunate to be rich in oil, and fast becoming rich in potash, that

*Director, Lea County Water Recharge Division, Lovington, New Mexico

it is financially able to handle many of the County's problems without outside aid. At any rate, Lea County is doing just that in regards to the problem of declining ground water.

Following the publication of the results of the U. S. Geological Survey and the State Engineer of New Mexico, regarding the inventory of available water in Lea County, with the probable life of available water, the people of Lea County became considerably concerned, and eventually evolved the idea of financing research and experiments in the possibility of increasing the small annual recharge, to lengthen the maximum life of it's water basin. The reason for a "keep at home" decision probably rested on the following facts, in addition to the fact that Lea County could finance any research necessary.

1. The County felt that it should be entitled to control and govern any program of improving it's natural resources.

2. The County felt that since the water was the basis for all the economy within it's boundaries, that it was too important an issue to postpone for an indefinite period of time in awaiting outside aid.

3. The County felt that the water problem within it's borders was of a community nature, and as a community, it would take immediate efforts to solve them.

4. The County realizing that it's water problem was of a community nature, that any improvement spelled investment, that by investment there was hope for a return.

Lea Countians are interested in the future of Lea County. Coupled with this as has been stated is the fact that Lea County is in position to invest in it's economy, and are more fortunate than other counties of New Mexico in this respect.

For the past year and a half we in Lea County have been carrying on a program of research and experiment, in the field of the feasibility, both economically and engineering wise, of artificially recharging the underground water basin. This program has been intensive, and concrete. Every endeavor has been made to concentrate the study into as short a time as possible. It is not complete. There remains considerable research and experiments. We feel a sense of pressure, knowing that our underground water basin, without some adjustment will arrive at a point where so many other ground water areas are today, overdevelopment with abandonment of valuable irrigated lands and abandonment of industry. We know we are overdeveloped in some areas. We know our natural recharge is small, probably less than present commitments show. We know that time will place our economy in jeopardy, for all of our economy is based on a secure future of water supply. We feel that any sound investment will be returned many fold. We realize fully, and with concern

towards the future, that something must be done. Artificial recharge may not be the complete answer, but we feel that it is important enough to make a complete engineering and hydrologic study.

The returns on investment from a water recharge operation in Lea County can be very attractive. It may provide an excellent opportunity to provide an inheritance to one's heirs. The use of recharged water will generate income in the future that would not have otherwise been possible. The fact that tangible additions are being made to the water inventory of our county will result in intrinsic values such as our people being able to plan further into the future, create interest in community affairs, and attract industry and investments to the County that might otherwise be discouraged. For these reasons the people of Lea County have a vital interest in water. We have high hopes, and this is an important feeling for any group, as they are able to plan, not for a short generation of time, but into an indefinite period.

Our plans in Lea County are not simple. The overall program will be an expensive one. We mean to continue to study and to plan. We want to be sure that there will be ample return on our investment. We feel that the recharge program will be feasible. At the present time we are in the process of organizing a Lea County Conservancy District for the primary purpose of artificial recharge. We feel that the existence of a Conservancy District will more than pay for it's self through it's functions, not only of recharge but also in the field of flood protection and the prevention of inundation to our agricultural lands, our towns and cities. There are many factors which enter into the existence of such an organization. Relevant cost and income factors must be considered. The proper costs to charge against a ground water recharge well in order to determine the feasibility of recharging, additional operating and maintenance cost required to keep the well in operation during it's lifetime, and the average life of a recharge well, must be considered. Experience with recharge wells is not sufficient to establish long--time records of maintenance figures. Monetary evaluations have not been made of the many benefits such as a reduction of damages to highways, lessened health hazards, possible use of the lake beds for production of grasses, and etc. However, it is almost certain that when these monetary evaluations and engineering studies are completed we will find a justification for a Conservancy District, as the income values will more than offset the maintenance cost with considerable to spare. I do not intend to go into these today, but merely to touch them lightly in order that you may get a more accurate idea why my county feels it's responsibility in curing the ills of it's water resources.

It is the hope of Lea County that through the activity of it's Conservancy District, there will be a successful halt to the declining water levels. We hope that in a few short years we will have made our towns and cities much safer from floods and inundation. We want our people to have a more secured feeling with a more secure water supply. We want industry and agriculture to come to Lea County. We want industry and agriculture to know that we can provide what they require.

NOTES ON NEW MEXICO'S WATER PROBLEMS

C. L. Forsling*

First, a brief word about the Pack Foundation. Charles Lathrop Pack was a lumberman who believed in the cause of conservation of our natural resources. He founded the Charles Lathrop Pack Forestry Foundation in the early '20's. Since that time the Foundation has contributed extensively in one way or another in its chosen field. In 1956, management of the Foundation became the responsibility of Mr. Arthur Newton Pack who has made Arizona and New Mexico his home for 25 years. In appreciation for Arthur Newton Pack's adopted states, the Foundation has allocated a large part of the resources of the Foundation to education and research on water and watershed problems in this arid Southwest. The hope is to help inform the people of this area on the facts and problem solutions on this all-important matter of water supply for now and for the future. It is a distinct pleasure for me, representing the Charles Lathrop Pack Foundation, to express these views on New Mexico's water problems.

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Water supply, as in the past, will always be a limiting factor in New Mexico. Under foreseeable circumstances, there will always be more suitable land than there will be water supply to irrigate it. Nevertheless, irrigation still has some prospect of expansion in the State, chiefly in the San Juan Basin. Despite the limit on water, with good management there should continue for a long time to come to be a supply ample to meet the growing needs for increase in population, expansion in industry, and greater per capita use, and for continuation of most of the present and planned irrigated acreage except in certain ground-water areas. But in this connection, the importance of good management of the water resources needs to be stressed.

It should be noted that this discussion pertains only to water supply derived from streamflow or pumped from groundwater storage where there is a substantial annual recharge. It does not deal with the situation in the High Plains or a number of other localities in the State where the water currently being used consists chiefly of ground water that had accumulated over the ages. These areas require special consideration outside the scope of this paper.

*Director, Forest and Watershed Conservation Research, Charles Lathrop Pack Forestry Foundation.

Among the opportunities for conservation and development of water supply in New Mexico are the following:

1. The full development of the state's share of the flow of the San Juan River and a few other limited water supplies.

2. The reduction of conveyance losses, including seepage, evaporation, and transpiration losses, in main streams and canals and in distribution systems.

3. The control of water-wasting vegetation on overflow areas, along stream channels and in reservoir basins, to reduce nonbeneficial consumptive use.

4. Reduction of evaporation losses in reservoirs.

5. More efficient irrigation practices to reduce the quantity of water that has to be delivered to the crop land.

6. Reduction of needless use and waste in domestic and industrial use of water.

7. Increasing the yield of water from the high watersheds.

8. Solving the sedimentation problem.

I should like to discuss the last two briefly.

Increasing Water Yields

Most of New Mexico's water supply is derived from the higher mountain watersheds where the average annual precipitation is 20 to 30 inches, of which approximately 3 to 10 inches is yielded as streamflow. This is chiefly water that has infiltrated into the soil mantle of the watershed and is subsequently fed into the streams or goes to help restore the water table. At the opposite extreme in the semidesert areas, the 8 to 10 inches of precipitation per annum, on the average, yields only one-twentieth to one-tenth of an inch of runoff. Practically all of this arrives in the drainage channels as over land flow from the occasional torrential rains.

Basic research has already indicated that by manipulating the plant cover on the higher yielding watersheds the amount of water that is transpired by the vegetation may be reduced and the yield to streamflow thereby be increased. What has not been worked out, however, are the practical operating measures, including the evaluation of costs and benefits, which would need to be applied in watershed management. There are so many conditions as regards climate, geology, topography, soil, plant cover, use and economic values to be coped with, even on a single watershed, that it is neither practical nor safe to deal in generalities on this subject. Specific guides must be worked out for the watershed manager for each major set of conditions.

The experiments and pilot tests that need to be undertaken to develop sound watershed management practices to increase water yield will require a dozen or more years of measurements to yield dependable results. What is most important, therefore, is that they be started immediately so that results will be available before the need comes for the additional water that can prudently be derived from the mountain watersheds.

The Control of Sedimentation

Probably the most serious water problem to be dealt with in New Mexico is the salvage of water now wastefully consumed by vegetation, which although not confined to them, has come in extensively on the recent sediment deposits within reservoir basins, on reservoir deltas, and on flooded areas along main streams, and have spread up and down the overflow areas of a great many of the main arroyos and intermittent streams of the State. These sediment deposits also create other difficulties including the destruction of storage space in reservoirs and the clogging and aggradation of stream channels with consequent aggravation of the flood, waterlogging, drainage, and other problems.

Some of this sediment is derived by sheet and smallgully erosion on the sparsely vegetated slopes of the tributary watersheds. By far the greater part of it originates during flood runoff from the side cutting and deepening of the channels which have already been excavated in the valleys of most of the subdrainages and from the gullies that are being cut headward in the few remaining untrenched tributaries. Anyone acquainted with the Rio Puerco, the Rio Gallisteo, and many of the tributaries of the Pecos River, for example, are familiar with the type of channel here referred to.

There was very heavy cutting in most of these valley trenches during the summer and fall rains of 1957. There appears to be no tendency for such channels as the lower stretches of the Rio Puerco, for example, to become stabilized and much sediment is carried out of them whenever there is streamflow of consequence.

The very useful program that the U. S. Bureau of Reclamation has under way to channelize the stream in the Middle Rio Grande Valley as a means of salvaging at least a portion of the water that is now being lost to the thousands of acres of phreatophytes, is in effect a large scale experiment to learn how to deal with the sediment that has already been carried into the Rio Grande in the Middle Valley. However, only very little is being done to solve the problem of keeping the excessive quantities of silt from coming into the main Rio Grande. Until that is done, all measures taken solely in the Valley are mere palliatives.

The limited studies that have been made or are under way at the present time are falling far short of supplying a solution to the chain-of-events

problem of erosion on the watersheds, sedimentation in major valley areas and reservoirs, and establishment of water-wasting vegetation on the sediment deposits. There is an obvious need for a fresh look at the whole problem and the development among the various agencies involved of a comprehensive program of research and investigations looking to the development of an effective program of action to stabilize conditions in the tributary channels and on the slopes of the watersheds.

Other Investigations Needed

As research that should be started now is needed to develop measures for obtaining the optimum yield of water from the watersheds and find a solution to the erosion-sedimentation problem, so also is research needed to determine suitable practices to reduce conveyance losses, to control water-wasting vegetation, to reduce reservoir evaporation, and to increase efficiency in irrigation. It is encouraging to note in various reports, including some prepared for this conference, that work is under way on many of these problems. However, the question naturally arises whether or not current research and investigations constitute a fully rounded out program adequate to meet the needs. The chances are the answer is "no". It would appear that a very important need is for a group or body headed perhaps by the State Engineer, by one of the State's research agencies, or by this Conference, whose function would be periodically to review the problems and the current research work and to strive by whatever means available to assure that an adequate program of research and investigation is being undertaken by the several agencies properly engaged in work in this field. It will be only by solving these problems, together with the development of presently unused streamflow, that New Mexico will be able to meet its growing needs for water. Should economical methods of inducing rainfall or reclaiming salt water be perfected, they would be just so much net gain to the economy and welfare of the State.

A major need in New Mexico, as in most other places, is informing the citizens of their water problems in order that they may develop adequate programs and policies to follow. This conference is an example of informing the public. In recognition of this educational need, the Pack Forestry Foundation has allotted three-quarters of a million dollars to be used mostly in New Mexico and Arizona during the next few years, chiefly for a program of information and education on watershed and related problems. Also, a limited program of research has been started to fill a few of the gaps in the watershed picture and to bring together the basic information for the education phase. At the present time the Foundation has a project under way in Arizona to evaluate the effects of past forest fires on watershed and related values. Some of the permanent demonstrations for use in the education phase are nearing completion at the interpretive center that has been established at the Arizona-Sonora Desert Museum near Tucson. It is expected that work will start on another interpretive center in New Mexico in 1958.

"DEVELOPING RECOGNITION OF NEW MEXICO'S WATER PROBLEM"

R. R. Aston*

The interest of Southspring Foundation in our local and national water problem is certainly not academic. The investigation and study of our water problem was one of the prime purposes in forming this non-profit agricultural research organization. The officers of this Foundation experienced the complete failure of water supply on farms located in the Mohawk Valley of Arizona during the late 1920's. Our background is one of grim reality concerning the vital role of water in each of our lives and fortunes.

It became necessary for the Southspring Foundation to establish policies and plans to determine where they might help on our great and complex water problem. In addition it was necessary to determine just what the major elements of this problem were. The following problems are basic in any discussion of water in New Mexico:

1. First and foremost the problems and the solutions should and must be approached in a CONSTRUCTIVE and POSITIVE manner. Solutions are not to be found in generalities or platitudes. A genuine public concern can result in much constructive action, but, under no conditions, should the problem be approached in a spirit of alarm and panic. Each effort should be measured by the yard stick of WHAT CAN BE DONE!

2. Secondly, that our Great Plains area, and New Mexico in particular, are undergoing A GREAT DROUTH PERIOD. We in the Great Plains must realize that DROUTH IS AS NORMAL AS RAINFALL. This physical fact is complicated by a rapidly growing population. The population of the United States is expected to be 330 MILLION BY 2000 A.D., almost DOUBLE IN 43 SHORT YEARS. The Kiplinger Letter estimates that NEW MEXICO POPULATION WILL GROW 42% BY 1970. This tremendous additional burden on our limited water supply will be complicated by the fact that WATER USE ACCELERATES TWICE AS FAST AS POPULATION.

3. Thirdly, that the whole water problem is SURROUNDED BY A CLOUD OF NEGATIVE THINKING. IGNORANCE and INDIFFERENCE IS MORE COMMON THAN ANIMOSITY.

4. Fourthly, that the PROBLEMS OF WATER SUPPLY ARE EXTREMELY COMPLEX. That an INFORMED AND AWARE PUBLIC is THE FIRST STEP TOWARDS FINDING A SOLUTION TO OUR WATER PROBLEMS.

5. Fifthly, that NEW MEXICO MUST PUT INTO EFFECT A COMPREHENSIVE AND EFFECTIVE WATER CONSERVATION PROGRAM.

*Southspring Foundation, Roswell, New Mexico

This, very generally and in a simplified way, states the Foundation's view of the problem concerning water. This brings me to a discussion of WHAT CAN BE DONE TO SOLVE THIS VAST, COMPLEX, VITAL PROBLEM.

1. SOUTHSPRING FOUNDATION URGES THE STATE OF NEW MEXICO TO UNDERTAKE A COMPLETE WATER STUDY. Mr. John L. Gregg of Elephant Butte Irrigation District expresses the need most effectively:

   a. An impartial study of New Mexico's water problem, including an accurate inventory of its surface and underground water resources;

   b. An estimate of present and future water requirements, including an appraisal of domestic and industrial uses contrasted with agricultural uses; and,

   c. The outlining of a comprehensive and effective water conservation program.

   "This would be highly beneficial if properly conducted, on a practical and strictly impartial basis, and kept free from influences of pressure groups and politics. This study should place proper emphasis upon underground water in addition to thoroughly analyzing surface water problems."

2. The Foundation urges a NATIONAL WATER INVENTORY, using the vast amounts of information already compiled and supplementing it with a comprehensive study to determine the actual COMPOSITE WATER SITUATION in our great country. This survey should coordinate all of the agencies working on this complex problem. IT MUST BE NON-PARTISAN AND DONE WITH FULL RECOGNITION OF THE PRINCIPLES OF INDIVIDUAL LIBERTY, PRIVATE OWNERSHIP, REGULATED FREE ENTERPRISE, SELF GOVERNMENT AND JUSTICE.

There are several approaches that may play a part in future solution of some of our water needs: CLOUD SEEDING - DESALTING - ATOMIC POWER - EVAPORATION CONTROL - REDISTRIBUTION.

THERE IS AMPLE WATER IN THE UNITED STATES. THE MAIN PROBLEM IS ONE OF DISTRIBUTION. THE UNITED WESTERN INVESTIGATION carried out by the DEPARTMENT OF INTERIOR in 1951 shows that each year 294 MILLION ACRE FEET OF PRECIOUS WATER SPILLS USELESSLY INTO THE PACIFIC OCEAN. As a yardstick, the PECOS VALLEY ARTESIAN BASIN ESTIMATES ANNUAL USE AT 360,000 ACRE FEET.

This problem is not only a PROBLEM OF TODAY, BUT A PROBLEM OF TOMORROW. It will require not only ENGINEERING, BUT IMAGINEERING. America has been built by people doing the IMPOSSIBLE. In our approach to this problem, I like to keep the SEABEE slogan of World War II in mind: "THE DIFFICULT WE DO AT ONCE, THE IMPOSSIBLE TAKES A LITTLE LONGER!"

THE EVALUATION OF GREAT NATIONAL PROBLEMS SHOULD BE UNDERTAKEN WHILE THERE IS TIME TO ORGANIZE THE THINKING AND MARTIAL THE FACTS...TODAY'S PLANS ARE TOMORROWS ACCOMPLISHMENTS:

Let's not turn our backs or close our minds to this problem of water. There are many who view our GREAT SOUTHWEST AS A VAST AND INEVITABLE BOOT-HILL. The OPPORTUNITIES OF TOMORROW ARE THE RESPONSIBILITIES OF TODAY. WE ARE BLESSED TO HAVE BEEN BORN IN THE TRUE PROMISED LAND. LET US INSURE THE BLESSINGS OF OUR LAND FOR FUTURE GENERATIONS.

NEW MEXICO WATER LAW AND POLICY

Robert Emmet Clark*

After the first New Mexico water conference last year, I made two statements which, together or separately, may be at least partly responsible for my presence on this side of the lectern today. First, I told Dr. Stucky that I hoped that these conferences would continue each year and that representative points of view on water resources matters would be increased in number. The audience at this conference indicates that my fears on that point were unnecessary. My second remark was that it was surprising to realize how many of the most important questions asked at the conference were essentially legal questions. Many of the inquirers were not aware, so far as I could tell, of the legal implications of some of their questions. Those who were aware of them displayed what seemed to be a rigid, or pessimistic attitude about the functions of legal institutions and their adaptability to the actual processes of society. These observations have been on my mind during the past year. When Professor Stephens asked me to participate in this conference I accepted the opportunity to probe, and perhaps clarify, some of the perspectives that the questions last year brought into view.

I am pleased that your program chairman employed the title "Water Law and Policy" for my discussion. He might have called it "Water Rights in New Mexico." The program indicates that "water rights" will be discussed and emphasized by other speakers. What these gentlemen will say about "water rights" will, I am sure, be of much interest, not only because of the special qualifications of the speakers, but also because the phrase "water rights" itself contains overtones of practicality and certainty. However, the phrase is often misleading. And it may even be too narrow to cover the discussion by members of this panel. Moreover, the term "rights" may premise the existence of correlative "duties." But perhaps the less said about legal duties, the better, because a discussion of legal rights and duties might lead us to ask "What is a duty?" and What is a right?" Further inquiry might be demanded and we could become interested in the origins of legal rights and duties and such questions as: Are we born with them, or are they acquired from the organized community - local, state and national - in which we live? Are property rights, including water rights, created by the community? Or does the community get its existence from property rights?

These may appear to be unnecessarily speculative questions with which to open a discussion of water law. However, all of you must be aware that, whether or not we consciously frame, or ask, these questions, we all act on the basis of assumed answers to these and similarly

*Professor of Law, University of New Mexico.

disturbing questions. These questions go to the fundamentals underlying our choices of values and objectives. They assume the method by which our society formulates policies, makes choices among alternative social objectives and enacts laws, including water laws.

We can agree, at any rate, that there are such useful concepts as legal rights and that these concepts describe and generalize relations. Nobody ever saw a water right - the evidence, paper or otherwise, of one - Yes. But the "right" remains an idea of rational or partly rational beings.

These legal relationships, called rights to the beneficial uses of water, which in New Mexico include recreational uses and fishing purposes,[1] are the primary concern of this conference. Other rights must not be overlooked. In New Mexico these include rights to protection from the detrimental effects of water, e.g. from flood,[2] pollution,[3] and wrongful diversions[4] or the obstruction of canals and water courses.[5]

We know that these rights were not created in a cultural vacuum. Thus there are pragmatic or operational answers to the questions suggested. We know that there are some historical answers also. Not too long ago in this region land and water rights were often determined (if not created) at the end of a gun barrel and not by legislatures or courts. When social institutions were weak, when legislators were semi-literate and when legal institutions were largely unformed, and the common good of the community depended upon physical strength (and, I might add, when right was often confused with might), society's grants to the strong were practically and theoretically justified. For what benefited the patron usually benefited the partidario and thus the community was benefited or kept alive. Rights and duties existed largely for those who could seize the former while avoiding the latter. Indeed one accepted writer of the period, Herbert Spencer, held that a balance between them would destroy equality and opportunity. However, our grandparents did not entirely ignore their duties, as is evidenced by their treatment of horse thieves and this statute enacted in 1876, and still the law in New Mexico, which reads:

75-1-5 Interfering with the traveler's use of water--Penalty

Hereafter, if any person or persons, shall embarrass, hinder and molest any person or persons at the time they may wish to take the water for their animals, and shall claim or demand of the traveler any compensation for the use of the water, such person or persons on conviction thereof, before the court of a justice of the peace or district judge, shall be fined in a sum not less than twenty-five dollars ($25.00), nor more than fifty dollars ($50.00), and shall be liable to pay all damages caused thereby to the person so hindered. (Laws 1876, ch 41, sec 2).

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[1]State v Red River Valley Co. 51 N.M. 207, 182 P2d 421 (1947).

[2]See Martinez v Cook, 56 N.M. 343, 244 P2d 134 (1952).

[3]See Carlsbad Irrigation District v Ford, 46 N.M. 335, 128 p2d 1047 (1942).

[4]See Pueblo de Sandia v A. T. S. Ry. Co. 37 N.M. 591, 25 p2d 818 (1933)

[5]Rix v Town of Alamagordo, 42 N.M. 325, 77 P2d 765 (1938).
Jacquez Ditch Co. v Garcia, 17 N.M. 160, 124 p 891 (1912).

The myth of those days hangs over us. The myth is powerful (and it sells well too. Without it I think Hollywood and TV would be selling worse fantasies, or be bankrupt). Those were the days when the West was won; when the only good Indian was a dead one; when at every term of court in Dona Ana and Lincoln Counties there were not less than a dozen homicide cases to be tried (and the defense in all of them was the same - self-defense); when John Wesley Powell went down the Colorado River and later wrote his Report on the Lands of the Arid Region (1879) which collected dust in Washington for years; when government was personal, and when our forebears, as part of the lived and unedited myth, affirmed that "that government is best that governs least!"

Best for whom: we might ask.* The few or the many, the self-seeking or the hard working, the Indian or the white man, the homesteader or the patron?

In those days permits to appropriate water were not issued by a state official who was also a qualified engineer. The help of a lawyer in obtaining a water right was infrequent. Many lawyers, having completed the 8th grade or less, heard the call of the law and crossed into New Mexico territory carrying their entire libraries, sometimes composed of one volume of the Revised Statutes of Texas of 1879. Those were the days when water controversies were often shooting matches, and, if such a controversy reached the court house, the lawyers called it a "swearing march."

Since those days social and political processes, and the legal sanctions that accompany them, have become more refined. But they deal with the same underlying problems. The main one is the search for a better balance between rights and duties, between individual and group desires and community growth and improvement. In short, the real problem is one of balancing the public interest and private rights. This is the role of government. This is the background in which legal institutions develop. This is the area in which law as a method of social control must also perform positive and opportunity giving functions.

Complex problems have required the molding of more complex legal institutions as a method to find fair and useful answers. For example, the old community acequias were recognized as public ditches by the Legislature in 1852.[6] In 1895 these community ditches became corporations with the power to sue and be sued.[7] More recently drainage, irrigation, conservancy

*I borrow this question from Walter Gellhorn with full acknowledgment of the debt. See Gellhorn & Bryse Administrative Law, Cases and Comments (1954) Ch. I.

[6]All rivers and streams of water in this state, known prior to January 7, 1852, as public ditches or acequias, are established and declared to be public ditches or acequias. (Laws 185-52 p 277).

[7]N M STAT. ANN. 1953 COMP. 75-14-11.

and artesian districts became legal institutions.[8] The period from the first artesian well control law in 1905[9] to the ground water law amendments of 1953, 1955 and 1957 parallels the transition from the hand pump to the modern deep well jet pump. The statutory law alone enacted in New Mexico during this period fills a good sized volume. The decided cases would fill several volumes. But this printed evidence of developments in the law is no more than sediment from the flow of social events of a century. The creation of the office of Territorial Irrigation Engineer in 1905, the Water Code of 1907, the State Constitution prepared in 1911, the compiled statutes and the court decisions were the result of individual and group activity - or pressure if you wish - that had as its objective the satisfaction of some interest or want. Many of these demands on the decision-making process, which resulted in new statutes or new decisions by the courts or new administrative policies, had the public interest as an incidental goal only. Yet the public interest was often served. For example, in 1910 the Territorial Supreme Court in construing the legislation of 1907 which handed to the Territorial Engineer and the board of water commissioners the responsibility for approving or denying applications for new surface water diversions, held that the board had construed the concept of public interest too narrowly with regard to the functions of the Territorial Engineer. This official had rejected the application for a private reclamation project he found infeasible because there was insufficient water for the project and the construction of works for small acreage would not be justified. The Territorial Supreme Court said:[10]

"The view, apparently adopted by the water commissioners in their decision, that the power of the territorial engineer to reject an application, if in his opinion the approval thereof would be contrary to the public interest is limited to cases in which the project would be a menace to the public health or safety, is, we think, not broad enough. There is no such limitation expressed in terms in the statute, and, we think, not by implication, * * * The fact that the entire statute is designed to secure the greatest possible benefit from (the waters) for the public should be borne in mind." . . .

". . . The failure of any irrigation project carries with it not only disastrous consequences to its owners and to the farmers who are depending upon it, but besides tends to destroy faith in irrigation enterprises generally."

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[8] Ibid 75-19-1 et seq. (Laws 1912, ch 84 Drainage).
" 75-22-1 et seq. (Laws 1919, ch 41 Irrigation).
" 75-28-2 et seq. (Laws 1927, ch 45 "Flood protection, river control, drainage, water storage for supplementing irrigation needs . . all other improvements for public health, safety, convenience and welfare. . .).
" 75-13-1 et seq. (Laws 1931 ch. 97 Artesian Conservancy Districts).

[9] 36 Legis. Assembly, C. B. 20 approved Feb. 22, 1905.

[10] Young & Norton v Hinderlider, 15 N.M. 666, p 1045 (1910); 11 N M STAT., 1953 COMP. Sec. 75-5-6.

This policy decision by the Supreme Court needs no explanation. The knife of policy cut the line between public interest and private right.

Throughout this discussion I use the term "policy" to describe the totality of processes that produces decisions affecting the community and its members. The future development of New Mexico's water resources will involve many policies although only a few may be accepted or be authoritative at any specified time. By water resources policies I do not mean fixed or predetermined plans which ignore man's limitations or overlook the principle of inertia which seems to be an important social factor. Within the term "policy" I leave room for those partly irrational responses of society to myths and symbols and cliches of the past. That there are such responses was recently documented by many of the discussions over proposed structures on the Upper Colorado River.

It is clear, then, that I do not divorce policy from politics[11] and the whole social process. Nor do I believe that policy is a high level abstraction that denotes only the activities of persons who know, or think they know, most of the answers, while leaving politics to the politicians, who, by inference at least, are described by lower level abstractions. Politics is the social-governmental interplay over the choice of goals and methods - good, bad, selfish, idealistic, rational and foolish. It is the essential process by which free people establish institutions for attaining them. Legal institutions are built by this process. Contributions to knowledge by this conference must be put in that framework to be made effective. Our job here, as I see it, is to search for and help to explain rational, technical and useful alternative approaches in the development and administration of New Mexico's water laws and policies.

Among this group of experienced and public minded citizens I feel that there probably exists a wide variety of opinion as to the utility, meaning, or even desirability of some present laws and policies. If suggestions were made for changes in them I suspect the variety of opinion would be even greater. Among some of you - perhaps the engineers and physical scientists - there may be a strong belief that more knowledge of physical conditions and technological advances should be the main criteria of sound policy and effective law. Others may believe that economic considerations and the activity of the market place are the most reliable criteria. Still others - the social scientists perhaps - may seemingly over-emphasize the human condition and affirm that model laws and model dams are desirable but not at the expense of man's individual identity. These are all legitimate points of view. The answers to many water, as well as other, problems, lie in bringing all of the points of view into the open where their merits can be discussed and where selections can be made. It is the social-political process that permits us to expound our various choices and to advocate them to others. Any rational choice implies knowledge of at least

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[11] For a recent statement of this point of view See Wengert, The Politics of River Basin Development, 22 Law and Contemporary Problems 258 (Spring 1957). For the point of view that policy should represent "a clear, accepted, reasonably stable body of principles," see Ackerman, Questions for Designers of Future Water Policy, 38 J. Farm Econ. 971 (1956).

two points of view or alternatives. Often, however, no choices are made because no real knowledge is offered, or the small kernel of it that is offered is wrapped in such a large husk of bias, confusion and ignorance no one can take the time to shuck it out.

Until economists, engineers or philosophers become kings (and presumbaly we all have strong feelings against kings by any name) society will have to depend on the imperfect social process and work of inquiring groups like this once for the development and utility of water law, and other human, institutions.

As a student of New Mexico water law I am fortunate to be able to study very old, and also modern, water law institutions that are perhaps among the most effective, fair and dynamic in the country. Yet these institutions still require constant study, care and improvement. The vital features of these institutions were not the brain children of any water resources conference. The doctrine of prior appropriation, for example, whereby the first beneficial user of water obtains a property right in it, was not a gift of the gods. It was the illegitimate child of necessity by an old Roman Law sire. The California miners have always received excessive credit for developing it. The fact is that they were trespassers on the public domain (which had been taken with blood and gold by the United States for the United States) and they had no rights as riparian land owners. A theory that separated an interest in water from an interest in land was needed. The appropriation idea was handy. Moreover it had been practiced under a variety of names for centuries by the Indians, the Spanish Colonists, the Moslems and the Romans before them.

The much later application in New Mexico of appropriation doctrine to ground waters was the result of various pressures to establish some economic equilibrium in the Roswell artesian area. The legislation of 1927 and 1931,[12] and the amendments to it, pitted those advocating uncontrolled uses ("absolute" legal rights, if there were such a thing) against those who have identified their welfare with that of the community over a continuing period of time. This group sought regulation as a means to achieve wise use. They were not entirely pure of heart, of course, since fewer wells meant less market competition in the sale of crops, too. But that ground water legislation of a generation ago or the motivation behind it, needs no defense. The late Herbert Yeo, and the men who helped prepare that legislation, may not have anticipated the eventual declaration of a ground water basin along the Rio Grande. Yet their efforts, the desires of the people on the East Side, the technical knowledge of the State Engineer's staff, and the decisions of the courts have all combined to uphold a law and develop a policy that provides a flexible framework for continued development in New Mexico far beyond anything imagined thirty years ago. If you doubt this, examine the ground water anxiety of some of our more thoughtful neighbors in Colorado and Texas.

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[12] 11 N.M. STAT. 1953 COMP. 75-11-1 et seq.
See Yeo v Tweedy 34 N.M. 611, 286 P. 970 (1930);
Bliss v Dority 55 N.M. 12, 225 P2d 1007, App. dismissed
341 U. S. 924 (1950).

I do not wish to create an illusion that we have model laws. On the contrary, they contain seeds of misunderstanding and possible controversy. For example, the legislative amendment of 1953 declares a strong policy against a neighboring state depleting ground water resources from sources common to both states.[13] This law cannot be enforced short of a suit between states. Suits of this type, a little research will show you, cost many thousands of dollars, take on the average of 11 to 14 years to decide and have no effect whatsoever on the hydrologic cycle. The statute remains a declaration of sound policy, but we must await action by our thinking neighbors in Texas who know that eventual ruin awaits a wonderful area of production today.

The law should require cooperation between the oil drilling companies and the State Engineer just as it does between the water well drillers and the State Engineer in any artesian area.[14] Some of the practices of oil drillers need careful scrutiny. In Lea County Mr. Minton reported last year[15] that about 176 acre feet of salt water was being allowed to flow out on the ground every year in that one county alone. The results of the practice of flooding wells to increase output by using fresh water should be studied.

The inability under present law to obtain better cooperation between municipalities and the State Engineer's office is resulting in the residents of towns drilling shallow domestic wells which in times of high water or flood become contaminated. This supply often reaches the public water because these people have attached their pipes to the city system. This calls for stronger local policy and better ordinance enforcement. Cooperation between the State Engineer and the towns on the question of issuing well permits within the town limits would also help.

Most of you know that in New Mexico all surface waters are appropriated except some waters of the Canadian and water from the Colorado system. The San Juan diversion will import legal problems into the Rio Grande Basin. These will have to be met and solved.

Current problems of the law and the administration of surface waters have not been concerned with the initiation of rights so much as with changes in types of uses and places of uses, i.e., with transfers of rights or to different uses. With these new problems go new policies of

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[13] 11 N.M. STAT. 1953 COMP. 75-11-29 (Laws 1953, ch. 64 sec. 2).

[14] Ibid, 75-12-5.

[15] Minton, Underground Water Problems in New Mexico and Specifically in the High Plains Area. Report of First Annual New Mexico Water Conference (1956) p. 37.

encouraging and insuring maximum, and also wise, use. There will be decisions of fact made as to ground waters as to whether certain uses will or will not "impair existing water rights,"[16] or be a "detriment (to) the rights of others having valid and existing rights."[17]

Future developments involve extremely important policy functions of the State Engineer with which he is charged by statute. A 1955 amendment declares that "The State Engineer shall permit the amount allowed to be diverted at a rate consistent with good agricultural practices and which will result in the most effective use of available water in order to prevent waste."[18] (My emphasis). In effect this statute establishes a rule of reasonable diversion and use. Some policy will or should emerge as to its application. Inquiry is needed as to the effect of such a rule, both in theory and in practice, on the doctrine of prior appropriation. This provision may also raise questions about the feasibility and legality of metering wells, or controlling their depth or diameter.

The legal duties of the State Engineer are enormous, and the power granted him by the Legislature and confirmed by the courts is commensurate with his responsibilities. This grant of power is not a recent development. It did not originate at the time of the widespread condemnations of bureaucrats. The 1905 Territorial Legislature created the office of Irrigation Engineer.[18a] Since statehood, the State Engineer has been given the chief responsibility for husbanding one of the principal resources of an arid state. Many more duties have been added to the office since that time.[19] The tasks connected with the various interstate compacts are another aspect of the State Engineer's legal functions.

His job of Compact Commissioner under several Compacts, and his connection with the National Reclamation Association involve important inter-state and intra-state policies. The job of keeping down intra-state frictions alone is a big job. The State Engineer's liaison activities with the Bureau of Reclamation, the Corps of Engineers, the Department of Agriculture and various other agencies of the United States are large legal responsibilities. They require much more than the execution of policy; they involve policy making functions also.

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[16] 11 N.M. STAT. 1953 COMP. 75-11-3 (Ground water).

[17] Ibid 75-5-23 (Surface water)

[18] Ibid 75-5-17.

[18a] A.H.B. No. 98 approved March 16, 1905. Laws 1905, 36th Legislative Assembly, ch 102, Sec 11, Page 274. (The salary was fixed at $2000 per year, Sec 14). This act was repealed and replaced by the Water Code of 1907.

[19] See Ibid 75-2-11 (The board of water commissioners was abolished in 1923 and the records transferred to the State Engineer. Laws 1923, ch. 28, sec. 4).

I have used the State Engineer's office as an example of the functions of law and policy because the example is particularly relevant. These functions of that office are not always appreciated. The regulatory tasks of the office are often overemphasized and the importance of other policy functions slighted. Here we have a public official appointed by the chief executive, who is required by law to be a "technically qualified and registered professional engineer." He is chief administrator of the laws passed by the legislature at the behest of or with pressure from some groups or individuals in the community that want government to do or refrain from doing something. This same official is called, in cases involving conflicts over claims to certain uses, to hold hearings and sit as a semi-judicial official to find facts and make decisions under the law. In the process of carrying on the duties of that office we have an engineer trained in technology and the sciences, interpreting statutes, interstate compacts and decisions of the courts applicable to water resources. And let no one think he does not do this. The system could not function adequately if he did not. Apparently, he has the Supreme Court's sympathy too.[20] Sometimes he is called upon to defend or announce policies no longer tenable. These are often embodied in statutes. Other statutes are so vague or ambiguous or so lacking in scientific outlook, that the State Engineer has to give them some technical or scientific interpretation that squares with the physical facts. Or he must make rules and regulations which are within his power that announce some clarified policy. The whole idea of well spacing is an example.[21]

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[20] In Spencer v Bliss; 60 N.M. at 28 (1955) 287 P2d 221, the Supreme Court said: "The administration of the public waters of the state, especially the underground waters is a task requiring, expert scientific knowledge of hydrology of the highest order. The administration of surface waters alone, where the trained and experienced engineer may see and observe what he does, or should do, and what the agency he administers is doing, is beset by difficulties enough. But when the administration is turned to underground waters the engineer's troubles are multiplied a hundredfold."

[21] See Spencer v Bliss, Supra at 23:
"Q. Will you state what his (the State Engineer's) policy is in that regard? A. Well, his policy is not to permit more moved into more dense areas of pumping or toward more-toward more dense areas of greater intensity-density, in pumpage or diversion from ground water."

New Mexico District Court cases approving well spacing formulae: Lawrence v State Engineer, Lea County (#9979); Cooper v State Engineer, Lea County (#9565); See Harris, Water Allocation Under the Appropriation Doctrine in the Lea County Underground Basin of New Mexico. (Contribution to Symposium on the Law of Water Allocation in the Eastern United States, to be published by Conservation Foundation, 1957).

You will find no express authority for this practice anywhere in the Statutes. Another example is the State Engineer's handling of the relationship between ground and surface waters. He has had to lead the way toward a new approach to legal concepts or categories of ground and surface waters. He has had to make policy based on technical as well as other kinds of facts. For example, was the decision to make Elephant Butte the southern boundary of the new Rio Grande underground basin based on scientific knowledge, or on other non-scientific facts? If the scientific facts support the conclusion that ground and surface waters in the basin are related, then by any scientific criterion the underground basin boundary should have been the Texas state line. Why was a different decision made? The policy announced by the State Engineer's decision to draw the line at Elephant Butte only magnifies the other intrastate and interstate problems which underlie that decision.

In other states, Colorado for example, where the State Engineer wears heavier legal hobbles, the development of any kind of flexible solutions to problems is difficult. The Colorado consitituion and statutes set up a hierarchy of preferences among various uses, domestic, agricultural and industrial. These reflect the agricultural expansion period of the West, but they do not provide for or reflect the growth of a city like Denver, or Colorado's policy of encouraging industrial-urban development.

Along the Rio Grande these same conflicts exist and will become sharper. Larger and larger residential and industrial uses in urban centers like Albuquerque and El Paso are being projected. Legal recognition of the relationship between these two sources must be clarified. This means a complete analysis and reappraisal of present water law concepts and categories. The operational meanings of "beneficial use" or "reasonable beneficial use" or "non-consumptive beneficial use" are far from clear. The classification of waters developed by the legislature or sanctioned by the courts, e.g. "artificial" waters, "seepage" waters, "shallow ground" waters, "percolating" waters and "spring" waters belongs to the age of myth.

This once useful verbal classification needs critical study in the light of scientific and technical knowledge not available in 1907.[22] One or two court decisions cannot take the place of systematic research and scholarly inquiry. Decided cases are limited to the narrow issues of the litigation. Policy considerations are important factors in many of these decisions. But there may be alternative policies that are not presented to the court because the particular litigation presents issues of private rights which, to the litigants, or to the courts, may not appear to involve the public interest or future policy. Sound water resources policy requires study, discussion and, in some instances, new legislation. The development of New Mexico depends to a large extent on water law institutions that continue to be responsible to underlying social needs and human expectations.

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[22] 11 N.M. STAT 1953 COMP. 75-5-25; See Langenegger v state, decided August 26, 1957.

There is in existence (it may not exist in this audience) a belief that the law is like the multiplication tables; that a water right is always a water right; that legal institutions change scarcely at all, or that any changes are due to a mysterious and unknowable process, and that "justice" is always an objective, readily determined fact. If these beliefs are acted upon it is an easy step to the conclusion that everything is hopeless, or nearly so, and therefore there is no point in trying to change anything. Or an even worse conclusion is reached: that all is well or nearly perfect. My few examples from New Mexico history are some evidence that this reasoning is false. I could cite other examples also of emphasis on this mechanical type of thinking.

Lately there has been some public discussion of Russia's "trespass" to U. S. sovereignty with her satellites. Before men could fly they claimed that any invasion of the air space over any real property was such a trespass. The appropriate Latin maxim was quoted, (Cujus est solum est usque ad coelum et ad infernos) which roughly translated states the dogma that "to whomever the soil belongs, he owns also to the sky and the depths." This same maxim, I might add, was the one involved in the early New Mexico ground water cases in support of the proposition that a land owner should have the right to unlimited ground water withdrawals, and is still being contended for by people in the Rio Grande Valley, including some people in the unregulated Mesilla valley.

In a suit brought by a chicken farmer who claimed his property, his chickens included, had been "taken" by the fact that military aircraft flying over his farm during the war had made so much noise they ruined his egg business, the United States Supreme Court said:[23]

> "It is the ancient doctrine that at common law ownership of the land extended to the periphery of the universe - - * * * But that doctrine has no place in the modern world. The air is a public highway, as Congress has declared. Were that not true every transcontinent-flight would subject the operator to countless trespass suits. Common sense revolts at the idea. To recognize such private claims to the air space would clog these highways, seriously interfere with their control and development in the public interest, and transfer into private ownership that to which only the public has a just claim."

The concept of legal rights somehow leads people to jump to the conclusion that these rights are absolute rights. In 1945 Justice Jackson of the U. S. Supreme Court said: "Rights, property or otherwise, which are absolute against the world are certainly rare, and water rights are not among them.[24] In other words, the United States constitution, state constitutions and due process requirements protect rights against

[23]United States v Causby, 328 U. S. 256 (1946).

[24]United States v Willow River Power Co. 324 U. S. 499 (1945).

unjustified or unreasonable infringement. However, this does not make these rights absolute as against claims of the community and the general development of society. This has been the history of our society and it is the tradition of which we are the fortunate beneficiaries.

One law writer[25] said: "The law must be certain yet it cannot stand still." With respect to the development of New Mexico's water resources and legal institutions, I think that statement outlines the size and difficulty of our task. This conference will, I believe, suggest wise and fair directions in which improvements can and should be made.

[25] I think it was Dean Roscoe Pound.

FUNCTIONS AND ACTIVITIES
of the
STATE ENGINEER OFFICE

by
C. B. Thompson
Chief, Technical Division
and
F. E. Irby
Chief, Water Rights Division

History

The office of the Territorial Engineer (later State Engineer), and the Water Right Code which defined his powers and duties, were created by an act of the Territorial Legislature which became effective on March 19, 1907. Statehood came on January 6, 1912. For many years the work coming under his direction was not excessive and the offices of both the State Highway Engineer and State Engineer were held by one appointee. As the State developed, however, the work of the office increased and in 1921 the two departments were separated.

A tabulation of Territorial and State Engineers is as follows:

TERRITORIAL ENGINEERS

1.	David M. White	April 1905-March 1907
2.	Vernon L. Sullivan	March 1907-January 1911
3.	Charles D. Miller	January 1911-January 1912

STATE ENGINEERS

4.	Charles D. Miller	January 1912-July 1912
5.	James A. French	July 1912-November 1918
6.	Leslie A. Gillett	December 1918-November 1920
7.	Charles A. May	December 1920-November 1922
8.	James A. French	December 1922-November 1924
9.	George M. Neel	December 1924-June 1926
10.	Herbert W. Yeo	July 1926-June 1930
11.	George M. Neel	July 1930-June 1932
12.	Thomas M. McClure	July 1932-November 1946
13.	John H. Bliss	November 1946-November 1953
14.	John R. Erickson	November 1953-February 1955
15.	John H. Bliss	February 1955-August 1955
16.	Stephen E. Reynolds	August 1955

Location

Since its inception the main office of the State Engineer has been located in the Capitol in Santa Fe. In 1927 a field office was established in Roswell. Offices were opened in Deming in 1951 and in Albuquerque in 1956.

Purpose

The major purpose of the agency is to develop, supervise, and administer the water resources of the State. Other purposes are as follows:

1. To review plans and specifications for all dams impounding more than 10 acre-feet, or exceeding 10 feet in height (stock dams whose maximum storage capacity does not exceed 10 acre-feet or works designed solely for silt retention which do not impound water for beneficial use are excepted).

2. To make final inspection of such structures in order to insure as to their adequacy and safety.

3. To make occasional inspections of dams in order to afford protection to citizens from failures due to deterioration and inadequate maintenance.

4. To formulate an orderly plan of development for the water resources of the State.

5. To conduct hydrographic surveys.

6. To coordinate the work of various Federal agencies as regards water resource programs.

Legal Provisions

Article 17 of the State Constitution recognized the appropriation of the surface waters of the State for beneficial use and declared that such waters belonged to the public. It recognized and confirmed all rights to use surface water for beneficial purposes existing at the time of its ratification.

Ground waters of the State in reservoirs or basins having reasonably ascertainable boundaries were declared public waters and made subject to administration by the State Engineer in 1931. The 1953 Session Laws declared, for practical purposes, all underground waters of the State to be public and subject to appropriation.

Statutory provisions governing the operation of the office will be found in Chapter 75 of the New Mexico Statutes Annotated, 1953 Compilation, and supplements thereto.

Organization

For many years the office operated with a State Engineer and an Assistant State Engineer as the principal administrative officers; however, upon the appointment of John R. Erickson as State Engineer in November 1953, the office was reorganized and three operating divisions were established, i.e., Administrative, Technical, and Water Rights. Each division is headed by a chief who is directly responsible to the State Engineer. Figure 1 shows the current organization chart.

Staff Duties

Administrative Division

The functions of this division are as follow: handling of payrolls and budget matters; purchasing; dispatching, receiving, and delivery of mail; reception of visitors; telephone service; maintenance of property records; and personnel procurement and certification. The extent of activities of this division depends to a large degree on the magnitude of the programs being carried on by the Technical and Water Rights Divisions. The current staff of the Administrative Division totals 8 persons, one of whom is assigned to the Roswell office.

Technical Division

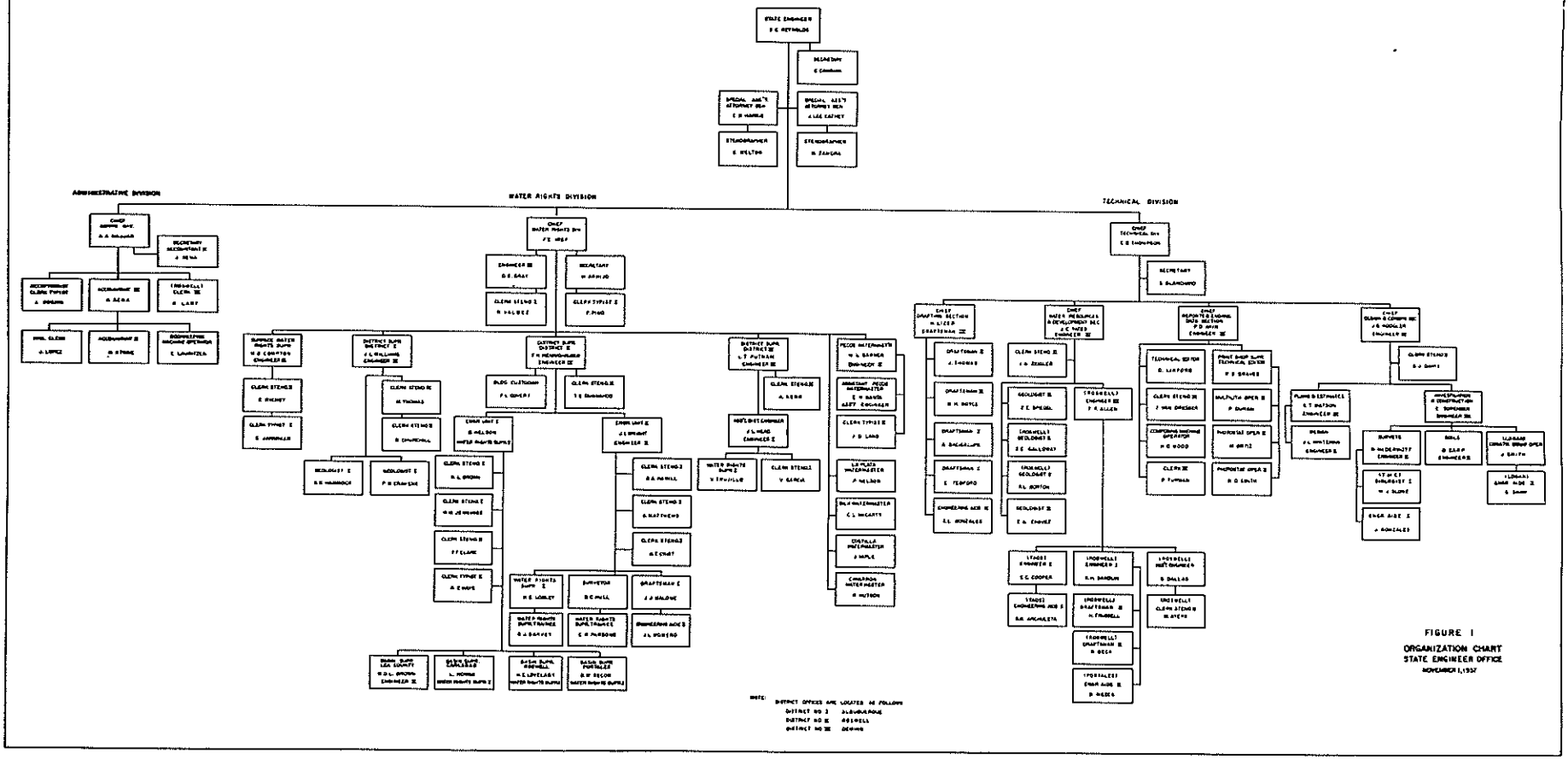
The Technical Division, having a personnel complement of 21 professional and 22 sub-professional employees, is divided into four sections, i.e., reports, water resources, design and construction, and drafting.

The Reports Section, consisting of 10 employees stationed in Santa Fe, is responsible for the compilation of hydrographic, meteorologic, and engineering data including the filing of reports from various private, state, and federal agencies. This group also handles the preparation of a sizeable number of reports each year. In addition to the compilation of regular biennial reports, a technical report series has been established. Thus far seven reports of this series have been published, two have been set up for printing, and one is under preparation. Of these, six cover ground-water investigations in the State, one summarizes the water right laws, two are compilations of meteorological data, and one is a compilation of hydrologic data. The office printing and reproduction shop is a part of the Reports Section and handles a wide variety of work for all divisions and for the Interstate Stream Commission. The printing of business forms, envelopes, letterheads, maps, charts, legal briefs, and complete engineering reports constitutes a major portion of the work load.

The work of the Water Resources Section is divided into two principal activities: (1) the conductance of hydrographic surveys and preparation of maps and reports therefor, and (2) ground-water investigations. Personnel are presently assigned to various parts of the State as follows: Santa Fe 4,

ORGANIZATION CHART OF STATE ENGINEER OFFICE

NOVEMBER 1, 1957



NOTE: DISTRICT OFFICES ARE LOCATED AS FOLLOWS
DISTRICT NO. 1 ALBUQUERQUE
DISTRICT NO. II ROSWELL
DISTRICT NO. III DEMING

FIGURE 1
ORGANIZATION CHART
STATE ENGINEER OFFICE
NOVEMBER 1, 1957

Roswell 8, Taos 2, and Portales 1. The following hydrographic surveys are in progress or have recently been completed:

No.	Name	Area Covered (sq.mi.)	Method	Percent Complete
1.	Rio Puerco de Chama	9	plane table	100
2.	Rio Grande de Ranchos	16	photogrammetry	80
3.	Rio Chama	274	"	1
4.	Roswell	966	"	70
5.	Roosevelt-Curry Counties	610	"	60
6.	Bluewater	236	"	90

A Kelsh plotter for stereocompilation of planimetry and topography has recently been acquired and is housed in the Roswell office. The staff includes four geologists who are engaged in studies involving the quantity and quality of ground water in storage, ground-water movement, delineation of boundaries of proposed basins, and related problems. This group frequently assists the legal counsel and Water Rights Division staff in hearings and court cases.

The Design and Construction Section, comprising 10 employees, handles the review of plans and specifications for all dams and surface-water filing maps. Other duties include: (1) investigations involving irrigation, flood control, municipal water supply, and recreation, and the preparation of loan application reports for submission to the Bureau of Reclamation under Public Law 984; (2) other water-supply investigations as directed by the Interstate Stream Commission (including core drilling, foundation studies, soils laboratory work, and the design of dams); (3) channelization, drainage, salt cedar eradication, and other water-salvage work along the main stem of the Rio Grande; (4) investigations and the preparation of plans and specifications on projects for various State departments, irrigation districts, and municipalities; (5) inspection of dams and other hydraulic works; and (6) handling of applications and field examinations for projects proposed under Public Law 566. Personnel of this section are currently assigned as follows: Santa Fe 7, Logan 2, and T or C 1. Work in progress or recently completed is as follows:

No.		Type of Project	Sponsoring Agency	Fund	Percent Complete
1.	Tularosa	Irrigation	Interstate Stream Comm.	1/	90
2.	Santa Cruz	"	"	"	0
3.	Canadian River	Indust. Water	"	"	25
4.	Springer	Mun. Water	"	"	25
5.	Santa Rosa	"	"	"	100
6.	Dixon	Irrigation	"	"	90
7.	Palomas	"	"	"	20
8.	El Rito	"	"	"	80
9.	Black River	"	"	"	0
10.	Portales	"	"	"	10
11.	La Plata	"	"	"	0
12.	Middle Rio Grande	Water Salvage	"	2/	60
13.	Caballo	"	"	"	15
14.	Running Water Draw	Recreation	Game & Fish Dept.	3/	100
15.	San Gregorio	"	"	"	100

1/- New Mexico Irrigation Works Construction Fund
2/- Improvement of the Rio Grande Income Fund
3/- Game Protection Fund

The Drafting Section is a service unit whose work depends largely on the magnitude of activities in progress in other sections and divisions of the office. The duties of this section, not unlike those of similar groups found in most engineering offices, are largely routine involving the preparation of hydrographic survey maps; plans for dams, irrigation works, and flood channels; illustrations for engineering reports; and exhibits for hearings and court cases. In addition this group is responsible for the indexing and filing of all drawings submitted to the office in conjunction with water rights. Personnel of this section (all stationed in Santa Fe) currently number 6.

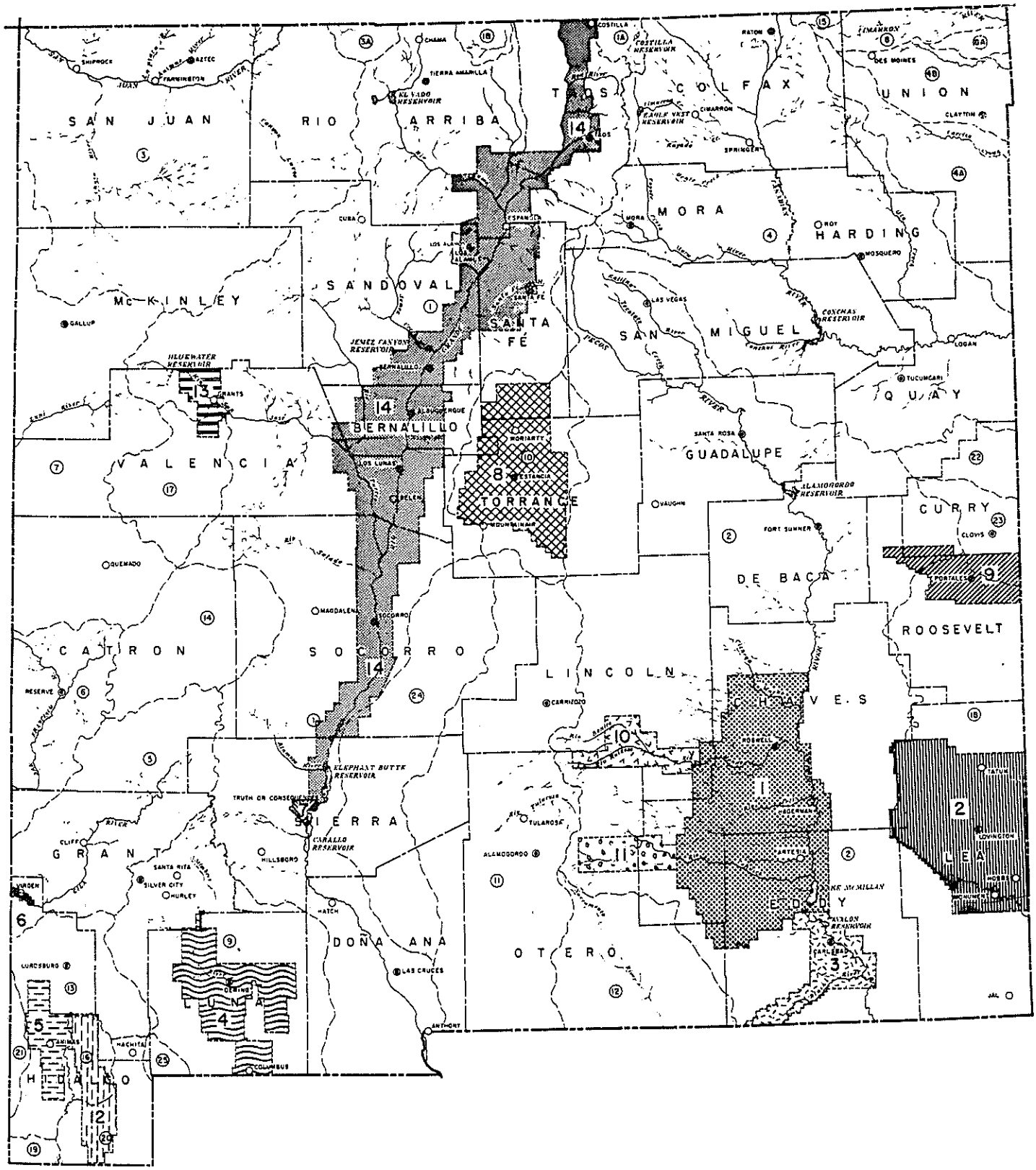
Water Rights Division

The staff of the Water Rights Division is composed of 15 professional and 32 sub-professional employees. Distribution of the personnel complement is as follows: Santa Fe 11, Albuquerque 5, Roswell 26, and Deming 5.

The work of the division entails the administration of surface-water rights in the 25 drainage basins of the State and of ground-water rights in the 14 declared basins which are shown on Figure 2.

Enumerated below are the ground-water basins, their dates of declaration, and status.

No.	Name	Date of Declaration	Status
1.	Mimbres	July 29, 1931	Closed to appropriation for all new uses except domestic and stock watering purposes.
2.	Roswell Artesian	August 21, 1931	No new appropriations, except for stock and domestic uses, have been approved in this basin since August 1931 for artesian water, and since August 1937 for shallow water.
3.	Lea County	August 21, 1931	Ground water may be appropriated for irrigation and industrial use in certain townships of the basin and for domestic and stock watering purposes in the entire basin.
4.	Hot Springs	April 15, 1935	Closed to the appropriation of cold artesian water and open to the appropriation of thermal artesian water. Certain non-artesian cold water appropriations to supplement existing surface-water rights may be made.
5.	Virden Valley	December 5, 1938	Appropriations of ground water may be made.



DRAINAGE BASIN INDEX

(1)	RIO GRANDE	(21)	TULAROSA BASIN C
(1A)	COSTILLA CREEK	(22)	SACRAMENTO RIVER C
(1B)	RIO SAN ANTONIO	(23)	ANIMAS VALLEY C
(2)	PECOS RIVER	(24)	SAN AGUSTIN BASIN C
(3)	SAN JUAN RIVER	(25)	PURGATOIRE RIVER
(3A)	NAVAJO RIVER	(26)	PLAYAS VALLEY C
(4)	CANADIAN RIVER	(27)	LAVA BED VALLEY C
(4A)	CARRIZO CREEK	(28)	LEA PLATEAU (COLORADO RIVER OF TEXAS)
(4B)	NORTH CANADIAN RIVER		
(5)	GILA RIVER	(29)	SAN LUIS BASIN C
(6)	SAN FRANCISCO RIVER	(30)	HACHITA C
(7)	LITTLE COLORADO RIVER	(31)	SAN SIMON
(8)	CIMARRON RIVER	(32)	RED RIVER
(8A)	CARRIZOZO CREEK	(33)	BRAZOS
(9)	MIMBRES RIVER C	(34)	JORNADA DEL MUERTO C
(10)	ESTANCIA VALLEY C	(35)	WAMEL BASIN C

C CLOSED DRAINAGE BASINS

LEGEND

- STATE CAPITAL
- COUNTY SEAT
- PRINCIPAL TOWN
- DRAINAGE BASIN BOUNDARY
- STATE LINE
- COUNTY LINE
- DECLARED UNDERGROUND WATER BASIN BOUNDARY

10 5 0 10 20 30
SCALE IN MILES

DRAWN BY W.H. BOYCE
JUNE 1957

DECLARED UNDERGROUND WATER BASINS

1 ROSWELL ARTESIAN BASIN
2 LEA COUNTY BASIN
3 CARLSBAD BASIN
4 MIMBRES VALLEY BASIN
5 ANIMAS VALLEY BASIN
6 VIRDEN VALLEY BASIN
7 HOT SPRINGS BASIN
8 ESTANCIA BASIN
9 PORTALES BASIN
10 HONDO BASIN
11 PENASCO BASIN
12 PLAYAS VALLEY BASIN
13 BLUEWATER BASIN
14 RIO GRANDE BASIN

FIGURE 2

MAP SHOWING DRAINAGE BASINS AND UNDERGROUND WATER BASINS

No.	Name	Date of Declaration	Status
6.	Carlsbad	October 16, 1947	Closed to appropriation for all new uses except for domestic and stock watering purposes. Ground-water diversion from valley fill permitted to supplement surface-water rights. No diversion, except for domestic and municipal use, permitted from Carlsbad limestone.
7.	Animas	May 5, 1948	Closed to appropriation for all new uses except domestic and stock watering purposes.
8.	Estancia	January 31, 1950	Limited ground-water appropriations may be made in parts of the basin.
9.	Portales	May 1, 1950	In parts of the basin limited ground-water appropriations may be made..
10.	Hondo	September 1, 1953	Permits are granted to appropriate ground water to supplement surface-water rights.
11.	Penasco	September 1, 1953	Permits are granted to appropriate ground water to supplement surface-water rights.
12.	Playas	February 23, 1956	Limited ground-water appropriation may be made in the northern part of the basin.
13.	Bluewater	May 21, 1956	Closed to appropriation for all new uses except for domestic and stock watering purposes.
14.	Rio Grande	November 29, 1956	Permits are granted to appropriate ground water to supplement surface-water rights and to change diversion from surface water to ground water.

Basin Nos. 1, 4, 5, 7, and 12 are administered from the Deming office; Nos. 2, 3, 6, 9, 10, and 11 from the Roswell office; and Nos. 8, 13, and 14 from the Albuquerque office.

All surface-water work is handled in the Santa Fe office; however, water-masters are stationed in various parts of the State as follows:

No.	Name	Headquarters
1.	Costilla Stream System	Questa
2.	Cimarron & Rayado Stream System	Cimarron
3.	Lower Gila River	Virden
4.	La Plata River	La Plata
5.	Pecos River	Roswell

During the 22nd biennium 15,019 ground-water instruments and 812 pertaining to surface water were handled.

The administration of the ground and surface waters of the State requires the Water Rights Division staff to perform many diversified duties, some of which are as follows: (1) processing of water rights instruments and filing maps (involving 21 forms for ground water and 11 for surface water), (2) collection of filing fees, (3) furnishing certified copies of filings for legal use, (4) presiding at hearings on protested applications, (5) furnishing assistance to Special Assistant Attorneys General in court cases, (6) distribution of streamflows in accordance with court decrees and permits, (7) conducting of pumping tests and leakage tests, (8) scheduling of wells, (9) inspection of well construction, and (10) licensing and bonding of well drillers.

Two publications have been issued by the division for the guidance of appropriators and their technical and legal advisors. These are: (1) "Manual of Rules and Regulations Governing the Appropriation and Use of the Surface Waters of the State of New Mexico" and (2) "Manual of Rules and Regulations Governing the Drilling of Wells and the Appropriation and Use of Underground Waters in Declared Basins of the State of New Mexico." Both manuals are available upon request without charge. Another publication "Water Laws of New Mexico," Chapter 75, New Mexico Statutes Annotated, 1953, including the 1955 and 1957 supplements is available at a postpaid price of $10.00.

Special Assistant Attorneys General

Closely related to the activities of the Water Rights Division is litigation in the district courts and in the N. M. Supreme Court. The legal work is handled by two Special Assistant Attorneys General, assisted by two stenographers, all of whom are officed in Roswell. During the past biennium the following cases have been handled:

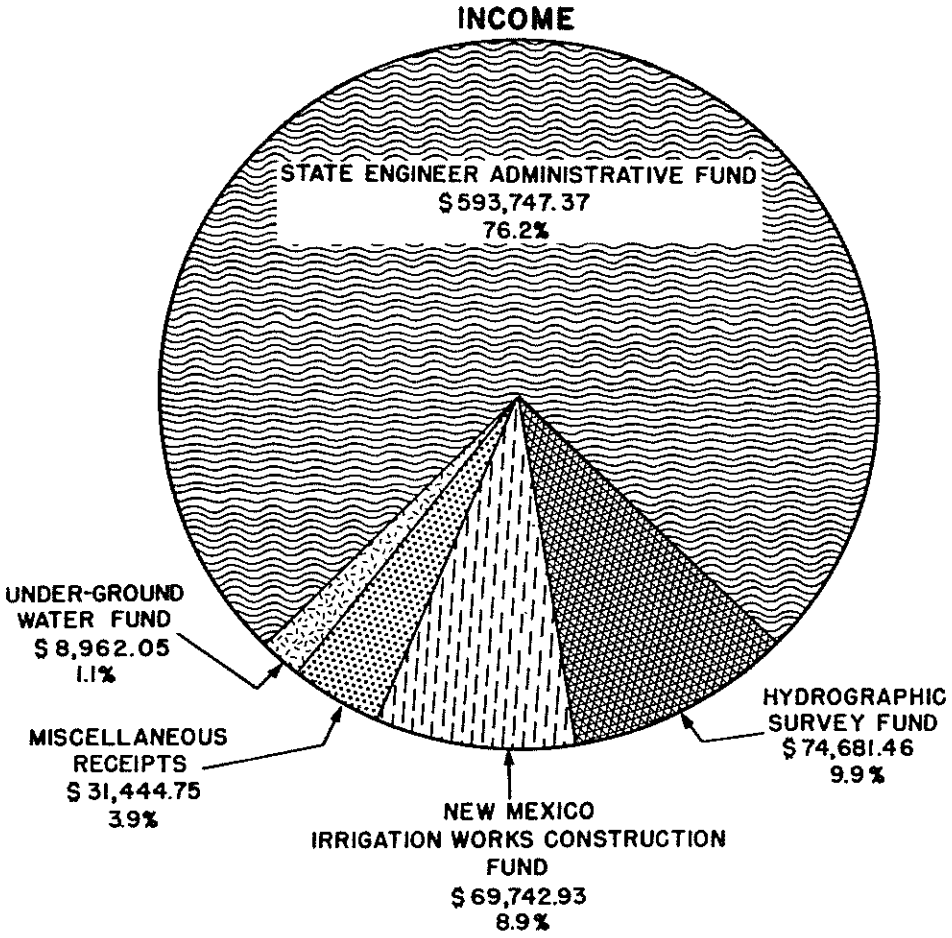
Type of Case	N. M. Supreme Court	District Court	Letters of Opinion
Surface Water	1	30	4
Ground Water	7	67	23

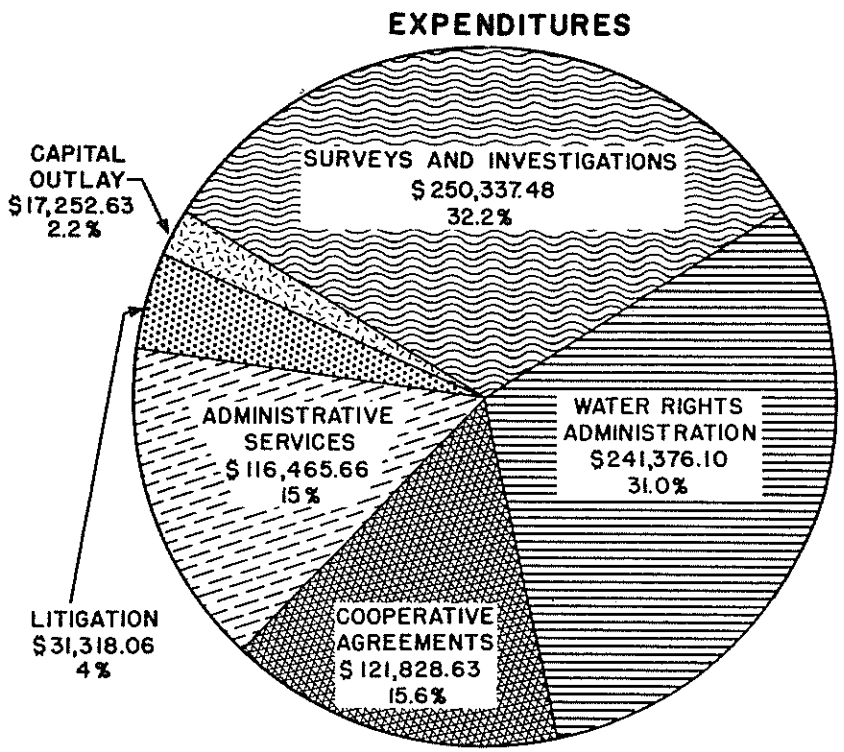
FIGURE 3

STATE ENGINEER OFFICE FINANCIAL CHART

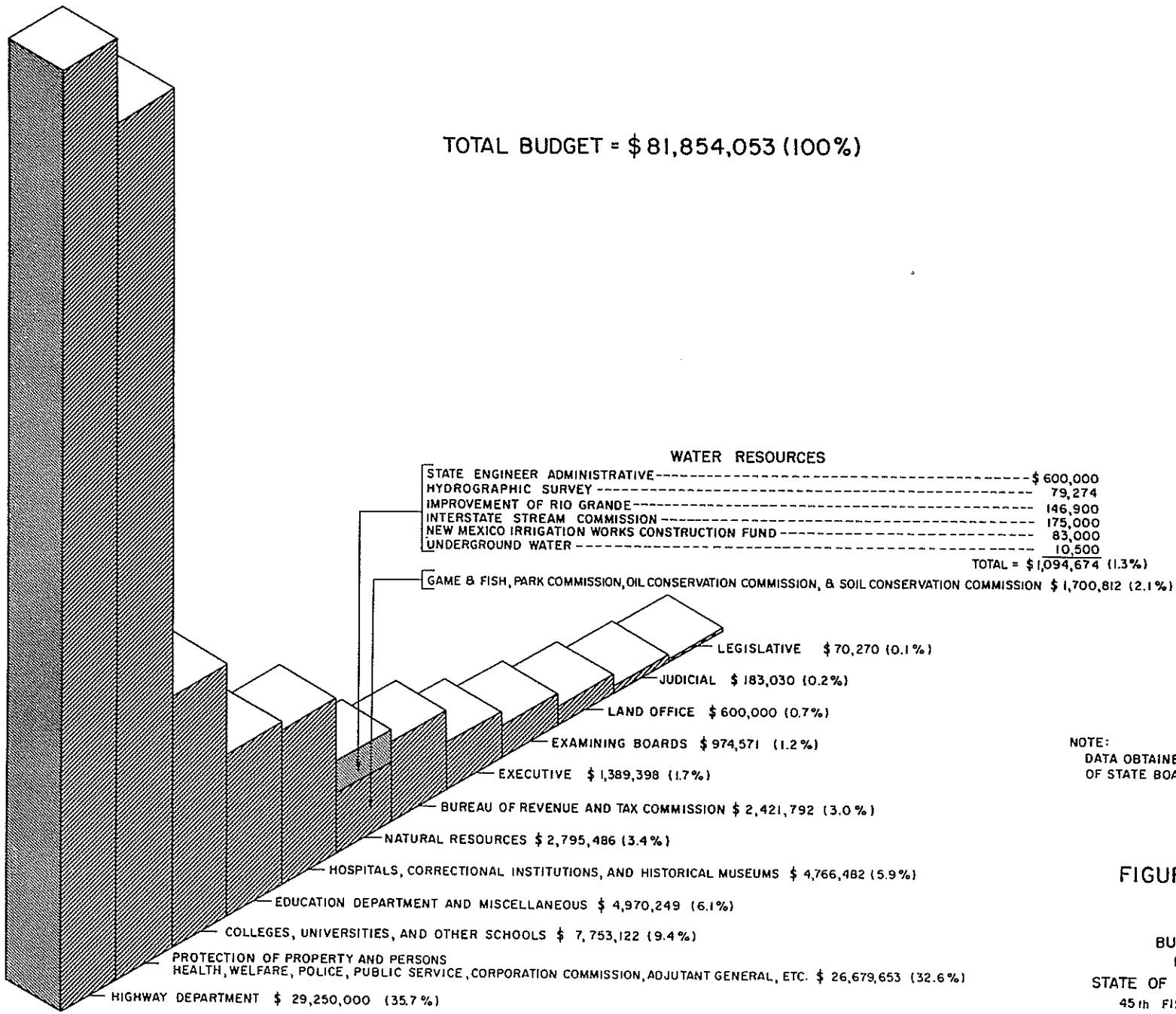
45th. FISCAL YEAR

JULY 1, 1956 - JUNE 30, 1957





TOTAL $778,578.56 = 100%



NOTE:
DATA OBTAINED FROM RECORDS OF STATE BOARD OF FINANCE

FIGURE 4

BUDGET
FOR
STATE OF NEW MEXICO
45th FISCAL YEAR
JULY 1, 1956 - JUNE 30, 1957

COMPILED BY: C.B. THOMPSON
DRAWN BY: M.H. BOYCE
OCT. 30, 1957

In addition to regular duties the legal staff is frequently called upon to address public meetings.

Cooperative Agreements

The State Engineer Office has for many years cooperated financially with various Federal agencies in water resource programs. During the 45th Fiscal Year (1956-57) the following cooperative agreements were in effect:

Agency	Type of Program	State Funds Contributed
U. S. Geological Survey, SW	Collection of streamflow records	$ 45,610.56
U. S. Geological Survey, GW	Ground-water investigations	75,096.27
Soil Conservation Service	Snow surveys	600.00
U. S. Bureau of Reclamation	Rio Grande water salvage	57,987.00
		$179,293.83

Finances

The work of the office like that of most State departments is financed largely by legislative appropriation -- the money for the most part being credited to the State Engineer Administrative Fund. However, certain monies are derived from continuing funds such as the Hydrographic Survey Fund which also receives revenue from counties to repay the costs of conduting such surveys. A small amount is obtained from the Underground Water Fund which derives its revenue from water right filing fees. Some income is received from other public agencies for whom engineering work has been accomplished. In addition, for the purpose of financing certain types of investigations and construction work, money is allocated to the office from the Improvement of the Rio Grande Income Fund and the New Mexico Irrigation Works Construction Fund, both of which are budgeted by and administered by the Interstate Stream Commission. The latter fund derives its revenue from the Permanent Reservoirs for Irrigation Purposes Income Fund which, together with the Improvement of the Rio Grande Income Fund, is supported by rents and royalties from lands which were granted New Mexico by the so-called Ferguson Act of 1898. Figure 3 (a double pie chart) shows the distribution of income and expenditures of the office during the 45th Fiscal Year ending June 30, 1957.

Even though the State Engineer Office budget is sizeable, the amount of money allocated for water research and administration is meager indeed in comparison with that being spent on other State governmental functions. Figure 4 shows graphically the budget for the State of New Mexico for the 45th Fiscal Year. It is to be noted that out of a total of $81,854,053, only $1,094,674 (1.3%).was allocated to water resource work (this includes both State Engineer and Interstate Stream Commission funds).

Associated Activities

The State Engineer's Office participates in numerous activities associated either directly or indirectly with water resource development such as the International Arid Lands Symposium and Conference, New Mexico Water Conference, and the Southwest Irrigation Exposition. A partial list of agencies with which the office has cooperated during recent years is as follows:

1. New Mexico Mapping Advisory Committee
2. Association of Western State Engineers
3. National Reclamation Association
4. Pacific Southwest Inter-Agency Committee
5. Arkansas-White-Red—Basins Inter-Agency Committee
6. American Geophysical Union
7. International Commission on Irrigation and Drainage
8. International Commission on Large Dams
9. New Mexico Geological Society

In addition to his other duties the State Engineer also serves as Secretary of the Interstate Stream Commission, a companion agency whose activities include the negotiation of interstate water compacts; institution of legal proceedings in the name of the State for the conservation, protection, and development of public waters; investigation and development of the water supplies of the stream systems of the State, interstate or otherwise; and the matching of appropriations made by the Congress for water resource investigation and development.

LEGAL PROBLEMS CAUSED BY THE NATURE OF THE VARIOUS WATER RIGHTS IN THE PECOS VALLEY

John F. Russell*

The Roswell Artesian Basin is bounded on the north by a point approximately 25 miles north of the City of Roswell; on the west by the Sacramento Mountains; on the east by the Pecos River, and by the Seven-Rivers area on the south. The actual Basin boundaries extend much further than most of these points, but the area beyond these points is primarily recharge area and there is not much irrigation beyond the boundaries described.

There are two underground sources of water supply in the Roswell Basin---the artesian aquifer and the shallow water aquifer. The artesian aquifer is the deep water found in the San Andreas limestone formations. This limestone outcrops in the western and northern portions of the Basin and slopes generally in a southeasterly direction toward the Pecos River. This limestone formation is very porous and permits the water to move in a southeasterly direction. The recharge to the Artesian Basin comes from precipitation in the northern and western areas and also from stream flows which pass over the limestone which is exposed to the west. The movement of this recharge water builds up the artesian pressure causing wells which penetrate the artesian aquifer to flow and also causes upward percolation through faults in the formation. The source of recharge to the shallow water aquifer are:

1. Local precipitation,
2. Upward percolation from the artesian aquifer and through leaky artesian wells,
3. Return flow from irrigation, and in some cases, seepage loss from constructed works, and
4. Surface drainage.

The Roswell Basin is traversed from north to south by the Pecos River. Crossing the Basin from the west and moving toward the Pecos River are numerous streams among which are the Hondo River, North Spring River, South Spring River, Berrendo River, Felix River and Cottonwood Creek. There are also numerous draws which give surface drainage and which discharge into the Pecos River, or one of its tributaries. There are several drainage districts within the Roswell Basin which collect ground waters and drain the land. Running in a southerly direction is the Hagerman Canal which furnishes water for the irrigation of approximately 10,000 acres.

These various sources of water and their inter-relationship have created a great many legal and administrative problems.

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*Roswell Attorney and Legal Counsel Pecos Valley Artesian Conservancy District.

In its virgin state, the artesian pressure in the artesian aquifer was great and created many springs throughout the Basin. Many of these springs flowed in or near the various stream systems crossing the Basin. As the Artesian Basin was developed, it resulted in a reduced artesian pressure causing the spring flows to gradually decline, and in many instances, they ceased flowing, which resulted in a decreased stream flow.

The Shallow Water Basin maintained its equilibrium by discharging its surplus waters into the stream systems. When the Shallow Water Basin was developed, the lowering of the water table decreased the natural discharge into the stream system, and in some cases, the water table was drawn down to a point below the stream beds, which resulted in a reduction of the stream flow.

The Hagerman Canal is a constructed work for the purpose of carrying water for the irrigation of about 10,000 acres in the Pecos Valley. Its source of supply is from the stream flows and from artesian wells which either flow or pump into the canal system. The seepage losses from the canal and the return flow from the irrigation of lands from the canal raised the water table under the lands east of the canal. Drainage districts were formed to reclaim these lands and to use the waters for the irrigation of other lands. Some of the drainage district lines are open ditches and others are underground tile which collect the waters and discharge them into ditches which eventually discharge into the Pecos River. In some instances, water was pumped from these ditches for irrigation purposes or was discharged into the Pecos River where it was later recaptured and used for the irrigation of other lands downstream.

The 1931 Session of the Legislature enacted on Underground Water Code which gave to the State Engineer the jurisdiction over all underground supplies, the boundaries of which were reasonably ascertainable by scientific investigation. In 1931, the State Engineer declared the boundaries of the Roswell Artesian Basin and thereafter approved no applications for the appropriation of artesian waters from the Basin for the reason that all of the artesian waters had been fully appropriated at that time. The State Engineer did not feel that all of the waters of the Shallow Water Basin had been appropriated and applied to beneficial use. This source of supply was open to new appropriations or for the purpose of supplementing existing rights until August of 1937 when it too was closed to any further appropriations. The areas outside the boundaries of the Roswell Artesian Basin as declared by the State Engineer in 1931, were not under his jurisdiction or control. In these areas, it was not necessary to obtain a permit to drill wells or to appropriate the waters from either the shallow or artesian source. Continued development and expansion of the underground waters outside the original boundaries of the Roswell Artesian Basin resulted in the extension of these original boundaries to include all lands upon which it was felt that waters from the underground source could be applied to beneficial use.

All of the factors which I have enumerated created many administrative and legal problems in connection with the use of these waters, most of which problems remain unsolved to date. Some of these problems are:

1. What remedial rights do the owners of surface water rights from the streams have where the development of the artesian or shallow basin has reduced the stream flow to a point where their original rights can no longer be supplied from the stream?

One school of thought contends that an appropriative right from the stream system extends to and includes the waters of the shallow and artesian basins which was an original source of their supply. They contend that they should be permitted to drill wells in the Basin to supplement their present surface supply and to bring it back to the original quantity of water to which they are entitled under their permits and licenses.

The opposing school of thought contends that the surface and underground water sources are separate and distinct and that an appropriative right from a stream under the 1907 Surface Water Code does not grant or carry with it any rights to the use of an underground source of supply. They contend that the only way in which a person can acquire a right to the use of the underground waters of the State, is in accordance with the provisions and procedures set out in the 1931 Underground Water Code.

This opposing school also contends that the surface right owners are guilty of laches and are now estopped to claim any of the underground waters of the Roswell Artesian Basin. One argument along this line is to the effect that the Shallow Water Basin was open and subject to appropriation from 1931 to 1937. During this six-year period, all surface right owners could have applied for, and obtained a permit to appropriate the waters of the Shallow Basin to supplement their surface rights, and many surface right owners did so apply and obtain these supplemental rights. All of the artesian and shallow waters had been appropriated prior to 1937 and to now permit these surface right owners to drill supplemental wells and withdraw water from the underground source would impair the existing rights of all owners of rights within the Basin.

2. To what extent can the owners of drainage waters use the stream systems as carriers of such waters?

The owners of drain lines are permitted to discharge the drainage water into the stream systems and to recapture and take this water out of the stream system for the irrigation of lands downstream. They cannot use the stream system as a storage reservoir and claim the right to divert for irrigation purposes during the crop season the same quantity of water which they had discharged into the stream system during the year. An owner of drainage water cannot divert at a greater rate than his drainage line is then contributing to the stream system and this amount is decreased by such carriage loss as the State Engineer may set. This involves the measurement of the drainage line as it discharges into the stream, and further measurement where it is being diverted from the

stream for irrigation purposes.

3. Do the owners of drain lines have appropriative rights in the Shallowground Water Basin?

The drainage systems in most cases were originally constructed below the then water table level of the Shallow Basin. The waters collected by these drainage systems consist of:

(a) Precipitation,
(b) Return flow from irrigation,
(c) Seepage loss from constructed works, and
(d) Waters of the Shallow Basin which naturally discharged towards the Pecos River.

These are the same waters which make up the Shallowground Water Basin, and when comingled, they lose their identity and become a part of the Shallowground Water Basin and are subject to appropriation and application to beneficial use. These rights, in most cases, antedate the 1931 Underground Water Code and are vested rights. It must be remembered, however, that the right is vested for the method of diversion used at the time of the enactment of the 1931 Underground Water Code. These owners cannot change their method of diversion to wells and pumps if such change in method of diversion will impair existing rights.

4. What is the legal status of the water rights which were initiated in the extension areas of the Roswell Artesian Basin prior to being taken into the Basin?

When a new area is taken into the Roswell Artesian Basin, there are often wells being drilled at the time of the Order, or lands in the process of being broken out for the purpose of being irrigated from these wells or wells which were completed prior to the time the area was included in the Basin. It would appear that since no permit was required to drill these wells or to apply the water to beneficial use, that these inchoate rights should be treated the same as an applicant's right for a permit to drill a well and appropriate the waters for beneficial use. Under the existing regulations of the State Engineer, he would be given two years in which to complete the construction of his works and to apply the waters to beneficial use, and in the event that he had not completed these requirements within the two-year period, he would then, upon application, be granted an extension of time for an additional two-year period.

A problem arises when the individual completes his well and applies the water to beneficial use on more acreage then he could continue to cultivate from that well or wells, and he then applies to the State Engineer for a permit to drill a supplemental well for this acreage. It would appear that the applicant should not be permitted to secure a source of supply in excess of the initial production of the wells drilled prior to the time the area is taken into the Basin.

Much of the land in the extension areas is irrigated from wells drawing upon recharge rather than storage, and the water level in the area declines rapidly resulting in the pumping from an uneconomical depth. Applications to transfer these rights into the original Basin have been made. These applications have been protested by the Pecos Valley Artesian Conservancy District and the protest has been upheld by the State Engineer on the theory that all of the waters of the original Basin have been appropriated and any additional appropriations would impair all existing rights with the original Basin.

LEGAL ASPECTS OF WELL METERING IN THE PECOS VALLEY

The legality of metering all wells in the Roswell Artesian Basin involves the following statutes:

1. Sec. 75-2-9 provides, "that the State Engineer shall have the supervision of the apportionment of water in this State according to the licenses issued by him and his predecessors and the adjudications of the Courts".

2. Sec. 75-11-18 provides, "that all underground waters of the State of New Mexico are hereby declared to be public waters and belong to the public of the State of New Mexico and to be subject to appropriation for beneficial use within the State of New Mexico. All existing rights to the beneficial use of such waters are hereby recognized".

3. Sec. 75-11-4 provides, "Existing water rights based upon application to beneficial use are hereby recognized. Nothing herein contained is intended to impair the same or disturb the priorities thereof".

All artesian rights in the Roswell Artesian Basin wereperfected prior to the enactment of the 1931 Underground Water Code and many of the shallow rights were perfected prior to that date. It is my opinion that the State Engineer does not have the supervision of the apportionment of these underground water rights since they are not, in most cases, licensed rights, nor have they been adjudicated by the Courts and the foregoing statutes provide that these rights are recognized and nothing in the statutes shall impair them.

All underground water rights from the Roswell Artesian Basin are in the process of being adjudicated and when the adjudication order is signed, these rights will be subject to the supervision of the apportionment of the water according to the adjudication order.

WATER COMPACTS - Experiences and Mechanics

J. D. Weir*

Although negotiated and executed by sovereign states, interstate water compacts directly or indirectly affect the rights of individual inhabitants within the respective states, and it is therefore fitting that a discussion and consideration of the mechanics of and problems inherent in such compacts be a part of any program under the theme of this conference of "Water for New Mexico - Your Problem and Mine".

Before proceeding, may I briefly review the basic legal concept and procedure involved in compact making. Sec. 10 (2) of Art. I of the Federal Constitution provides: "No State shall, without the Consent of Congress ... enter into any Agreement or Compact with another state..." This provision has been construed to mean that the Constitution authorizes a state to enter into any agreement or compact with another state with the consent of Congress. In practice a compact is negotiated by commissioners designated by the participating states. Its binding effect on signatory states is accomplished through ratification by their respective legislatures. Under existing New Mexico law, the Interstate Streams Commission, among other things, is authorized to negotiate compacts with other states to settle interstate controversies or looking toward an equitable distribution and division of waters in interstate stream systems, subject, in all cases, to final approval by the legislature of New Mexico. Ordinarily, the consent of Congress to negotiate a compact is first sought by the interested states. The Congressional Act granting such consent in nearly every case designates a federal representative to serve on the compact commission, and in the case of most if not all of New Mexico's compacts such federal representative serves as chairman, without vote. States may enter into a compact without first obtaining the consent of Congress to negotiate, but subsequent Congressional approval of the compact arrangement implies previous consent.

It may be well to note here that both the interstate compact and interstate litigation over water matters are twentieth century phenomena. Among early cases was Mississippi River litigation in 1901 and 1906 in Missouri v. Illinois, and Arkansas River litigation in 1902 and 1907 in Kansas v. Colorado. The earliest compact dates back to 1922. Both result from pressing claims being made upon our streams and the end of a period when each State could determine for itself, without regard to its sister States, what and how much use it would make of

*Attorney, Las Cruces, New Mexico and General Counsel Elephant Butte Irrigation District.

interstate waters. The power of a state over the waters within its borders is limited by vested rights therein of other states, and one state may not unreasonably appropriate the waters of a river within its borders, to the injury of another state through which such river flows. Interstate compacts and interstate litigation reflect, in essence, two different approaches to the problem -- one the cooperative, horse-trading approach, the other, a strictly legalistic and usually contentious approach. But either may give way to the other, as witness the Rio Grande Compact, which upon conclusion in 1938 terminted pending U S. Supreme Court litigation between Texas v. New Mexivo for alleged excessive diversions of water in New Mexico in violation of a 1929 Compact, followed in 1951 by a suit in the same court between the same parties for enforcement of the Rio Grande Compact.

As of 1956 there were twenty interstate water compacts in effect, in seven of which New Mexico was a signatory, indicating we are disposed to approach the problem from a cooperative, horse-trading angle rather than on a strictly legalistic or contentious basis. The earliest in which New Mexico was a party was the Colorado River Compact in 1922 and the last the Canadian River Compact in 1950. One or more of the following major purposes and objectives are stated in the seven existing New Mexico compacts: to provide for the equitable division and apportionment of the use of the waters of a particular stream; to establish the relative importance of different beneficial uses of water; to promote interstate comity; to remove causes of present and future controversies; to secure the expeditious agricultural and industrial development of a particular basin, the storage of its waters, and the protection of life and property from floods; to assure the most efficient utilization of the waters of a named stream; to provide for the integrated operation of existing and prospective irrigation facilities on the stream in two compacting states; to adjust the conflicting jurisdictions of two states over irrigation works and facilities diverting and storing water in one state for use in both states; to equalize the benefits of water from a named stream, used for the irrigation of contiguous lands lying on either side of the boundary, between the citizens and water users of one state and those of the other, and to place the beneficial application of water diverted from a named stream for irrigation by the water users of two states on a common basis; to make secure and protect present development within the states; to facilitate the construction of works for, (a) the salvage of water, (b) the more efficient use of water, and (c) the protection of life and property from floods; and to provide for the construction of additional works for the conservation of the waters of a named stream.

With the above as a general background, a brief review and discussion of each New Mexico compact in chronological sequence follows.

Colorado River Compact, 1922

Entered into by the states of Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming, and covers waters of the "Colorado River System" and "Colorado River Basin". It was the first interstate water compact negotiated in the United States. Division is made into the "Upper Basin", which means

those parts of the States of Arizona, Colorado, New Mexico, Utah and Wyoming within and from which waters naturally drain into the Colorado River System above Lee Ferry, and also all parts of said States located without the drainage area of the Colorado River System which are now or shall hereafter be beneficially served by waters diverted from the System above Lee Ferry; and the "Lower Basin" which means those parts of the States of Arizona, California, Nevada, New Mexico and Utah within and from which waters naturally drain into the Colorado River System below Lee Ferry, and also all parts of said States located without the drainage area of the Colorado River System which are now or shall hereafter be beneficially served by waters diverted from the System below Lee Ferry. As will be noted, New Mexico is concerned with both the Upper and Lower Basin provisions of this compact, its share of the waters of the San Juan, Little Colorado, and Gila River Basins being involved; and directly related thereto is the subsequent Upper Colorado River Basin Compact of 1948, hereinafter summarized, to which New Mexico is also a party.

No provision is made in the Colorado River Compact for a compact commission, but Article V imposes upon the chief official of each signatory state charged with the administration of water rights, along with federal agencies in an ex-officio capacity, certain responsibilities under the compact. Likewise, Article VI provides for the appointment of Commissioners by the respective legislatures, to resolve controversies and disputes arising under the compact.

Interestingly, this Compact provides that use of the waters of the Colorado River for navigation purposes shall be subservient to domestic, agricultural, and power purposes, and that impounding and use of any waters for the generation of electrical power shall be subservient to the use and consumption of such water for agricultural and domestic purposes and shall not interfere with or prevent use for such dominant purposes.

Litigation under this compact has been primarily between Arizona as plaintiff against California and other defendants from time to time. The first was in 1931 when Arizona sought to enjoin storage facilities authorized by the Boulder Canyon Project Act; second was an action by Arizona in 1934 against California and others to perpetuate testimony arising out of the Boulder Canyon Project Act for use in contemplated later litigation; and third, an action in 1936 by Arizona against California and others for a partition of the right to appropriate in the future waters of the Colorado River not as yet appropriated. In 1952 a fourth action by Arizona was filed against California and seven municipalities or political subdivisions within that state and later the United States and Nevada became parties by intervention. New Mexico and Utah became parties involuntarily by order of the Supreme Court in their capacities as Lower Basin states. New Mexico's interest primarily relates to the use of the waters originating within its boundaries of the Gila and Little Colorado Basins, and if proper agreement with Arizona relative thereto cannot be effected, such rights will be actively litigated in the pending Arizona v. California suit, which in Western Water News has been reported from time to time as "The Long Suit".

La Plata River Compact, 1922

Entered into by Colorado and New Mexico, and providing for the equitable distribution of the waters of the La Plata River, a tributary of the San Juan which is atributary of the Colorado. Administration is vested in the State Engineers of the signatory states, or their successors. The rotation provision of the Compact gave rise to litigation which has become a landmark case in interstate water law, being Hinderlider v. La Plata River and Cherry Creek Ditch Co., 304 U.S. 92 (1938), where in the Supreme Court of the United States determined, among other things: (1) that "whether the apportionment of the water of an interstate stream be made by compact between the upper and lower states with the consent of Congress or by a decree of this Court, the apportionment is binding upon the citizens of each State and all water claimants, even where the State had granted the water rights before it entered into the compact,"; (2) that "As the States had power to bind by compact their respective appropriators by division of the flow of the stream, they had power to reach that end either by providing for a continuous equal division of the water from time to time in the stream, or by providing for alternate periods of flow to the one State and to the other of all the water in the stream"' and (3) that "As Colorado possessed the right only to an equitable share of the water in the stream, the decree of Jan. 12, 1898, in the Colorado water proceeding did not award to the Ditch Company any right graded than the equitable share" and that, therefore, "the apportionment made by the Compact cannot have taken from the Ditch Company any vested right, unless there was in the proceeding leading up to the Compact or in its application some vitiating infirmity."

Rio Grande Compact, 1938

Entered into by the States of Colorado, New Mexico and Texas with respect to the use of the waters of the Rio Grande and Rio Grande Basin in Colorado, New Mexico and Texas above Fort Quitman, Texas. Administration under Article XII is vested in a commission consisting of the state engineers of Colorado and New Mexico and duly designated representatives of Texas and the United States. The United States representative is chairman, without vote. The compact is unique in that it does not apportion the waters between New Mexico and Texas, but between water users in New Mexico above Elephant Butte on the one hand and water users in New Mexico and Texas below Elephant Butte on the other hand. The compact and the stream over which it has jurisdiction affects perhaps the largest and most populous agricultural areas of the state, and, of course, is of particular importance and significance to the inhabitants within the Middle Rio Grande Conservancy District and Rio Grande Projects. The compact is subject to the Rio Grande Convention of 1906 between the United States and Mexico, which obligates the United States to deliver to Mexico from the bed of the Rio Grande at El Paso 60,000 acre-feet of water annually. This Convention incidentally was the forerunner of the ultimate construction of Elephant Butte and Caballo reservoirs and other structures under the Rio Grande Project. Interestingly in this connection, a suit was instituted in 1889 entitled the United States v. Rio Grande Dam and Irrigation Company, 174 U.S. 690, allegedly upon complaint

of the Mexican authorities, to investigate and prevent erection of storage facilities at the approximate present site of Elephant Butte and appropriation of waters of the Rio Grande upon the ground that there would be substantial diminishment of the navigability of the stream. The action was dismissed, with a finding that the Rio Grande was not navigable for a considerable distance below the proposed dam site.

As heretofore noted, adoption of the Rio Grande Compact terminated then pending litigation between Texas and New Mexico, but in 1951 Texas (which in effect were all water users below Elephant Butte reservoir) filed suit in the United States Supreme Court against New Mexico and the Middle Rio Grande Conservancy District to restrain the defendants from storing waters of the Rio Grande and its tributaries in reservoirs in New Mexico constructed after 1929 above San Marcial, except to the extent permitted by the Compact, and from diverting and using in New Mexico waters of the Rio Grande and its tributaries allocated to Texas by the Compact, and to deliver water in the Rio Grande at San Marcial in the quantities specified by the Compact, and otherwise to comply with the terms of the Compact. Various legal attacks were interposed to the complaint by the respective defendants, numerous hearings before a Special Master were held, ultimately resulting in dismissal of the action due to absence of the United States as an indispensable party defendant because of involvement of Indian rights. The proceeding never reached a trial or hearing on the basic issues complained of. The extreme continuing drouth perhaps was a contributing factor to the origin of the controversy, but the basic issues still remain unresolved and undetermined and will require further unrelenting study, consideration and cooperation to fairly and equitably protect all inhabitants of the state and permit continuance of the compact as a practical and workable document.

Costilla Creek Compact, 1944

Entered into by Colorado and New Mexico and pertaining to Costilla Creek, a tributary of the Rio Grande which rises on the west slope of the Sangre de Cristo range in the extreme southeastern corner of Costilla County in Colorado and follows in a general westerly direction crossing the Colorado-New Mexico boundary three times above its confluence with the Rio Grande in New Mexico. Administration is vested in the state engineers of the two states, constituting the Costilla Creek Compact Commission, and daily handling of water is accomplished by a watermaster appointed by the New Mexico commissioner. The compact affects a limited area and population, and no significant litigation has arisen therefrom to date.

Upper Colorado River Basin Compact, 1948

Entered into by Arizona, Colorado, New Mexico, Utah and Wyoming, covering equitable division and apportionment of the use of the waters of the Colorado River System, the use of which was apportioned in perpetuity to the Upper Basin by the Colorado River Commission, consisting of a commissioner representing each signatory state and a commissioner representing the United States, the latter of whom is the presiding officer with all powers and rights vested in the commissioners of the respective states. Four members of the commission constitute a quorum. Much time and effort of the Commission along with other groups and agencies, has been devoted to the ultimate successful enactment of legislation authorizing the Colorado River Storage Project and Participating Projects. No significant litigation has arisen directly involving this compact, but as hereinbefore noted certain of the signatory states in the Colorado River Compact are indirectly involved in the pending Arizona v. California suit. Of greatest importance to New Mexico will be the ultimate determination as to use within the basin or diversion to other basins of waters of the San Juan River.

Pecos River Compact, 1948

Entered into by Texas and New Mexico, pertaining to the Pecos River, a tributary of the Rio Grande which rises in north-central New Mexico and flows in a southerly direction through New Mexico and Texas and joins the Rio Grande near the town of Langtry, Texas, including all tributaries thereof. Administration is vested in the Pecos River Commission, consisting of a commissioner from each of the signatory states designated by the President representing the United States. The United States representative is chairman, but without vote. All members must be present to constitute a quorum. Activities under the compact to date have been primarily devoted to determining and attempting to secure financing for construction of a low-water channel through the delta area from a point opposite Artesia to the head of Lake McMillan and a levee and floodwater channel lying along the east side of the valley, through the same area; also, a program to relieve the artesian pressure on the salt brine which discharges in the Malaga Ben area, thus preventing an average of about 370 tons of salt per day from entering the river at this point, the brine to be pumped into a nearby disposal area. No significant litigation arising under the compact has occurred to date.

Canadian River Compact, 1950

Finally is the above compact, entered into by New Mexico, Texas and Oklahoma, covering waters of the Canadian River, a tributary of the Arkansas River which

rises in northeastern New Mexico and flows in an easterly direction through New Mexico, Texas and Oklahoma and including the North Canadian River and all other tributaries of said Canadian River. Administration is in the Canadian River Commission, consisting of commissioners of each of the three signatory states designated or appointed in accordance with the laws of the state, and a representative or commissioner from the United States designated by the President, the last named to be the presiding officer, without vote. All members must be present to constitute a quorum, and a unanimous vote of the Commissioners for the three signatory states is necessary to all actions taken by the Commission. Under Article IV New Mexico has free and unrestricted use of all waters originating in the drainage basin of the Canadian River above Conchas Dam; it has free and unrestricted use of all waters originating in the drainage basin in New Mexico below Conchas Dam, but conservation storage of such waters shall be limited to an aggregate of 200,000 acre-feet; and the right to provide conservation storage in the drainage basin of the North Canadian River but limited to the storage of such water as at the time may be unappropriated under the laws of New Mexico and Oklahoma. The compact was negotiated subsequent to the construction of the Conchas Dam and Reservoir and the Arch Hurley Conservancy District. The compact defines the term "conservation storage" and excludes any portion of the reservoirs allocated solely to flood control, power production, and sediment control. Although embracing a rather large but somewhat erratic water supply, the same has remained undeveloped primarily becasue there is very little irrigable acreage below Conchas Dam along the Canadian or its tributaries other than what is under the Arch Hurley Conservancy District.

No significant litigation has as yet occurred under this compact.

Conclusion

Compacts, like individual contracts, are no better than the conscience and willingness of the parties to mutually and constantly strive for their practical and workable administration. At best they can contain only basic general policies and principles which may assume new aspects and necessitate re-evaluation and redrafting in the light of day to day administration and changing conditions. Our United States Supreme Court, no less, has approved and recommended them in preference to long, expensive and uncertain litigation. Thus in Colorado v. Kansas, 320 U.S. 393,392 (1943), it said:

> "The reason for judicial caution in adjudicating the relative rights of States in such cases is that, while we have jurisdiction of such disputes, they involve the interests of quasi-sovereigns, present complicated and delicate questions, and, due to the possibility of future change of conditions, necessitate expert administration rather than judicial imposition of a hard and fast rule. Such controversies may appropriately be composed by negotiation and agreement, pursuant to the compact clause of the Federal Constitution. We say of this case, as the court has said of interstate differences of like nature, that such mutual accommodation and agreement should, if possible, be the medium of settlement, instead of invocation of our adjudicatory power."

BIBLIOGRAPHY

Constitution and Statutes:

Constitution of the United States, Art. I, Sec. 10

New Mexico Statutes 1953 Anno., Vol. 11, Secs. 75-34-1 through 75-34-8, Interstate Stream Commission and Protection of Inter-State Streams

Texts, Papers and Reports:

Am. Jur., Vol. 49, States, Territories and Dependencies, Sec. 11

Am. Jur., Vol. 56, Waters, Secs. 373 and 374

Compact Commissions and Interstate Committees, 22nd Biennial Report of the State Engineer of New Mexico (1954-1956) p. 275

Documents on the Use and Control of the Waters of Interstate and International Streams, Compacts, Treaties and Adjudications, compiled and edited by T. Richard Witmer, U. S. Dept. of the Interior (1956)

Interstate Water Compacts, Clifford H. Stone (1951) Rocky Mountain Law Review, Vol. 24, N. 2, P. 141

New Mexico Water Resources, S. E. Reynolds, Annual New Mexico Water Conference, N.M.A.&M.A. (1956) p. 6

Water Use and Water Control Planning on the Rio Grande, Harold B. Elmendorf, Annual New Mexico Water Conference, N.M.A.&M.A. (1956) p. 98

Cases:

Arizona v. California (1931) 283 U.S. 423

Arizona v. California (1934) 292 U.S. 341

Arizona v. California (1936) 298 U.S. 558

Arizona v. California (1956) 351 U.S. 977

Colorado v. Kansas (1943) 320 U.S. 383, 392

Hinderlider v. La Plata River and Cherry Creek Ditch Co. (1938) 304 U.S. 92

Kansas v. Colorado (1902) 185 U.S. 125

Kansas v. Colorado (1907) 206 U.S. 46

Missouri v. Illinois (1901) 180 U.S. 208

Missouri v. Illinois (1906) 200 U.S. 496

Texas v. New Mexico (1939) 308 U.S. 510

Texas v. New Mexico (1957) (No. 9 Original) 1 L Ed 2d 541

United States v. Rio Grande Dam and Irrigation Co. (1899) 174 U. S. 690

BENEFICIAL USE, PREFERENTIAL RIGHTS, PROBLEMS IN TRANSFER OF WATER RIGHTS, AND OTHER PROBLEMS UNDER NEW MEXICO STATUTES

Charles D. Harris*

Any discussion of the New Mexico water law involves two key phrases--beneficial use and impairment of rights. These are the legislative guide posts and the standards by which the State Engineer administers water rights. In a larger sense, a discussion of these terms involves some discussion of the basic philosophy of water law which, in turn, involves a discussion of the entire philosophy of property law.

It appears to me that the western states, and particularly New Mexico, in developing the law of prior appropriation have been confronted with two diametrically opposed concepts. These concepts are flexibility and security. Probably the fundamental concept of our water law is that of security, that is, "first in time is first in right."

The early court decisions concerning water law in the west and certainly the early legislation was directed toward securing property rights in water. In the case of Yeo v. Tweedy, 34 N.M. 611, 286 Pac. 970, the New Mexico Supreme Court discussed the alternatives to the prior appropriation doctrine and stated:

> "The preventive for such unfortunate and uneconomic results is found in the recognition of the superior rights of prior appropriators. Invested capital and improvements are thus protected. New appropriations may thus be made only from a supply not already in beneficial use. Nonuse involves forfeiture. A great natural public resource is thus both utilized and conserved."

In New Mexico we have been hard put to achieve the idealization of the doctrine of prior appropriation as pronounced by the Supreme Court in 1929. We know now that in many instances our water resources cannot be both utilized and conserved. In most of our groundwater basins such as Lea County, Portales, Mimbres, and Animas basins any appropriation involves mining of water. In other words, once the water is utilized by man, it cannot be at the same time conserved.

Even in 1929, however, the Supreme Court was concerned with the social implications of the use of water. In the same case, the Supreme Court said:

> "Such bodies of subterranean water are the principal resource of the localities where they occur. Their employment to the best economic advantage is important to the state."

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This same idea was expressed in the recent case of State v. McLean, 62 N.M. 264, decided in 1957. Chief Justice Lujan stated:

> "All water within the state, whether above or beneath the surface of the ground, belongs to the state which authorizes its use and there is no ownership in the corpus of the water but the use thereof may be acquired and the basis for such acquisition is beneficial use. The state as owner of the water has the right to prescribe how it may be used. This the state has done by the enactment of Sec. 75-11-2, which provides that the beneficial use is the basis, the measure and limit to the right to the use of water."

In the McLean case the Supreme Court went on to hold that the defendant had not made beneficial use of the water for a period of more than four years. In that case the defendant had allowed the water to flow from the artesian well in question, uncontrolled, 24 hours a day, without a constructed irrigation system. However, the defendant claimed that water was absorbed on native salt grass and was used to water livestock and that it was a beneficial use. The Supreme Court held against the defendant, ruling that he had lost the right through continuous nonuser through waste.

This case does not help us much in determining the meaning of beneficial use but the Supreme Court did say that allowing water to waste out on the land without being under the control of an irrigator was not beneficial use. As far as we are able to determine, this is as near to a definition of beneficial use as the Supreme Court has ever given us. The McLean case did say that an appropriator is limited to the use of such water as may be necessary and useful for some beneficial purpose on the land from which it is taken but the law has never defined what beneficial use is.

Query: Does the beneficial use have to be beneficial to the landowner or does it have to be beneficial to the public as a whole? Certainly, the McLean case stands for the proposition that waste will not be tolerated and it further stands for the proposition that the standards of care in preventing waste are greater than the standard required in the early days of irrigation.

It may well be that the trend is toward elimination of wasteful practices. Certainly the technological advances which have enabled appropriators to use underground irrigation systems or concrete-lined ditches have gone a long way toward elimination of waste. It may well be as the shortage of water in the state increases, the public will demand stricter enforcement of the laws prohibiting waste.

PREFERENTIAL RIGHTS

Any discussion of transfer of water rights requires discussion of the legal preferences to use of water established in New Mexico. The earliest statute giving a preference to the use of water was enacted in 1876, which declared that all waters in springs, rivers and ditches are free in order that all persons traveling in the state shall have the right to take water therefrom for their own use and that of the animals under their charge. Section 75-1-4, N.M.S.A. 1953, Section 75-1-5, N.M.S.A. 1953. This statute evidently gave travelers and livestock an absolute right to the use of water without regard to the doctrine of prior appropriation. While this statute is interesting as setting up an absolute preference, it has not had much importance on the development of water law.

However, in 1953 the Legislature promulgated an amendment to Section 75-11-1 which creates an important preference. This amendment provides that the State shall issue a permit to applicants for domestic use and for livestock water. These permits do not require advertising and hearing as is usually required in applications for appropriations. Neither does the statute provide any grounds upon which the State Engineer can deny an application for livestock or for domestic purposes. The Legislature recited in the 1953 amendment that this statute was enacted for the reason that relatively small amounts of water were consumed in the watering of livestock or for household or other domestic use. However, it can be seen that even though the amount of water used is small, that this statute gives to appropriators for domestic or livestock water, an absolute preference over other users, the effect of which is a transfer from prior appropriators by operation of law and without compensation. The constitutionality of this section has not been passed upon by the New Mexico Supreme Court.

The same section also gives a preference to appropriators for the use in prospecting, mining and drilling operations designed to discover or develop the natural mineral resources in the State. The preferences given for drilling, prospecting and mining operations is not an absolute one since it is limited to three acre feet of water for a definite period not to exceed one year and the State Engineer is also given the discretion of determining whether or not the proposed use will permanently impair any existing rights. If the State Engineer in a preliminary examination of the application finds that the proposed use will permanently impair existing rights, the statute requires advertisement and hearing as provided in other applications. It can thus be seen, that the appropriation of water used in prospecting, mining or drilling operations designed to discover or develop the natural mineral resources of the State of New Mexico have a preference over any other water users except domestic and livestock uses. This portion of Section 75-11-1 has not been passed upon by the Supreme Court. This is another instance of a transfer of water rights by operation of law.

These are the only preferences which we can find in the New Mexico statutes, however, during the last year important litigation has arisen over the claim of preferential rights for municipal uses. This involves the doctrine of pueblo rights.

Under the California cases, the California Supreme Court has held that the cities of San Diego and Los Angeles were originally formed as pueblos by either the Spanish or Mexican governments and that the original pueblo grants gave to those cities the right to use of waters of the San Diego and Los Angeles rivers respectively, not only for the original pueblos but the right in futuro to the successors of the original pueblos to use all of the water that was reasonably necessary for the growth of the cities, as in the cases of San Diego and Los Angeles. These cities have the right to take all the water and to drive out of business any other users to their source of water without compensation.

The New Mexico Supreme Court has discussed the pueblo rights doctrine in the case of New Mexico Products Co. v. New Mexico Power Company, 42 N.M. 311, but in that case held that Santa Fe never did have a pueblo grant and therefore, the pueblo rights doctrine would not apply. There is now pending before the New Mexico Supreme Court another case involving pueblo rights doctrine, and that is the case of Cartwright v. Public Service Company of New Mexico. In this case the public service company had taken all of the waters of the Gallinas River for use under its franchise to supply the city and town of Las Vegas with municipal water. The agricultural users from Gallinas River brought a suit demanding compensation for the company taking of what they claim their rights. The public service company in its answer to the suit claimed that it had an absolute right by virture of a New Mexico grant to the Pueblo of Las Vegas to take all of the water of the Gallinas River reasonably necessary for municipal uses without compensation to any other users on the Gallinas River.

The State of New Mexico filed a brief in the Supreme Court as a friend of the Court and argued that under the New Mexico Law, beneficial use was the measure, the basis and the limit to the use of water, and that since the city and town of Las Vegas had not beneficially used all of the waters of the Gallinas River prior to the time that the agricultural users had appropriated the water, that the public service company did not have a prior right. In the event the Supreme Court upholds the position of the public service company, then we will see another example of a transfer of water rights by operation of law without respect to the priority of beneficial use. This case could have a far reaching effect especially with regard to the Rio Grande. The City of Albuquerque also filed Amicus Curiae brief in which they supported the position of the public service company. It is the position of the City of Albuquerque that she also has an absolute preference to the waters of the Rio Grande and to the waters underlying the valley fill of that stream.

It can thus be seen that if the Supreme Court of New Mexico adopts the pueblo rights doctrine, that it will create a tremendous change in the administration of water law in New Mexico. In the case of the City of Albuquerque, that city would have prior and paramount rights to all of the waters of the Rio Grande, whether surface or underground and all other users from that stream would take water at the sufferance of the City of Albuquerque.

PROBLEMS IN TRANSFER OF WATER RIGHTS UNDER NEW MEXICO STATUTES

The pertinent statutes providing for transfer of surface water rights are found in Secs. 75-5-21 and 75-5-23 and 75-5-24. Since we are concerned here with the change of place of use or change of purpose, the important statute is Sec. 75-5-23 which provides that an appropriator may change the purpose or place of diversion, storage or use upon application to the State Engineer, provided that no such change shall be allowed to the detriment of others having valid and existing rights to the use of waters of said stream system.

The underground statute is Sec. 75-11-7 which allows a change of location of well or use of water upon application to the State Engineer and upon showing that such change or changes will not impair existing rights.

The most vexatious problem today facing the State Engineer and perhaps the state of New Mexico concerns the changes of water rights occurring in the Rio Grande Underground Water Basin as declared by the State Engineer. This basin extends along the valley of the Rio Grande from the Elephant Butte Dam to the Colorado State line. According to the investigations made by the State Engineer, there is a considerable amount of ground water under the valley floor of the Rio Grande and extending throughout the New Mexico stretch of that river. I understand that the underground water along the Rio Grande is connected with the surface stream and along much of the river there are accretions from the underground reservoir into the river.

There is much water in storage in the Rio Grande Underground reservoir but, according to the State Engineer, this water cannot be taken out of the underground storage without adversely affecting the flow of the Rio Grande. The State Engineer has proposed to administer the Rio Grande Underground Water Basin in a manner that would allow use of the unappropriated water of the underground reservoir and at the same time insure that the perennial flow of the Rio Grande will not be adversely affected.

Under the State Engineer's administration, a person can make an application to appropriate the underground water provided that he at the same time withdraws from use direct appropriations from the surface stream to the extent that the underground use affects the flow of the stream. For instance, if it is determined that the appropriation of one thousand acre-feet over a given period of time will affect the river to the amount of decrease of ground water accretions to the river of one hundred acre-feet, then the appropriator will have to dry up direct diversions from the river to the amount of one hundred acre-feet per annum for a given period of time. It is believed that this system will protect the prior appropriations along the river and at the same time will enable New Mexico to utilize the unappropriated ground water.

This problem is a complex one fraught with many difficulties, not the least of which is the fact that a tremendous amount of the Rio Grande Underground Water Basin lies within the boundaries of the Middle Rio Grande Conservancy District. The Middle Rio Grande Conservancy District, under Secs. 75-28-28 and 75-28-29 have the power to distribute irrigation water for purposes most essential to welfare and economy of landowners within the district. The conservancy district in this instance has not deemed it expedient to take any steps to protect the surface stream from underground water uses and as far as I am aware

have not consented to the transfer of any rights from surface use in order to enable applicants to appropriate underground water.

It may well be that there will be considerable litigation along the Rio Grande and possibly additional legislation before a definitive public policy of the state of New Mexico can be formulated.

OTHER PROBLEMS

The hydrologists tell us that there is a hydrological connection between all waters. Rainfall falls upon the surface of the land, sinks into the land and emerges as spring water or seepage water into surface outlets. In the administration of the Rio Grande, the State Engineer has sought to utilize the scientific facts concerning the inter-relationship between surface and ground waters. Such has not always been the case along the Pecos River. We know now that the development of artesian and shallow water in the Roswell Artesian Basin has affected the flow of the Pecos River. In many cases the surface water appropriators in this area have sought to recapture their original supply of water by drilling wells.

Two such cases are now pending before the New Mexico Supreme Court. In the case of Langenegger v. State Engineer, the applicant sought to drill wells in order to recover drainage rights. This application was turned down by the State Engineer on the ground that the drainage rights were private rights and the applicant had no right to the underground waters and for the further reason that the granting of the appplications would impair downstream Pecos River users. The district court upheld the decision of the State Engineer and upon appeal to the Supreme Court, a decision was handed down denying Mr. Langenegger relief on the basis that the drilling of the shallow wells would impair the surface users. There is some doubt about the decision handed down by the Supreme Court since the Court seems to imply that Mr. Langenegger had a right to the public underground waters. The case is still before the Supreme Court upon a motion for rehearing.

The other case involving the transfer of water rights which is before the Supreme Court is the case of Templeton, et al., v. State Engineer. In this case, the applicants claimed that the appropriations from ground water sources had so depleted the flow of the Felix River that the applicants could not maintain the river appropriations and, therefore, they argue that they should be entitled to drill wells in order to get sufficient water to fulfill their appropriative rights. In this case the district court reversed the decision of the State Engineer and upheld the position of the applicants. This case is now pending before the New Mexico Supreme Court.

With the number of cases now pending before the Supreme Court involving the transfer of water rights, a considerable amount of water law should be made. In the case of Spencer v. Bliss, 60 N.M. 16, the New Mexico Supreme

Court held that the burden was upon the applicant to show that a proposed move would not impair existing rights. Since the applicant's burden is the proving of a negative, this is a difficult burden. The tendency of the administrative decisions by the State Engineer would indicate that it is becoming more difficult to change the place of use of water rights.

"PRESENT AND FUTURE METHODS FOR EFFICIENT IRRIGATION"

Dr. Vaughn E. Hansen*

Introduction

Two separate talks have been prepared in an attempt to treat this subject. Neither seem to fit the tone of the conference, furthermore, it may even be ambiguous to treat present and future methods for efficient irrigation. What is efficient irrigation practice under one set of conditions may not be efficient practice under another set. For example in Japan where hand labor is cheap, land scarce, farms small, machinery expensive, and produce valuable; a system of terracing and small basin irrigation has proven to be an economical method of irrigation, whereas such a system of irrigation in most areas in New Mexico would be very inefficient. Considerable variation exists within New Mexico and hence to say any particular system is efficient or inefficient is dangerous without first detailing all the conditions under which it is to operate.

If my consulting experience in South America, Africa, Europe, United States, and Hawaii have taught me anything, it is that conditions change and hence the solutions change. Therefore, for a general nontechnical conference such as this one has been - a conference dealing with concepts and policies - it seems inappropriate to deal with technical aspects of efficient irrigation.

Important ways to avoid waste of water have been outlined by prior speakers. Other speakers during the day will stress the value of sprinkler irrigation, lined ditches, underground pipe, good land management, and they will also present the need for better estimates of water requirement and efficient application. Efficient economical irrigation includes all of these elements, extending from the watershed through the storage facilities and conveance channels to the farm and involving the eventual application and utilization of water on the farm. All these elements are part of efficient irrigation. Therefore all of these items have a place in a discussion and evaluation of present and future methods for efficient irrigation. Techniques are available for improvement, and improvement can be made. Sprinkler irrigation, for instance, is here to stay. However, it and other methods of water control and application can be justified and indeed will be used extensively only when the economic conditions of an area in question justify their use.

The speed with which new concepts and new ideas are utilized depends upon the attitude of irrigation leaders, technical specialists, administrators, and farmers towards irrigation and toward progress in general. A

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progressive attitude will do much to promote progress; likewise a negative attitude built around the tendency to reject or ignore progress will be very detrimental. Because of the importance of a progressive attitude and vision of the future, this paper will deal primarily with the challenge we face rather than with technical details of irrigation water application.

The Challenge We Face

Today we are living in a marvelous age - an age of change and an age of miracles. Yesterday it was the atomic bomb, today it is satellites and tomorrow it will be inter-planetary travel. What does this age and these events have to do with this specific conference and the problems being considered here?

The influence of these and concurrent developments will have a very profound effect upon irrigation and our water resources. This influence will come about as a result of the new energy sources which are being made available to man. Progress and energy are inseparably connected. The greater the availability of energy, the greater the ability to readily transport energy and the lower the cost of energy, the greater the rate of human progress. Modern progress and technical developments will bring into the realm of feasibility projects and schemes which are now infeasible. We need to reconsider our practices and policies in the light of future energy costs and availability. It may be impossible for us to realize and to visualize the detail of pending developments, but we can be certain of the trend and general influence of those developments. For instance we know without question that energy will in the near future become cheaper and more readily available.

A Challenge to Dream

In this age of progress, our greatest handicap is our lack of imagination and our failure to dream. However, our dreams must be based upon sound engineering principles. An earlier speaker has referred to the combination of imagination and engineering as imagineering. This is a very descriptive word and one which fits the need. We need to imagine and yet we need to engineer. Combining the two together is the desirable thing and referring to that combination as imagineering has considerable merit.

But as we imagineer we should not be restricted by present economic balances. Certainly the economic factors which influence the feasibility of a project today will not maintain the same relative balance in the ten or fifteen years ahead. Twenty five years ago which engineer, technician, lawyer, or farmer would have dared to predict our present world technology and the projects which are today sound and feasible?

To properly develop and utilize our water resources by what we have chosen to term efficient irrigation must demand creative thinking based upon probably

future conditions. This planning and development must not be unduly hampered by our present conditions or our present prejudices. Is it going to be necessary for more of this generation to die before our children are uninhibited and free to make the desired progress in the world which faces them? Or are we big enough to adjust our thinking and our practices to fit these changing conditions?

This condition came forcefully to my mind the other morning just before I left to come to these conferences. My seven year old son brought to me a small airplane which he had made. He has been intensely interested in airplanes, rockets, and space travel. He spends most of his allowance on airplane equipment. The other day he wanted to build an airplane but did not have the money to buy a commercial model. However, he did have sufficient money to buy a small container of glue, and with that container of glue, a few small sticks, and some cardboard, he pieced together a new design. It was this creation of his which he brought to me with a gleam of satisfaction in his eye. He was very pleased when he could show me that as the plane was dropped it glided carefully to the ground without any trace of aerodynamic instability. As I looked at the plane and his accomplishment I could only marvel at what had been done. At the same time I was grateful that I had not unduly restricted his creative development. Even though one of my fields of technical interest is fluid mechanics and aerodynamics at Utah State University, I was grateful that I had not inhibited my son by passing to him certain preconceived notions which were mine as a result of my formal training. I saw originality and understanding within his creation that made me marvel. I am certain that in the future the academic knowledge of aerodynamics which I have accumulated will be of help to him in working out some of the details that are in his mind. But I'm also certain that too early an assimilation of those academic details can only inhibit his creativeness.

Cases Demanding Imagineering

Underground Water Development

In the field of underground water development much of our practice and administration today is based upon the experiences of the past and conditions as they now exist. Restrictions on the rate of development of these underground sources of water are based principally upon the present rates of recharge and depletion and upon existing economic pumping lifts. It is generally believed that we need to preserve these underground resources for our posterity.. Whereas we are not trying at the present time using our mineral and oil reserves in such a manner that we will have a perennial supply.

When we talk of depletion I am reminded of the concern during the war for the depletion of our oil reserves, and I am also reminded of the tremendous amount of effort and energy which went into discussions and analysis of the length of time before we would be without oil reserves. However, despite all the pessimistic gloom that existed during the war, today we have greater known oil reserves than at any time in our history. How short sighted would we have been had we refused to utilize the known reserves and had kept them in the ground for our posterity. Our resources of precious minerals, of coal, of oil, and other commodities are mined and utilized for the benefit of mankind. Will our children sometime in the future chide us for being so short sighted with our water resources that we literally hide them in the ground to keep them for posterity?

In the first place I doubt that we know how much underground water exists. Have we actually inventoried our underground water or have we principally speculated on the reserves which exist? It is my firm conviction that we have only started to locate and to evaluate our underground water resources. We need to do more than speculate. We need to actively determine the resources which exist. Private individuals, foundations, state and federal governments, could undertake to advantage a more intensive program of locating and evaluating underground sources of water. Surely this will take money, but it also took money to locate our mineral and oil reserves.

Water Shed Yields

Our estimates of water reserves and resources are based primarily upon conditions over a relatively short period of observation. But what can be done to modify the conditions themselves? To what extent can the yield of the watershed be approved? Only a small percentage of the rainfall on a watershed leaves as surface or subsurface flow. A small change in yield would make a tremendous increase in total available water. Lengthy conservation studies are valuable to test the hypothesis and to justify our claims of getting greater yield from changes in vegetative matter. However, such studies take considerable time to complete. Do we have the necessary time? Should we sit back and wait until that information is available? How about appraising our present knowledge and acting upon the available facts. I firmly believe that we have sufficient knowledge of watersheds, watershed management, and the consumptive use of water by various types of vegetation to predict with reasonable accuracy the improvement which could be expected in watershed yield. We also have sufficient knowledge to make such changes without causing erosion.

We need to appraise our knowledge and to have the courage to back up our convictions. Enough is known to make significant progress. We may not know whether the increase will be 20 or 25% but actually we don't care. Either figure is good enough to justify action. We can predict the first significant figure. We are not too concerned at present about the second.

Climatic Control and Salt Water Reclamation

We should not rule out the possibility of climatic control and salt water reclamation in the near future. If either of these processes has even a reasonable degree of success, our entire economic water balance will be altered. These things are not unrealistic. In fact, today, both climatic control and salt water reclamtion are possible but not economically feasible because of the excessive cost of energy in relation to the benefits realized. How will this condition change when energy costs become one tenth of what they are today?

Consequently in considering these questions of water resource development and administration we should take into consideration the changes which will occur in the near future. The foremost consideration should be whether it is physically possible. Economic justification should be based upon future conditions and not upon present economies.

First Great Commandment

The Lord gave a great commandment to Adam and Eve while they were in the Garden of Eden. The instruction while there to multiply and replenish the earth was only part of this first great commandment. The other vitally significant portion of direct concern to this conference was the commandment to subdue the earth. This means climate and ocean, as well as disease, etc. Just as surely as the commandment was given it will be fulfilled. And when it is fulfilled the climate and the ocean will be used to benefit rather than plague man. Why not let our imagination overcome our prejudices and inertia and take active steps to plan for these times?

You may say that these are not realistic suggestions. Likewise neither were the atom bombs or satellites or trips to the moon fifteen years ago. Who among you can dream of the progress to be made in the next fifteen years? Man's lack of sound imagination and faith in the future is his greatest handicap.

Let's take the advice of Mr. D. D. Monroe given at the banquet last evening wherein he stated that we are spending too much time worrying about our problems. Let's talk about our possibilities and opportunities for progress. It would be wise to remember the parable of the talents wherein the man who had talents and developed them was given additional talents. Whereas, he who had limited talents and hid them up in the earth to save them for the future lost that which he had. Likewise we should develop the resources that are in our hands and not hide them up or leave them hid up in the earth. Neither should we waste our time worrying about the talents or resources we do not have.

Specifically, we should spend our intellectual energies developing our known water resources and not wasting excessive time bemoaning the fact that we have water shortages. Much remains to be done. We have a challenge and we have an opportunity; we have the resources to accept the challenge and to meet the opportunity, and thereby build for ourselves a civilization which will stand as a monument to our efforts for which our posterity will be eternally grateful.

WATER APPLICATION AND REQUIREMENTS FOR CROPS IN NEW MEXICO

C. H. Diebold*

We have much yet to learn about the water application and requirements for crops in New Mexico. We need more precise information about: (1) the effect of different kinds of soils, (2) the significance of rainfall during the growing season, (3) the effect of fertilizer, (4) the effect of plant spacing, (5) the effect of the irrigation layout, (6) the length of growing season, (7) the call system versus rotation system. Briefly, I shall attempt to review part of the literature and try to point out certain factors that warrant further study.

One of the earliest studies in New Mexico was conducted at State College from 1922 to 1926 by Bloodgood and Curry (1). They compared different flows of water and different lengths of border for alfalfa on Gila clay adobe. Water was applied at approximately 15 day intervals. The average annual depth of water applied to 4 borders 200 feet long was 48 inches. Borders 700 feet long had an annual average annual application of 61 inches. 1400 pounds per acre more alfalfa were produced on the 700 foot long borders than on the 200 foot long borders. These early studies did not report farm ditch losses, the effect of fertilizer and plant spacing.

Blaney and Criddle (2) list consumptive use values for alfalfa at State College of 40 inches and about 37 inches at Carlsbad. They also reported consumptive use values for cotton of 27 inches at State College and 29 inches at Carlsbad. These studies as well as those in other western states were used to develop empirical consumptive use coefficients for different crops for the growing season, K. To adjust this data for a given location, the mean monthly temperature is multiplied by the monthly percent of daytime hours to give a monthly consumptive use factor, F. The sum of these factors for the growing season multiplied by the consumptive use coefficient for the crop gives the normal expected consumptive use.

To show the effect of climate on one crop, alfalfa, I have compiled the normal consumptive use predicted by Blaney, Hanson and Litz (4). The values for alfalfa vary from 28 inches in the San Juan Valley to 36 inches at State College.(table 1). These authors further reduced the consumptive use values by subtracting the average rainfall that falls during the growing season of the specific crop. Thus the normal consumptive use of water minus rainfall at Bloomfield would be 23.8 inches or a reduction of 4.5 inches. However, they point out that there may be areas where the rainfall may not be effective.

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Table 1. Estimate of normal consumptive use (4)

Location	Alfalfa inches	Corn inches	Spring grain inches	Cotton inches
Bloomfield-Shiprock	28.3	17.6	15.0	-
Albuquerque	34.2	20.9	14.2	-
Hatch-Mesilla	36.4	21.1	-	22.9
Carlsbad	40.4	-	15.8	25.8

Just how reliable is rainfall in New Mexico? First, let us include as effective precipitation, those days in which more than .50 inch precipitation occurs or adjacent days with .25 or more precipitation, table 2. Based on the daily precipitation records published by the U. S. Weather Bureau from 1930 through 1956, effective rainfall was unreliable at Bloomfield. For example in 21 out of 22 years in June there was zero effective rainfall. Even in August, the wettest month, there were only 6 times in 25 years that effective rainfall exceeded one inch. For the Bloomfield area, should not the precipitation be disregarded in calculating water requirements? Similar analyses are needed to determine those areas where effective precipitation is too unreliable to include in irrigation requirements.

Are the consumptive use values high enough for high yields under heavy fertilization and close spacing? The most complete data on alfalfa that might apply to New Mexico are from Yuma, Arizona (10). At Yuma there are normally 7 cuttings of alfalfa as compared with 5 for the Hatch-Mesilla Valley. Annual consumptive use values for alfalfa are 48.4 inches at Yuma (5) and 36.4 inches in the Hatch-Mesilla Valley (4). But the annual water application at Yuma on

Table 2. Effective rainfall* at Bloomfield, New Mexico 1930-1956

Total	April	May	June	July	August	September
Number of months	21	22	22	22	25	24
Zero effective rainfall	18	18	21	16	15	16
.5 - 1.0" " "	2	3	1	2	4	6
1.0" " "	1	1	0	4	6	2

*Effective rainfall includes days with .50 inch or more precipitation and adjacent days with .25 inch or more precipitation.

carefully controlled expreimental plots varied from 72 to 88 inches, table 3. These figures included deep percolation loss but no losses for either surface runoff or for ditch losses. On this deep sandy soil the annual yield of alfalfa increased from 8.1 tons per acre to 11.2 tons per acre by increasing the water application from 72 to 88 inches. In these plot studies, heavy applications of phosphate increased yields just as strikingly as the increased applications of water. The highest yield, 12.5 tons per acre, was obtained with 1300 pounds of P_2O_5 per acre during the 4 year period using the wet treatment - 88 inches of water. Under improved management, 48 inches annual consumptive use would appear inadequate for high yields.

How much water was used per ton of alfalfa grown at Yuma? From 1950-52 it took 8.4 acre inches to produce a ton of alfalfa under the wet treatment, 9.2 acre inches for the medium treatment and 10.2 acre inches for the dry treatment. So, if you had a limited amount of water, you would grow more tons of alfalfa by irrigating less land than by trying to spread it over a large acreage. Similar trends have been recently reported by the Agricultural Research Service for other crops at other Southwestern locations.

Table 3. Alfalfa yields and irrigation results on a deep sandy soil at Yuma, Arizona 1949-1952 (10)

	Irrigation Treatment		
	Dry	Medium	Wet
Mean time between irrigations (days)	27.2	20.1	8.6
Moisture used between irrigations (inches)	4.0	3.4	1.8
Number of irrigations (annually)	13	18	42
Annual water application (inches)	73*	76*	88*
Annual yield of alfalfa (tons/acre)	8.1 (7.1)**	9.2 (8.2)**	11.2 (10.5)**

* Plot data
**Figures in brackets calculated for 1950-1952.

Differences in climate, soil and depth to water table may affect the tonnage produced per acre inch of water. At State College, Hanson (7) conducted irrigation studies on alfalfa on a deep fine textured soil. The annual yield of alfalfa was 6 tons per acre with 28 inches of water, 7-3/4 tons for 44 inches and 8-1/4 tons for 64 inches with the yield curve still going up.

Let us consider the effect of fertilizer and spacing on another crop, sorghum. Painter and Leamer (9) found at Tucumcari on a deep sandy soil that 5 irrigations gave higher yields of sorghum than 8 irrigations when no fertilizer was applied. The opposite occurred when heavy applications of nitrogen and phosphorus were made (table 4). Yields were further increased

by a row planting spacing of 4 inches as compared with 9 inches when more irrigations and more fertilizer were applied. The normal consumptive use for sorghum at Tucumcari is reported to be 24.5 inches (4). Is it enough for improved management?

What would be the expected water requirement under improved management at the farm headgate for the principal crops of New Mexico? Based on the best information available, I have presented some guestimates of water requirement in table 5 for alfalfa. Our field experience indicates that when the soil at the 6 to 12 inch depth is dry enough to make a fragile ball, you will need to irrigate

Table 4. Yields of grain sorghum for various moisture, spacing and fertilizer treatments, Tucumcari, New Mexico 1951 (9)

Irrigations	Plant Spacing	Yield, bushels per acre, for indicated lbs per acre of $N-P_2O_5$		
		check	120-180	240-280
8	4	34	89	102
8	9	40	65	83
5	4	40	81	79
5	9	44	68	70

in the next two or three days to maintain high yields. For deep, medium textured soils, you will need about five inches of water to refill the soil to a depth of five feet. Table 5 shows that with 75% farm irrigation efficiency that you need to apply at the farm headgate an additional 1.5 inches per irrigation for ditch loss, surface runoff, deep percolation beyond the roots and evaporation. At Bloomfield, in the San Juan Valley I estimate that the annual water application under improved management on deep medium textured soils would be 45 inches for alfalfa as compared with 62 inches at State College.

Now let us consider a deep sandy soil which need a refill irrigation. At that time it can store only 3 inches of water as compared with 5 inches of water for the deep medium textured or loam soil. Soil Conservation Service irrigation guides for New Mexico indicate that we will need to irrigate alfalfa or the deep sandy soil amost twice as often as the deep textured soils if we secure high yields. So, at Bloomfield using corrugations on slope and clean water, we would expect an annual water application of 70 inches or 25 inches more than the medium textured soil. At Albuquerque, where border irrigation is used on flatter slopes and with muddy water to seal ditches, the annual water application might be only 7 inches more on the sandy soils. At State College, 18 inches more water would be required annually for alfalfa on deep sandy soils than on deep medium textured soils. Part of this higher loss would be higher ditch losses caused by the use of clear water. To what extent has the difference in refill irrigation capacity between soils been considered in annual water requirements?

Table 5. Expected water requirement under improved management for alfalfa on deep medium and deep sandy soils

Soil Texture	Effective Depth	Location	Cuttings per season Number	Irrigations per season Number	Farm Irrig. Efficiency Percent	Water Irrig. Inches	Application Annual Inches
Medium	deep	Bloomfield	3	7	75	6.5	45
"	"	Albuquerque	4	8	80	6.2	50
"	"	State College	5	10	80	6.2	62
Sandy	deep	Bloomfield	3	13	55	5.4	70
"	"	Albuquerque	4	15	80	3.8	57
"	"	State College	5	19	70	4.2	80

Let us further consider how different kinds of soil may affect losses of water past the farm headgate. For the proposed South San Juan - Shiprock project, table 6, I estimated the loss of water from farm ditches on

Table 6. Comparison of expected losses of irrigation water for deep soils South San Juan - Shiprock (3)

Slope %	Soil Texture	Refill Irrig. Inches	Loss of Water				Est.Farm Irrigation Efficiency %
			Farm Ditches %	Surface Runoff %	Deep Perco. %	Evap. %	
0-1	silt loam	5	5	15	10	10	60
	loam	5	10	5	5	5	75
	loamy sand	3	20	5	25	-	50
1-3	silt loam	5	5	25	10	10	50
	loam	5	10	15	5	5	65
	loamy sand	3	20	15	25	-	40

sandy soils to be 20% of the total water requirement, 10% on loams and 5% on silt loams. If major savings are to be made of the clear water from the Navajo Dam, ditch lining on sandy soils is far more important than on the silt loam soils.

Losses from surface runoff are more important that ditch losses on

the silt loam soils. The low intake rate of the silt loam soils may require sets varying from 12 to 24 hours in order to refill the root zone. In contrast, losses of surface runoff from the sandy soils on nearly flat slopes is small. The sandy soils take water rapidly and are quickly filled.

Losses from surface runoff are higher on 1 to 3% slopes for all soils than on 0-1% slopes, table 6. Note that the highest losses are on the silt loam soils.

The losses listed for deep percolation beyond the root zone are those expected under improved management, table 6. Under average farm management, deep percolation losses are much higher. Studies made in the Pecos Valley about 1940 showed average irrigation efficiencies of 53% (8). One of the major losses was due to deep percolation.

In table 7 losses of water beyond the root zone are summarized from 52 irrigation trials for which we had soil moisture data (6). Many of these trials were made when the farmer thought he needed to irrigate or to fit into the farm operation program. You can see that major losses of water by deep percolation occurred on all soils irrespective of readily available moisture capacity or intake

Table 7. Relation between intake rates and deep percolation losses by classes of readily available moisture capacity for 31 border irrigations and 21 furrow irrigations (6)

Readily Available Moisture Capacity inches	Average Percentage of Water Lost by Deep Percolation					
	Border Irrigation Intake Rates			Furrow Irrigation Intake Rates		
	.0-1.0 in/hr	1.1-2.5 in/hr	2.6/ in/hr	0-1.0 in/hr	1.1-2.5 in/hr	2.6/ in/hr
3.0-3.9	12	21	34	35	0	34
4.0-4.9	6	11	-	29	12	0
5.0-6.0	22	10	4	3	0	38

rate. Loss of water by deep percolation will exceed all the other farm losses under average irrigation management practiced today in much of New Mexico.

If deep percolation losses cannot be reduced, then the figures in table 5 are too low. These losses may be reduced under improved irrigation practices: (1) Proper irrigation layout. (2) Well made high border ridges. (3) Eliminating unessential irrigations. (4) Knowledge of the refill irrigation requirement of the different soils. (5) Estimating the amount of water needed to refill the soil prior to irrigation. (6) Measurement of the flow of water to make sure the most efficient flow of water is used. We need to make much more progress in the adoption of improved irrigation practices.

In table 5, I assumed that water is available when the farmer calls for it. There are areas, however, where a rotation system is followed instead. Suppose that water were to be delivered every 15 days during the summer months. For crops such as alfalfa, the water may come from 2 to 5 days too late for high yields on sandy soils. On deep medium textured soils the water would come a week too soon with ensuing high deep percolation losses. Some may say that less water per irrigation could be applied. Under field conditions this would require either a change in irrigation lay-out or larger flows of water. The latter usually cannot be done without overtopping the border ridges. In most border irrigation lay-outs in New Mexico you will apply 5 inches or more water per irrigation. Rotation irrigation might increase the annual farm water requirement by as much as 6 inches per acre as compared with the call system. But the call (demand) system requires that irrigation canals and supply laterals have sufficient capacity to carry the maximum demand.

The time of irrigation is important. Many studies have shown that yields of small grains, sorghum and corn are reduced if the crop is stressed during the boot and flower stage. Prior to this period, it is possible to stress these crops without reducing yields. But cotton yields may be reduced by delaying the first post planting irrigation until early July. On a deep fine textured soil at State College, Hanson obtained the highest yield of cotton with a light, early June irrigation using a total of 30 inches of water (7). But the application of 36 inches of water, depressed cotton yields on this soil which has a tight subsoil through which water and air move slowly.

Based on present information, the expected farm irrigation requirement of alfalfa in New Mexico may vary from 45 to 80 inches due to differences in soil and climate. About 3 acre feet appears to be needed for cotton. Sorghums and small grains will require about 3 acre feet of water on deep medium textured soils. This includes an additional irrigation which is often needed to sprout volunteer grain or in preparing the land. It does not include the 2 to 4 irrigations needed to establish fall planted stands of alfalfa. It does not include water for leaching salty soils. These figures indicate a beneficial annual use of between 3 and 6 acre feet of water per acre at the farm headgate with improved practices if high crop yields are to be obtained.

(1) Bloodgood, D. W. and A. S. Curry, The Influence of Irrigation Head and Length of Run on the Use of Water for Alfalfa, N. M. Agricultural Experiment Station, Bul. 197, 1931.

(2) Blaney, H. F., and W. D. Criddle, Determining Water Requirements in Irrigated Areas from Climatological and Irrigation Data. SCS-TP-96, 1950.

(3) Blaney, H. F., and C. H. Diebold, Irrigation Water Requirements of Crops in Shiprock and South San Juan Projects, New Mexico (Provisional) Mimeo. Soil Conservation Service, Albuquerque, 1952.

(4) Blaney, H. F., and E. G. Hanson and G. M. Litz, Consumptive Use and Irrigation Water Requirements of Crops in New Mexico. Soil Conservation Service Research, 1950.

(5) Blaney, H. F., and Karl Harris, Consumptive Use and Irrigation Requirements of Crops in Arizona, Soil Conservation Research, 1951.

(6) Diebold, C. H., Irrigation Trials in the Southwest Region. Soil Conservation Service, Region 6, Bul. 113, 1952.

(7) Hanson, E. G., Water Requirements of Alfalfa. (Typewritten report on current research) March 1956.

(8) Israelson, O. W., and H. F. Blaney, Water Application Efficiencies in Irrigation, Soil Conservation Service Research, 1946.

(9) Painter, C. G., and R. W. Leamer, The Effects of Moisture, Spacing, Fertility and Their Interrelationships on grain sorghum production, Jour. Agron. 45: 261-264, 1953.

(10) Stanberry, C. O., C. D. Converse, H. R. Haise, and O. J. Kelley, Effect of Moisture and Phosphate Variables on Alfalfa Hay Production on the Yuma Mesa. Proc. Soil Science Society 19: 303-310, 1955.

HOW TO GET MOST EFFICIENT USE OF WATER

Sprinkler Irrigation

W. C. Bradshaw*

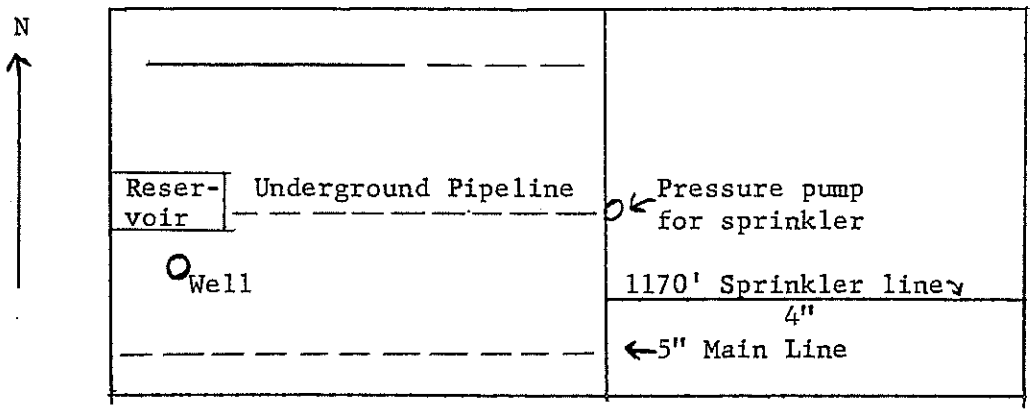
Much time has been devoted during this conference to the importance of water, water laws, water rights, administrative problems and other items.

Now, as a farmer, I would like to discuss with you the use of water for agricultural purposes and the actual mechanics of application, particularly sprinkler irrigation.

Certainly it should be the goal of every irrigation farmer to take the minimum amount of water required for a given crop and distributeit evenly throughout the field for a maximum economic yield. No doubt every farmer has watched a hard rain amounting to several inches fall on his land with the resulting erosion and heavy runoff and thought to himself: How wonderful it would be if such a rain fell slow enough so that there would be no runoff. Sprinkler irrigation comes very close to such an ideal situation.

I have been questioned many times about my reasons for going to sprinkler irrigation in an area where sprinkling is practically unknown.

My problem was as simple as this. I owned 75 acres of fertile land with a well producing around 500-550 gallons per minute, which is ample, figuring 7 gal. per minute per acre and using a reservoir for overnight storage. However, soil permeability became so great that it was taking about two acre feet of water per acre to push the water over the land each irrigation even with very short runs. By installing sprinkler irrigation I am able to put on the desired amount of water and cover the entire farm in a reasonable length of time with uniform distribution to each acre.



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The tract of land being irrigated is an 80 acre plot with approximately 2 acres cut off either end. The well and storage reservoir are located in the center of upper end of the rectangular block.

In order to attain the most practical and economical layout for the sprinkler system, an underground pipeline was laid to the exact center of the block where a pump for furnishing pressure to the sprinkler system is connected to the underground line. From this pump a 5" aluminum main line extends to either side of the field and two 4 inch sprinkler lines operate at right angles from the main line with sprinklers spaced at 30 feet along the sprinkler lines. The main line is in alternate 20 and 30 foot joints thus making it possible to make moves of 20, 30, 40 or 50 feet as desired.

The system was designed for an application rate of about four tenths of an inch an hour with fifty foot settings on sprinkler lines and a pressure of 35 lbs/sq in. Knowing this information it is quite easy to calculate time necessary to put on any desired amount of water per irrigation.

The total cost of the sprinkler installation excluding underground pipeline from reservoir to sprinkler pump came to about $5445.00 or $80.00 per acre.

Certainly lined ditches syphon tubes, gated pipe and other modern devices have greatly increased irrigation efficiency. They have made it possible to evenly distribute the water across the upper end of a field being irrigated, but the problem of uneven penetration as the water passes over the land still exists under such methods. Sprinkler irrigation reduces this last problem since the water is distributed evenly over the entire field.

One of the first questions that arises at the mention of sprinkler irrigation in an arid climate is excessive evaporation. From observation and experience I am convinced that after the first few minutes a line of sprinklers is in operation an artificial humidity is built up within the area being sprinkled and evaporation is reduced to a lower level thus bringing the losses well within limits experienced by other methods of irrigation. Of course in case of brisk winds some of this advantage may be lost.

Since the water is conveyed in closed conduits throughout the system until it is delivered to each sprinkler head, it is easy to conceive that total losses might be less than by other irrigation methods.

The crop yields under sprinkler irrigation have been very satisfactory. In 1956 I produced 2-3/4 bales of cotton per acre on one half of this farm and 6.4 tons of alfalfa per acre on the other half. This is considerably more with less water than I produced on a similar farm nearby under gravity irrigation.

The cost of operation of the system is not excessive. Six dollars a day (24 hrs.) will operate the extra pump required to furnish pressure to the system, which just about equals an irrigator's wages to tend the water using

the flood or furrow method. Approximately one man/hour of labor is required per acre each irrigation for moving the sprinkler lines. This is generally done early in the morning and late evening thus leaving labor free for other work during the day.

In closing I think we could say that sprinkler irrigation is certainly an efficient method of applying water to the land, especially if the land is uneven in slope or the head of water is not too large. It may not be the answer to everyone's problems but surely deserves consideration if some of the above mentioned problems exist.

LINED DITCHES

D. A. Franzen*

Ditch lining has become a rather common practice in this area, as it probably has in most irrigated areas. Asking farmers why they line their ditches generally brings forth two reasons. They are saving of water and saving labor costs. After lining their ditches, farmers report that they are irrigating up to one third more acreage per day, when using their wells. This would indicate that they had been losing up to 25% by seepage. Labor cost savings are mainly in ditch cleaning. Farmers who clean their ditches four or five times a year report that the costs run from about $200 to $220 per mile of ditch per year, mostly for hoeing weeds and grass. This cost is not entirely eliminated by lined ditches, but keeping down growth on the outside banks can be done at much less expense by mowing or by use of chemical sprays.

The cost of constructing concrete lined ditches involves the cost of shaping the dirt and the concrete work. Contractors prices are quite uniform, and are generally for a complete and finished job. Costs reported by farmers doing their own work vary considerably, ranging from $1.08 to $1.50 per linear foot. This wide range in reported cost is probably due to the omission of some cost items such as equipment and the farmers own time for supervision. But on the other hand many farmers are using equipment already on hand, and using labor between times of other farm work. Also, it should be noted that most farmers building their own ditches are making larger ditches with a greater capacity than contractors build using slip forms.

The cost of construction does not always represent the amount of the investment however, because many farmers are applying ACP cost sharing toward ditch lining. In general, this works out that the farmer gets back about one third of the cost on the contractor-constructed ditches and about one half the cost where they do their own work. The difference is due to the fact that ACP payments are made on a basis of cubic yards of concrete poured, and contractor-built ditches generally run more linear feet per cubic yard of concrete at a higher cost per linear foot. Farmers should also look into the matter of tax credit on concrete lined ditches.

As might be expected, there is less lining done on tenant operated farms because the landlord, who would normally pay for such improvements, would derive only a portion of the benefits. Under most rental deals in this area, the landlord pays for the water. Benefits of water saving would accrue to the landlord, whereas savings in the ditch cleaning would accrue to the tenant.

Most ditch lining is done by contractors in areas where they are available, such as in Mesilla and El Paso Valleys. In the Hatch Valley, however, most

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lining is being done by farmers, because it is difficult to interest contractors in moving all their equipment that distance except for large jobs. Most farmers use angle iron forms or templets, made of 2 inch stock, built to the shape and size of dtich desired. In preparing the ditch for lining, some farmers reshape the existing ditch, and others work down the old banks to construct a completely new base. The general opinion is that it is better and less costly to completely rebuild the dirt ditch. After being V'd out the ditch should be filled with water and allowed to settle and dry out before being finally shaped to the exact dimensions and grade desired. Then, using templets, alternate sections of about six feet each, are poured to the set grade. Filling in the gaps is relatively simple since the sections already poured serve as forms. Many farmers in the Hatch Valley have hauled their own sand and gravel from local pits, and some have used arroyo sand, but most agree that it is better and cheaper to buy good clean material from commercial sources. They generally train 6 to 8 men for a ditch lining crew, and frequently several farmers use the same crews and equipment.

An important thing to consider in ditch lining is that the ditch has adequate capacity to carry the larger head of water when using canal water. Careful planning and engineering will determine the size and grade needed for a ditch that will serve many years.

UNDERGROUND PIPE

C. L. Ezell*

Our farm is located about 2 miles south and west of Canutillo. It is classified land under the Rio Grande project which as you know has had gravity water allotments for the past several years. We have continuously used an alfalfa-cotton rotation program and the cotton has yielded an average of about two bales per acre. The land has been leveled to a gradient of 1/4" to 100 ft. side fall and end fall. Alfalfa borders are over 125 ft. wide. Cotton land is also bordered every 44 rows and four row equipment is used.

In 1950 we drilled our first irrigation well at a cost of $9050. This well is 146 ft. deep and produces about 2500 G.P.M. In 1951 we installed the first unit of underground pipe. This pipe was 24" galvanized, corrugated pipe installed with leak proof collars and the top of the pipe is about 8 inches below ground level. The system is covered and equipment passes over the covered pipe out to the road side. Cost of unit 1 was $5349.97 including pipe, collars, gates or valves, concrete air breathers and excavating and installing 1200 line or feet of pipe. The pump discharges into a concrete riser used as a distribution box.

In 1953 the line was extended 1900 linear feet at a cost of $8186.02 and in 1954 the final extension was completed requiring 1630 linear ft. of pipe and costing $7089.76 making the entire 4730 linear feet of pipeline cost $20,625.75. This installation furnishes water for 178 acres of land and the average cost of the pipeline per acre was $116.00.

By converting from an open ditch system to underground pipe we reclaimed about six acres of land and eliminated ditch cleaning, evaporation and seepage losses, gopher problems, and reduced the labor requirement for irrigation by one half. The pipe line is carried on a 15 year depreciation schedule for tax purposes. Deterioration of the line so far has been negligible. The corrugations appear to assist in scouring the system and sedimentation has not been a problem in spite of the small slope which characterizes the entire system.

In January 1955 our second well was drilled, also to a depth of 146 feet and yielding 2500 G.P.M. This well cost $5197.88 and was drilled about 150 yards south of the first well. Both pumps are powered by electricity costing $15.00 per horsepower year, as a minimum charge. The total cost of the two wells is $14,247.88 or approximately $80 per irrigated acre. Adding in the $116 average cost of the pipeline per acre, this average cost per acre of the complete system comes to approximately $200.00. Chemical analysis of the well water shows 2.23 tons all salts, per acre foot with a low sodium percentage.

*Farmer, Canutillo, Texas

Even when a normal supply of gravity water is available we propose to use well water for at least four alfalfa irrigations.

We are proud of our irrigation system. It connects with the project water system so that gravity water can be used. It requires almost no maintenance. The corrugated metal pipe is much lighter than concrete pipe and has fewer joints. It requires therefore much less labor to install and the corrugations assist in scouring. No weeds grow on my ditch banks and no weed seed is water spread on the farm except when gravity water is used. We farm right over the pipe and no land is lost in ditches.

It was a pleasure for me and Mrs. Ezell to be here and we have enjoyed the Conference very much.

LAND MANAGEMENT TO MINIMIZE AND UTILIZE WASTE WATER

Al W. Woodburn*

A topic of this kind could necessitate many hours of discussion to define each phase whether it be land, management, minimize water, utilize water, and when the word waste is put in it further complicates the picture. It is my intention to discuss with you first, some of the basic principles affecting land management that is facing the industry of agriculture today. So, the first division of my remarks will deal with land management. The first essential as far as land management is concerned, is that I believe every individual in this room is of the belief that the Creator gave us land. Among the first of the points to be discussed today, to utilize the land transferring it to a form of living standard for human beings. There is considerable discussion on what is beneficial use of water, what is utilization of water, and how each of these is to be minimized. The first essential thing in land management, I think, is that it must be used for the benefit of the human race, it must be exploited and it must be maintained. Under our present farm economies where irrigation water is used on land for the production from that land isn't sufficient to make an economic return to the individual farming area in the first place could be wasted water. So, we as irrigated farmers, should isolate each enterprise and make a determination whether that particular enterprise or that commodity we are producing is correct water utilization or whether it is a waste of our natural resources.

The next division that I would like to make as far as this assignment is concerned is water. Water is the life line and the controlling factor. The economic life of the State of New Mexico and every individual unit, whether he be rancher, irrigated farmer or a businessman in some town; water is the controlling factor as far as the potentialities or possibilities of his particular business. It beholds all of us to make wise use of it. In addition, as far as land management is concerned, quite often we have seen water wasted in the process of achieving maximum production of crops. To minimize and utilize wasted water, first, let's determine what is waste. First, the production of crops that do not return an interest on the investment where it is used could be classed as waste. Second, and without a question of doubt, all water that is run down bar ditches and other places to cause growth of vegetation as a harbor for insects where this feed is not used, without a question of doubt, can be classed as waste. Third, as far as land management in the city limits, evaporative coolers, lawns, perennial vegetation and the way they are handled, the way they are watered, and the way they are used could be classed as wasted water. Fourth, one of the greatest wastes of water known in the State of New Mexico, due to our high evaporation is the lack of facilities to take care

*County Extension Agent, Chaves County, New Mexico.

of water in transporting that water from it's source to the place where it is put to beneficial use. I would like to cite an example - Under our ACP program as far as the State of New Mexico is concerned, there is about $750,000 appropriated for the benefit of encouraging ACP payments to consist of land leveling, lining reservoirs, concrete pipes, and other things to conserve our natural resources. On the other hand the Soil Conservation Service in the State of New Mexico annually spends over a million dollars for personnel to render technical services through the Soil Conservation Districts and the Soil Conservation Supervisors. In addition, the New Mexico Extension Service, which devotes a portion of their time to study soil for natural resource conservation is approximately three-quarter million dollars. We have our agricultural experiment station which devotes a portion of their time on natural resouces conservation, their expenditure would be close to a half million dollars.

Without exception, I believe every farmer, irrigated farmer, and every rancher will invariably agree that water is the controlling factor of our economy and way of life and at the present time we are spending much more money for technical knowhow and experimentation than we are actually applying on what we already know. It seems that with more expenditure on search for technological methods to further conservation we should harness this leadership of technical knowhow also the leadership of the water conservationers for the purposes of securing money in sufficient quantities or re-investing state monies under conservation in conservation practices already known than in the continued expenditure of a new knowledge when we are not putting into effect those things that we already know are beneficial to protect our most important natural resource.

It is true we get lots of lip service and we hear lots of things about the availability of money for conservation practices, but at the present time both in the Mesilla Valley and in the Pecos Valley, during irrigating time I imagine you will find many, many open ditches and open canals in which gophers, vegetation growth, and everything else is using up the natural resource of water. The way that is being used since it isn't for the benefit of producing something that is good for people or using the water for the people who are dependent upon the land for a livlihood will be classed as a waste of water. The next phase of wasted water is application in the field. I have seen many instances where water was used and a lake would stay in the tail end of the field for three or four days which was completely beyond plant requirements, even to the point of killing some of the vegetation growth grown for beneficial purposes. There is a practice in California of putting in sump pumps collecting this water, pumping it back into concrete pipe lines and reusing the water which would assist in utilizing waste water.

Next in dealing with application of water. We all realize that the type of crop, water requirements of the crop, and the labor it takes to put water on land, the evaluation of all combined interests into the determination of how much good we get from usage of water. In our experience in the Pecos Valley we have found so far that we will get maximum utilization of water

by not getting absolute maximum yields and we are conducting our search for data to enable us to determine the amount of water to apply. Over application could be considered waste.

In summary, I have attempted to define this subject outlined to me, I have attempted to stress the importance of land management, how it fits together with the use of water to enhance and improve man's standard of living. I have attempted to issue a challenge to the leadership here stating that technology is ahead of financial resources to put into affect those things that we already know. I have attempted to point out that technology in application on the field is considerably ahead of the transportation of water from it's source of supply to the point where beneficial use is made. In conclusion, I am reminded of an incident whereby it was illustrated by a farmer in which he said, "When my outgo exceeds my income, my upkeep is my downfall". The further we continue following the type of economy dependent upon a cash crop, and a very small percentage of our land in that cash crop, the more difficulties our farming people are going to experience in maintaining their present income. It has proven consistently in our area the more commercial fertilizer we use without application of organic and humus matter the higher our water requirements are to make an economical yield.

INCOME PRODUCING VALUE OF WATER MUNICIPAL AND INDUSTRIAL IN VARIOUS AREAS OF NEW MEXICO

Professor C. T. Grace*

Resources for the Future set up a research fund to be used to investigate the economic effect of water from the proposed Navajo Dam upon the San Juan and Rio Grande Basins. The assignment of the Municipal and Industrial Usage was made to Dean M. E. Farris of the University of New Mexico, with Professor Frank Bromilow of New Mexico A & M and myself as members of the committee, later on we called upon the services of Dr. Paul Zickefoose of New Mexico A & M.

The first question that the committee was faced with was "what is the value of a gallon or an acre foot of water to a given industry or to a municipality."

It was decided that a questionnaire addressed to water users in our category and in the area we were concerned with (San Juan County, Taos, Rio Arriba, Santa Fe, Los Alamos, Sandoval, Bernalillo, Valencia, Socorro, Sierra, Dona Ana, and Otero counties). Otero county was included because a request for diversion has been made. As our reference to locate these users we employed the 1955 DIRECTORY OF NEW MEXICO MANUFACTURERS published by the Bureau of Business Research of the University of New Mexico. After several abortive attempts a questionnaire was developed that would get the information needed and not poke into the individual's business too much, so that he would pitch it into the waste basket. A covering letter to explain the purpose and a descriptive sheet along with the questionnaire was sent to 498 industries and service organizations in the previously listed counties.

The questions on the questionnaire were:

1. Water delivered to our plant or plants for calendar year 1954.

   _____Total gallons in 1954

   If you have more than one plant, please list locations and give consumption of each.

2. If possible, please give the amount of water returned to sewer, river or ground.

   _____Total gallons in 1954 or_____%

*Chairman, Department of Mechanical Engineering, University of New Mexico.

3. Source of water (check one or more), amount from each source, and cost by source in 1954.

Source	Amount	Cost
___Private or City owned Water Works	_____Gallons	$_____
___Pumped by you	_____Gallons	$_____
___Direct diversion from river	_____Gallons	$_____
___Other (please specify)	_____Gallons	$_____

4. Gross Sales for 1954 $_____
OR
Water cost per $1,000 gross sales for 1954 $_____

5. Average number of employees for year 1954_____

If you are a manufacturer, please answer the following question:

6. List your product(s) unit. Example, ton of coal, barrel of gasoline, loaves of bread, gross of pencils, etc.

7. Number of units produced in 1954_____

If you have any figures on your planned expansion of plant or product lines for 1957, 1960, 1965, 1970, 1975 would you please give us your thinking on these matters on a separate sheet.

If for any reason you do not have the necessary information for 1954 but do have it for another year, say 1953 or 1955, please state year and fill out the questionnaire.

The number of returns received from the questionnaire is probably rather good for this type of approach. One hundred and two returns having something written on the sheet were received, or 20% answering the request. Fifty-five of these returns stated that the information was not available, or that no water whatsoever was used, or that domestic water only was used.

Fifty-seven returns or 11% answered several of the questions asked.
Thirty-five or 7% returns gave the water delivered to the plant during 1954.
Twenty-nine or 5.8% gave an answer on the % of water returned to the sewer, river or ground.
Twenty-three or 4.6% gave information on water cost per $1,000 gross sales in 1954.

The spread in water cost per $1,000 gross sales was from 0.2 MIL per 1,000 dollars for a furniture and fixture manufacturer to $55 per $1,000 for a bath house. The number of employees ranged from 1 to 400, the reported gross sales (many did not answer this question) ranged from $5,000 to $4,700,000. So there were some rather large industries included in the returns.

After tabulating the returns and trying to make something out of them, it was decided that averages on water cost within industries did not mean much because of the great spreads or because of the small sample.

The next approach was to select what were felt to be natural industries for the areas considered, by virtue of raw materials available, the market at hand, and the consuming industries that are present in the area, or that seem logical as the industrial development of the state goes forward. Refer to Table II showing the basic economic factors that wer found from a variety of sources. Following Table II are the footnotes for the table.

My portion of this discussion will not get down to the items that really show the economic value of water as used in industry and by municipalities in the two basins. That part of the discussion will be handled by Professor Bromilow.

The pertinent information that Table II gives in this discussion is what amount of water in acre feet per year is required to supply one industry worker (including all employees, administration, clerical, and production workers) and the service employees that he requires. The footnote for line 2 of the table states that "it is assumed that each industry worker requires the services of one other worker in the community and that both of these workers are assumed to have two and one half dependents."

Line 1 then represents the estimate of the water that is required by the industry to support this one industry worker for one year. Line 2 shows the municipal water it is estimated will be required to support the industry worker his dependents, the service worker and his dependents, based on 150 gallons per day per person for seven people. The total of lines 1 and 2 is the value shown in line 3.

To get a rough estimate of the income producing value of water as utilized by the industry worker we might divide the value of sales in line 4 by the water in acre feet as shown in line 3, or the sum of lines--

7 Salaries & Wages
8 Property Income (in state)
9 State & Local Taxes on Industry
14 Material purchased (in state)
16 Fuel Cost
17 Elect. Energy Cost

divided by line 4 total water per industry employee per year. However, these two methods do not give a very good picture of the over-all gain to the state. The discussion of the real income producing value of the water will be given by Professor Bromilow in his discussion of how we used these basic economic factors in one of the diversion patterns.

Explanation of Items in Table II

Line 1 Industrial Water-Acre Feet - From Annual Survey of Manufactures: 1953 page 124

Line 2 Municipal Water-Acre Feet - Assumes that each industry employee requires one other worker in the community in the service category. Both of these workers are assumed to have two and one-half dependents. Thus 7 persons at 150 gallons water per day.

Line 3 Total Water-Acre Feet - Sum of Lines 1 and 2.

Line 4 Sales - An average of sales per industry employee for a group of companies in each field. Data obtained from the "Fortune Directory" (Supplement to Fortune July, 1957).

Line 5 Profit - Statistics of Income 1953 Part 2 Table 1 Line 35.

Line 6 Value Added - From Annual Survey of Manufactures: 1953 pages 24 to 40.

Line 7 Salaries & Wages - Same as Line 6.

Line 8 Property Income In State - *Apportionment In State and Out of State (Line 11) by Dr. Zickefoose in consultation with Mr. Ralph Edgel, Bureau of Business Research, U.N.M. "This information was computed from summaries of corporate balance sheets found in Statistics of Income. The industry breakdowns are not as distinct as one might hope, but those of the most nearly comparable industry group were used. By adding the total of interest paid, rents and royalties, corporate profits after taxes plus excess profits tax paid (which has since been discontinued) it was possible to compute a ratio of such payments to gross sales. This ratio, applied to sales per industry was used to make the estimates of property income. Distribution of this income was made on the basis that 90% of the capital would come from outside the state in all cases except Apparel and Related Products, Fabricated Metal Products, Stone, Clay, and Glass Products where a 50-50 distribution was used; and Chemicals and Allied Products where all the capital was assumed to come from outside the state."

Line 9 State and Local Taxes - Based on an assessment of 16% of Total Capital Investment (Line 20) and a tax rate of $6.25 per $1000 assessment. Or 1% of Total Capital Investment.

Line 10 Depreciation - From Statistics of Income 1953 Part 2 Table 1 line 26.

Line 11 Property Income Out of State - Same as Line 8.

Line 12 Federal Taxes Corporate - From Statistics of Income 1953 Part 2 Line 38.

Line 13 Miscellaneous Deductions - From Statistics of Income 1953 Part 2 Table 1 Lines 18, 21-23, 29, 30, 31. These deductions are: Benefits to Employees, Advertising, Interest Paid, Bad Debts, Repairs, Cost of Operation, and Other Deductions.

Lines 14 & 15 Materials Purchased In State and Out of State - Total amount determined by subtracting sum of Profit (Line 5), Value Added (line 6) and Cost of Fuel & Electricity (Lines 16, 17) from Sales (Line 4.) Apportionment In State and Out of State. * "The only available source was the 1947 Interindustry Relations Study of the Bureau of Labor Statistics. Total inputs as shown by this study do not always agree with value of materials purchased according to the census reports. The input data were adjusted to the census reports, so that in all cases the total bill of goods purchased was the same percentage of total sales as shown by the Census. Only the more important purchases were computed separately, the others were included in a miscellaneous category. A more or less arbitrary decision had to be made as to whether these inputs are now or whether they could come from the outside."

Line 16 Fuel Cost - From Annual Survey of Manufactures: 1953 page 122.

Line 17 Electric Energy Purchased - See Line 16.

Line 18 Employee State Tax - Based on Column 1 Food & Kindred Products - Income Tax 1% on net, $16.00 Property Tax at $6.25 per thousand $114.00, Sales Tax 2% of $2,000.00 or $40.00. All other columns calculated by ratio to salary in Column 1.

Line 19 Employee Federal Tax - Salary minus 10% earned income, minus $2,100.00 family deductions times 20% tax rate.

Line 20 Total Capital Investment per Industry Worker - An average for a group of companies in each field. Data obtained from "Fortune Directory" (Supplement to Fortune July, 1957).

Lines 21 & 22 In State and Out of State Investment - Same as Explanation Line 8 except read investment in place of income.

* From a report by Dr. Paul Zickefoose, Department of Economics, N.M.A.&M., which was commissioned by Industry Utilization Committee.

TABLE II

Economic Factors for the Group of Industries
Considered for San Juan and Rio Grande Basins

	1 Food & Kindred Products	2 Textile Mill Products	3 Apparel& Related Products	4 Chemicals & Allied Products	5 Stone, Clay & Glass Products	6 Fabri-cated Metal Products	7 Electric Machinery & Equipment
1.Industrial Water-Acre ft.	2.85	1.85	0.85	17.85	2.55	0.85	0.35
2.Municipal Water-Acre ft.	1.15	1.15	1.15	1.15	1.15	1.15	1.15
3.Total Water-Acre ft.	4.00	3.00	2.00	19.00	3.70	2.00	1.50
4.Sales	$27,000	$11,000	$5,650	$22,700	$12,130	$11,550	$14,800
5.Profit	868	445	124	3,030	1,515	925	1,440
6.Value Added	8,250	4,680	4,400	12,130	7,400	7,300	7,170
7.Salaries & Wages	3,600	3,000	2,750	4,430	3,850	4,260	4,030
8.Prop.Inc. in State	40	200	103	0	455	285	90
9.State & Local Taxes	40	70	40	170	90	65	56
10.Depreciation	200	165	33	625	315	175	195
11.Prop.Inc. out of State	365	20	103	1,910	455	285	820
12.Fed. Taxes Corp.	447	268	76	1,515	755	470	735
13.Misc. Deductions	2,550	895	1,295	3,480	1,460	1,260	1,244
14.Mat'l. Purchased in State	15,900	4,670	930	3,000	1,725	790	1,200
15.Mat'l. Pchsd. out of State	1,732	1,015	140	3,840	1,755	2,380	4,890
16.Fuel Cost	150	85	23	452	550	72	37
17.Elect. Energy Cost	100	105	32	249	185	83	61
18.Employee State Taxes	170	140	130	209	182	200	190
19.Employee Federal Tax	220	115	75	380	293	346	305
20.Total Capital Investment	4,000	6,800	4,000	17,000	9,000	6,500	5,600
21.In State Capital Investment	400	300	2,000	0	4,500	3,250	560
22.Out of State Cap'tl.Investment	3,600	6,500	2,000	17,000	4,500	3,250	5,040

For explanation of items by lines see Appendix _____ Page_____

INCOME VALUE OF WATER WHEN USED FOR VARIOUS INDUSTRIES IN NEW MEXICO

Ralph Charles*

The subject assigned me for presentation to this group is the "Income Value of Water for Irrigation in New Mexico." It is a part of a broader discussion of the income value of water when used for various industries. Possibly my approach to this subject needs some explanation. The other three panel members are reporting the findings of a study of a specific plan of water allocation for the San Juan-Chama Project in which they all participated. Consequently, their presentations follow the same general pattern, and they are able to give the actual figures, for the income value of water, that were obtained by the particular procedure used. Since I did not participate in this study, my approach must be on some different basis. I have chosen to explain two of the methods of determining values that are now generally used and point out some of the difficulties in their practical application. They are the "benefit-cost" and the "repayment" methods.

The evaluation of the benefit to be derived from any action is instinctive. A person either voluntarily or involuntarily weighs the benefit expected from an action against its cost in terms of effort required. Similarly, all public programs have been evaluated in some manner before being inaugurated and their costs have been considered justified by the economic or social benefits to be derived.

In the field of water-use development, the wide variation in the methods of evaluation led the Federal Inter-Agency River Basin Committee, acting under the authority of the President's Water Resources Policy Commission, to start a study in 1946 of the procedures being used by all of the Federal Agencies.

After some 5 years of study the Commission issued its recommendations for a set of criteria which it felt would enable the benefit-cost type of analysis to be conducted on the basis of improved measurement standards which, because of their uniformity, would facilitate comparison of projects and greater understanding by public and Government alike. Many agencies insisted that the method could not be applied fairly in their own highly specialized fields. Never-the-less, a few years later, under instructions from the Bureau of the Budget, Federal agencies started submitting analyses on this basis for every water utilization project proposed. The criteria and instructions advanced by the Commission comprise some

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forty pages in a 6" x 9" pamphlet and like other procedures for this purpose are complicated and difficult to apply uniformly.

Briefly, the method consists of determining the monetary benefits assignable to a specific use of water and comparing them with the appropriate costs to obtain a benefit-cost ratio. This ratio shows the dollars in benefits received for each dollar invested and, if the basis of measurement is comparable, can be used to compare either the various uses of water within a project or the complete water utilization projects. The method is considered to give an "income value" for each use of water analyzed.

There are many difficulties, however, both in measuring the benefits and, since most projects are multi-purpose, in allocating the joint costs. In the matter of cost allocation, the prescribed policy requires that the Separable Costs-Remaining Benefits method be used unless some other method is justified. The tendency is to use this method rather than attempt to justify another, even though the economist may feel that the Use of Facilities, the Benefits, or some other method would result in a more reasonable apportionment of the costs.

In the determination of the benefits, it is apparent that using the same procedure, so called "liberal" economists will consistently compute higher benefits than "conservative" economists. Benefits determined by economists in specialized fields frequently appear to run consistently higher or lower than in other fields. Some agencies seem to have worked out satisfactory methods of evaluating the special water-uses for which they have responsibility; others have not.

Irrigation benefits, for example, are measured by the standard farm budget method. This method is taught in the Agricultural Colleges and is generally used throughout the field of farm management. The results obtained by this method, being widely checked, are likely to represent reasonable values for the benefits to irrigators, or the direct benefits. However, the determination of benefits to others, or indirect benefits, is more difficult. They accrue, at times, far from the project and some of them frequently are overlooked. On the other hand, some people feel that indirect benefits should not be computed. The controversy over this point has not been settled.

Under existing procedures muncipal water benefits are usually derived in terms of alternative costs and, therefore, are not comparable to other measured benefits. As a result of the procedures used, higher benefits per acre-foot may be found for irrigation even though it is generally recognized that water is more valuable for municipal use than for either irrigation or industry.

In recent evaluations of the benefits of recreation in water utilization projects the responsible agency has determined the necessary basic recreational facilities required, computed the costs, and assigned as the benefits an amount equal to twice the costs of the facilities provided. The value of water for recreation, when determined by this method, obviously is not comparable to the value for irrigation obtained by a farm budget analysis.

Some of the procedures for determining the benefits of other water uses, such as for fish and wildlife, flood and sediment control, and soil conservation purposes, have been developed in great detail by the responsible agencies. While few people maintain that the benefits obtained by these methods are comparable, the constant efforts to improve the procedures results in continually improved evaluations.

The second method, that of determining payment capacity, is required by law on Federal Reclamation projects and is considered by many to give the best measure of the income value of water for irrigation. Payment capacity is defined as the maximum annual amount available to the water users from the farm income for payment of all irrigation charges, after deducting other obligations on gross farm income including expenses necessary to maintain the farm family living at an appropriate level, those necessary to produce and market crops and livestock, and those necessary to retain the farm, such as taxes and interest.

Payment capacity, like benefits, is determined by the farm budget method. Because of the difficulties of projecting net earnings over an extended period and because of limitations of existing data and analytical processes, no single method of payment capacity analysis is considered sufficient. Conclusions must be checked by one or more other methods. The "income to land", "comparative cost", or "credit experience" methods are commonly used for this check. It must be recognized that payment capacity comprises only a part of the direct benefits and only a small fraction of the total benefits usually measured.

Payment capacity is the important factor in reclamation project analyses, as the law requires that all reimbursable costs be repaid either by the water users or from other project revenues. The lack of such capacity has long been the greatest difficulty to overcome in developing feasible irrigation projects. In many areas, particularly the small projects in the Rio Grande tributaries of northern New Mexico, both the economic and social benefits from rehabilitating and expanding irrigation facilities would be high, but the irrigators cannot repay the costs.

For many years, in projects that include hydroelectric power, power revenues have been used to help pay the reimbursable costs allocated to irrigation. The vast development in the Lower Colorado River Basin were brought about largely because of the power and water revenues that were available to pay for project facilities. In the Rio Grande Project, although water users have contracted to pay the full cost of their distribution system, arrangements have been made to pay a large part of the costs of Elephant Butte Dam with power revenues. The Colorado River Storage Project, authorized in 1956, provides that power and other revenues shall be used to help pay the reimbursable costs of participating projects. The San Juan-Chama Project is one of these participating projects, and offers the only opportunity to finanace the rehabilitation of small projects in the upper Rio Grande Tributaries.

This explanation of the various methods of evaluation is not intended as a criticism of any method presently used, but is given to point out the fact that judgment must be exercised when using such evaluations. Benefit-cost ratios are one of many factors that influence the allocation of water to specific uses. In the plan for the Initial Stage Development of the San Juan-Chama Project, for example, the State's policy precluded allocation of any water to fish and wildlife purposes. No doubt the benefits of a small amount of water for this purpose, determined at the most favorable location, would have been greater per acre-foot than for any of the uses included in the plan.

In summarizing, I have explained the two most commonly used methods of evaluating water uses, and have pointed out the differences in procedure that make a valid comparison of uses, on the basis of these methods, difficult if not impossible. These methods can be construed to measure income value. I have indicated that other factors frequently are more important than income value in determining the allocation of water to specific uses. I also have outlined the provision under which power and other revenues from the Colorado River Storage Project can be used to help pay for the rehabilitation of irrigation units proposed in the San Juan-Chama Project. It is important that this provision be utilized, and the water allocated to New Mexico under the Upper Colorado River Compact be developed before it is put to use in some downstream state and is lost.

INCOME PRODUCING VALUE OF WATER WHEN USED BY DIFFERENT INDUSTRIES INCLUDING AGRICULTURE AND IN THE VARIOUS AREAS OF NEW MEXICO

Professor Frank Bromilow*

Before going into a discussion of one specific diversion pattern, it might be well to recapitulate the division of water that was used in all of the diversion patterns. As you will note in Table I, the amount of water available in the San Juan Basin ranged from a maximum of 206,000 Acre Feet allocated to industrial and municipal use to a minimum of 22.6 thousand Acre Feet. In the Rio Grande Basin, the maximum amount was 179,000 Acre Feet, while in two of the patterns no water at all was allocated to the use we planned to study.

The wide range of amounts of water available for municipal and industrial use was a choice not specifically made by our sub-committee. It was a result first of a major decision that two levels of diversion from the San Juan to the Rio Grande valleys would be studied. The first level being 110,000 Acre Feet and the second level being 235,000 Acre Feet. Once this decision had been reached by the entire study group, a meeting in May of 1957, again of the entire study group, made decisions on allocation of water to the following:

1. San Juan Irrigation
2. San Juan Municipal and Industrial
3. San Juan Losses
4. Rio Grande Tributary Irrigation
5. Rio Grande Other Irrigation
6. Rio Grande Municipal and Industrial
7. Rio Grande Water-shed Improvement
8. Pumping Depletion
9. Fish and Wild Life
10. Rio Grande Losses

Once these decisions had been reached, the job of our sub-committee was that of deciding on a division of the municipal and industrial water among the seven major industry classifications which might have possibility of establishment in New Mexico.

Tables in the Sub-committee report show in detail the allocation of this water to various industries and the economic impact of the use of this water by industries. Our reasoning in developing these patterns can best be shown by a few examples.

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Patterns 235a and c, which allocated only 22.6 thousand acre feet for industrial and municipal use in the San Juan Basin, had in it large allocations of water for agricultural use in that same basin. It was our thought that such large quantities of water allocated to agricultural uses would mean that the small amounts allocated to industrial uses would of necessity, have to be used in agricultural supported industries. For this reason, it was assumed that the entire 22.6 thousand acre feet would be used in industries in the class "Food and Kindred Products".

Where larger quantities were available in the San Juan Basin, such as in Pattern 235b, it was assumed that the level of agricultural industry would remain the same and that because of the mineral potential of the area the remainder would be used in the chemical and allied products industry.

Review of all of the patterns in the various ranges of allocated water, mentioned in the opening statement, shows a wide range of population increase which could be supported in the two areas. A low figure of 85,540 people could be supported in Patterns 110a and c with a maximum figure of 534,350 people being supported in Pattern 235b. These figures compare with an estimated population increase to 1975 of 26,800 in the San Juan Basin; 175,000 in the Rio Grande and Otero county areas for a grand total of 201,800.

For a detailed study of the effect of this water use, Table II, Pattern 110b, is the best example, since in this particular pattern a distribution of water uses among all seven of the possible industries in each basin was contemplated. This table is shown in two pages. The first page giving in detail the effect of the distribution of water to seven industry classifications in the San Juan Basin. The second page gives similar information for the Rio Grande Basin and in addition, the second page shows the total impact on the San Juan Basin and the Rio Grande Basin and similarly a grand total. Specific references to this grand total should be fruitful in terms of understanding the Table and I would like to take these figures and discuss them with you. Item No. 1 shows a total population increase supported by this water of 319,550, which you will note, is approximately 50% more than the estimated population increase for these areas to 1975. Study of the other items show specific effects on the various parts of the economy of the State.

In conclusion, I would like to point out that municipal and industrial use of water represents the greatest value for the support of increase in population. There is a range of water needed per person from 1.73 acre feet to a low of .52 acre feet per person added, which compares very favorably to the amount of water needed to support one person in an irrigation agricultural economy. These figures themselves are on the conservative side, since in arriving at them, it was assumed that all municipal water and all industrial water would be consumed. We know from other studies that municipal water, by proper sewage treatment, can be reclaimed. Similarily much of the water used in industry can be reused. For example, water used in cooling operations is available for other uses. It is felt that a broad program of industrial development supported by sufficient water allocated specifically for that purpose could result in tremendous increase in the economic status of the state.

TABLE I

Pattern	Industrial and Municipal Water			Industrial Water	Municipal Water	Population Growth			Acre Feet
	San Juan	Rio Grande	Total Water			San Juan	Rio Grande	Total	Per Person
110a	147.6	0.0	147.6	133.1	14.5	85,540	0	85,540	1.73
110b	206.0	72.0	278.0	225.6	52.4	200,550	119,000	319,550	0.87
110c	147.6	0.0	147.6	133.1	14.5	85,540	0	85,540	1.73
110d	206.0	53.4	259.4	208.2	51.2	200,550	112,000	312,550	0.83
235a	22.6	50.0	72.6	49.6	23.0	39,550	100,100	139,650	0.52
235b	153.8	179.0	332.8	245.3	87.5	89,850	444,500	534,350	0.62
235c	22.6	50.0	72.6	49.6	23.0	29,550	100,100	139,650	0.52
235d	153.8	142.0	295.8	232.1	63.7	89,850	299,600	389,450	0.76

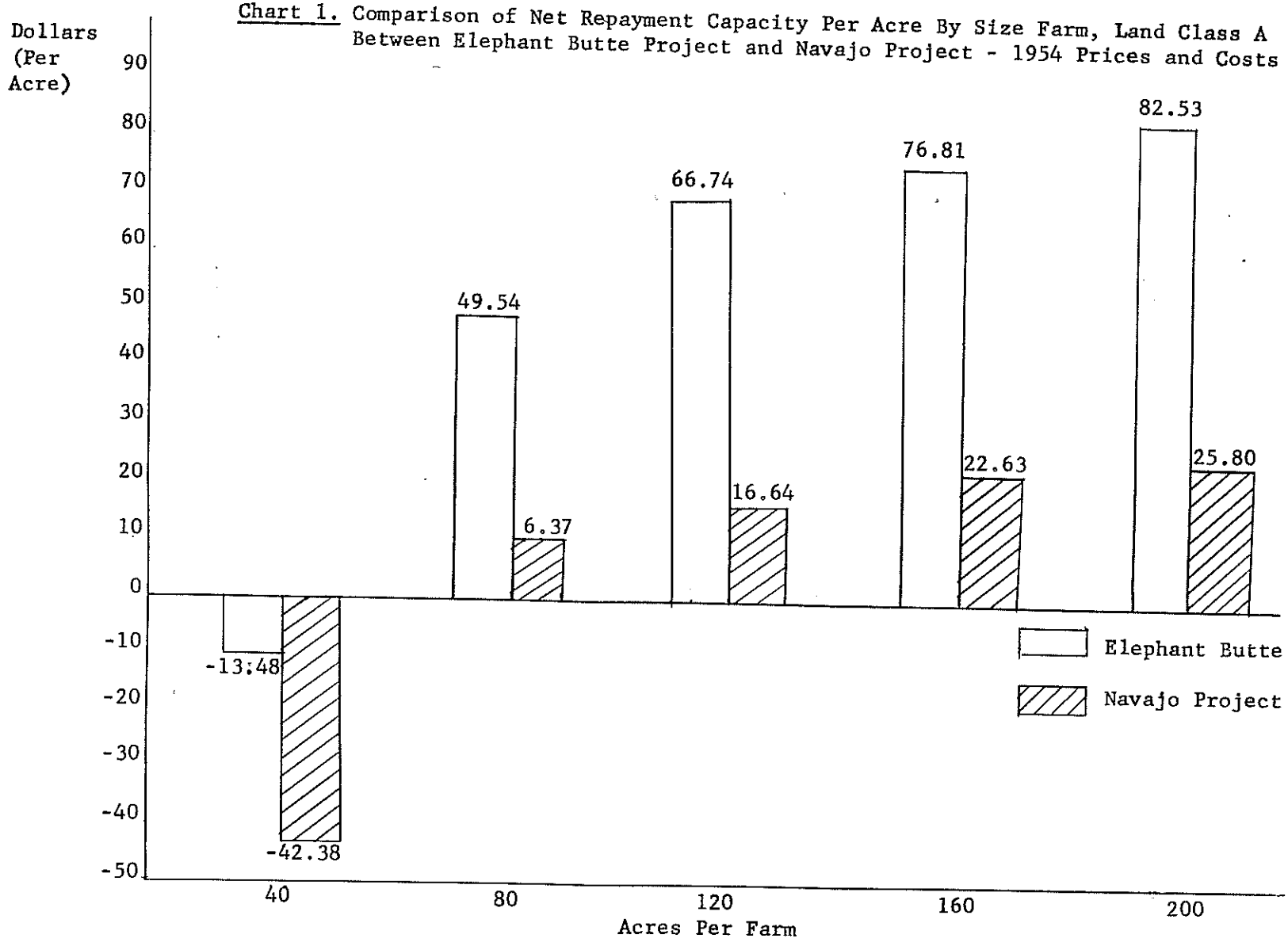
TABLE II MUNICIPAL & INDUSTRIAL WATER USE - Pattern 110 b
SAN JUAN BASIN

	1 Food & Kindred Products	2 Textile Mill Products	3 Apparel& Related Products	4 Chemicals & Allied Products	5 Stone, Clay & Glass Products	6 Fabri-cated Metal Products	7 Electric Machinery & Equipment
1.Population Increase	39,550	7,000	7,000	56,000	14,000	35,000	42,000
2.Industiral Employees	5,650	1,000	1,000	8,000	2,000	5,000	6,000
3.Total Water Acre Feet	22,600	3,000	2,000	152,000	7,400	10,000	9,000
4.Industrial Water Ac. Feet	16,100	1,850	850	143,000	5,100	4,250	2,100
5.Municipal Water Ac. Feet	6,500	1,150	1,150	9,000	2,300	5,750	6,900
			THOUSAND DOLLARS				
6.Sales	152,500	11,000	5,650	182,000	24,260	57,750	88,800
7.Profit	4,900	445	124	24,240	3,030	4,620	8,650
8.Value Added	46,500	4,680	4,400	97,000	14,800	36,500	43,000
9.Salaries and Wages	20,300	3,000	2,750	35,400	7,700	21,300	24,200
10.Prop. Income in State	226	200	103	0	910	1,425	540
11.State and Local Taxes	226	70	40	1,360	180	325	336
12.Depreciation	1,130	165	33	5,000	630	875	1,170
13.Prop. Income Out of State	2,070	20	103	15,300	910	1,425	4,920
14.Federal Taxes Corp.	2,530	268	76	12,100	1,550	2,350	4,420
15.Misc. Deductions	14,400	895	1,295	27,800	2,920	6,300	7,470
16.M'tl Purchased in State	90,000	4,670	930	24,000	3,450	3,950	7,200
17.M'tl Purchased Out of State	9,800	1,015	140	30,720	3,510	11,900	29,400
18.Fuel Cost	848	85	23	3,620	1,100	360	222
19.Elect. Energy Cost	565	105	32	2,000	390	415	366
20.Employee State Taxes	960	140	130	1,672	384	1,000	1,140
21.Employee Fed. Tax	1,240	115	75	3,040	586	1,730	1,830
22.Total Capital Investment	22,600	6,800	4,000	136,000	18,000	32,500	33,800
23.In State Capital Investment	2,260	300	2,000	0	9,000	16,250	3,380
24.Out of State Capital Invest-ment	20,340	6,500	2,000	136,000	9,000	16,250	30,420

TABLE II M. & I. - Pattern 110b Cont.
RIO GRANDE BASIN

	1 Food & Kindred Products	2 Textile Mill Products	3 Apparel & Related Products	4 Chemicals & Allied Products	5 Stone, Clay & Glass Products	6 Fabricated Metal Products	7 Electric Machinery & Equipment	Total San Juan	Total Rio Grande	GRAND TOTAL
1.	7,000	7,000	14,000	14,000	14,000	28,000	35,000	200,550	119,000	319,550
2.	1,000	1,000	2,000	2,000	2,000	4,000	5,000	28,650	17,000	45,650
3.	4,000	3,000	4,000	38,000	7,400	8,000	7,600	206,000	72,000	278,000
4.	2,850	1,850	1,700	35,700	5,100	3,400	1,750	173,250	52,350	225,600
5.	1,150	1,150	2,300	2,300	2,300	4,600	5,850	32,750	19,650	52,400
					THOUSAND DOLLARS					
6.	27,000	11,000	11,300	45,400	24,260	46,200	74,000	521,960	239,160	761,120
7.	868	445	248	6,060	3,030	3,700	7,200	46,009	21,551	67,560
8.	8,250	4,680	8,800	24,260	14,800	29,200	35,850	246,880	125,840	372,720
9.	3,600	3,000	5,500	8,860	7,700	17,040	20,150	114,650	65,850	180,500
10.	40	200	206	0	910	1,140	450	3,404	2,946	6,350
11.	40	70	80	340	180	230	280	2,537	1,220	3,757
12.	200	165	66	1,250	630	700	975	9,003	3,986	12,989
13.	365	20	206	3,820	910	1,140	4,100	24,748	10,561	35,309
14.	447	268	152	3,030	1,550	3,680	1,880	23,294	11,007	34,301
15.	2,550	895	2,590	6,960	2,920	5,040	6,220	61,080	27,175	88,255
16.	15,900	4,670	1,860	6,000	3,450	3,160	6,000	134,200	41,040	175,240
17.	1,732	1,015	280	7,680	3,510	9,530	24,500	86,485	48,247	134,732
18.	150	85	46	904	1,100	288	185	6,258	2,758	9,016
19.	100	105	64	498	370	332	305	3,873	1,774	5,647
20.	170	140	260	418	364	800	950	5,426	3,102	8,528
21.	220	115	150	760	586	1,384	1,525	8,616	4,740	13,356
22.	4,000	6,800	8,000	34,000	18,000	26,000	28,000	253,700	124,800	378,500
23.	400	300	4,000	0	9,000	13,000	2,800	33,190	29,500	62,690
24.	3,600	6,500	4,000	34,000	9,000	13,000	25,200	220,510	95,300	315,810

Chart 1. Comparison of Net Repayment Capacity Per Acre By Size Farm, Land Class A Between Elephant Butte Project and Navajo Project - 1954 Prices and Costs



ECONOMIC EVALUATION OF WATER FOR NEW IRRIGATION

H. R. Stucky*

The economic evaluation of the water for irrigation is dependent on three important items; first, water cost per acre foot; second, size of farm unit; and third, the productivity of the land to which the water is applied. These items have been considered in the study on the value of water for irrigation conducted by the Agricultural Economics Department of the New Mexico Agricultural Experiment Station in cooperation with the University of New Mexico and several other public agencies under a Resources for the Future grant of funds.

The methods for the agricultural study are quite well established. The Bureau of Reclamation and other public resource development agencies and farm management research workers use the farm budget method. This requires considerable basic data on production methods, crops to be grown, prices of products sold and on the prices of land, equipment, labor, supplies and other items to be purchased. It is usual to set a figure for family living and include this as a cost against water use, since the family must secure a reasonable income for living if the farm is to have any repayment ability. The minimum living costs are among the first expenses from the farm income which are paid.

The collection of the basic data for use in these budgeting processes is time consuming and accurate figures for a specific area being studied commonly are not available. In the case of a new project, such as the Navajo irrigation project, there are no data available on the best crops to grow, the expected yields, prices to be received, type of machinery required and many other items. This is true because none of the land within the immediate area of the project has been successfully irrigated. The result is that data from areas of similar soils, climate and topography are used when these can be found. When these are not available, then reasonable estimations based the data from less similar areas must be used.

The Colorado River Compact has allocated 834,000 acre feet of water to the State of New Mexico from the San Juan River. Some of this water is now used for irrigation. The balance is to be used for new irrigation, municipal and industrial uses, fish and wildlife, and for supplemental uses.

The water allocated for agricultural purposes can be used in any area from the Animas La Plata and the Navajo projects, in northwestern New Mexico to the areas around Taos and in the upper tributaries, in the Middle Rio Grande around Albuquerque, or in the Lower Rio Grande in Dona Ana and Sierra counties. It

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can also be used on various size of farms and soils with widely different productive capacity. There also is a wide difference in elevation, growing season and the type of crops grown.

Budgets were prepared by the Agricultural Economics Department at New Mexico A & M to determine the value of water when used for irrigation in each of the above areas. Several farm sizes were considered, but the 120 acre size was used as a base, and repayment to water on soils with average or above productivity. Soil ratings were set up in each of the areas with the assistance of federal and college soils, agronomy and economics representatives.

Effect of Farm Size on Repayment

Farm size is an important factor in determining the value of water. It takes about the same amount of money for a farm family to live on a 20 or 40 acre farm as it does for them to live on a 120, 160 or 200 acre farm. The family must provide itself with food, clothing, housing, recreation, education and medical care. Also it takes almost as much machinery to farm 40 acres as it does a 120 acre farm.

Chart 1 compares the budgeted net repayment capacity per acre of Class A high productivity farms varying in size from 40 acres to 200 acres in the Elephant Butte Irrigation District on the Lower Rio Grande and on the proposed Navajo project.

The 40 acre farm in the Elephant Butte District has a negative repayment ability of -$13.48 per acre of -$539.20 per farm. For the Navajo project there was a negative repayment ability of -$42.38 or -$1695.20 per farm. This is based on 40 acre farms of the highest yielding land in these areas. In both areas, the farms of 80, 120, 160 and 200 acres in size have a positive net repayment capacity per acre. The Elephant Butte District has a higher net because of cotton which is a high yield and high net income crop. The 120 acre size farm was used as a base because this amount of land will produce a reasonable amount of income which will repay the water costs, pay for family necessities and permit a certain amount of capital accumulation. The 40 or 80 acre farm size would not provide the above requirements. The 120 acre unit on good quality land provides opportunity for near the maximum number of farm families to gain a satisfactory living within a given area.

Effect of Land Quality on Repayment

Land class, or quality of soil, is important in determining the value of water when used for irrigation.

Chart 2. Net Repayment Capacity Per Acre on 120 Acre Farm Size By Land Class in Elephant Butte Project, 1954, Prices and Costs.

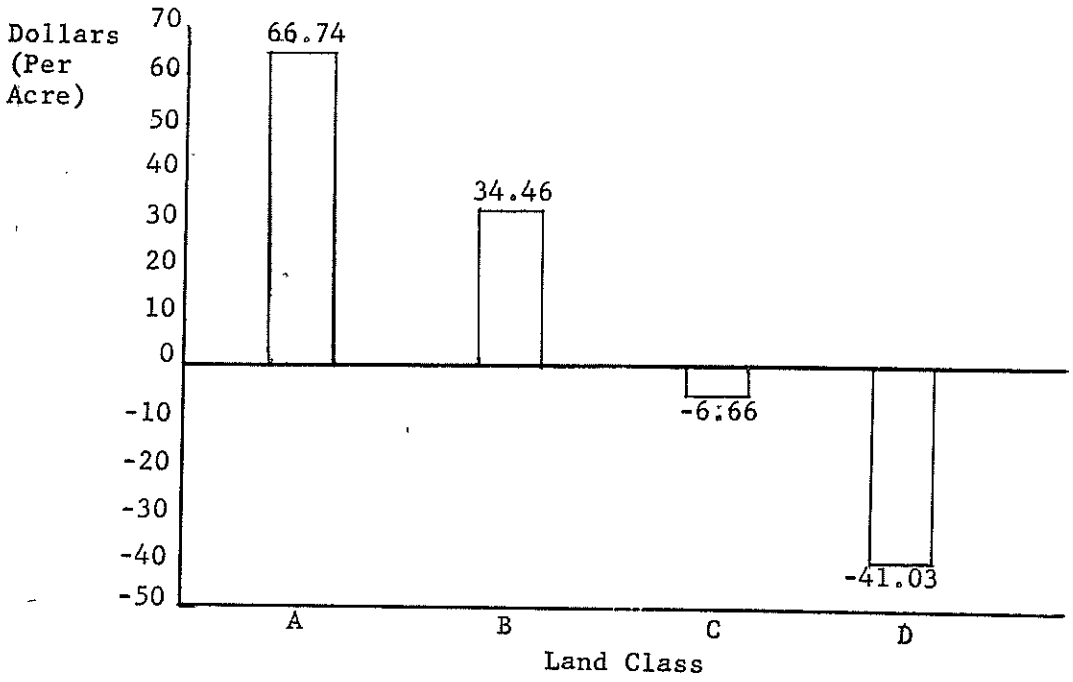

Chart 3. Net Repayment Capacity Per Acre on 120 Acre Farm Size By Land Class in Navajo Project, 1954, Prices and Costs.

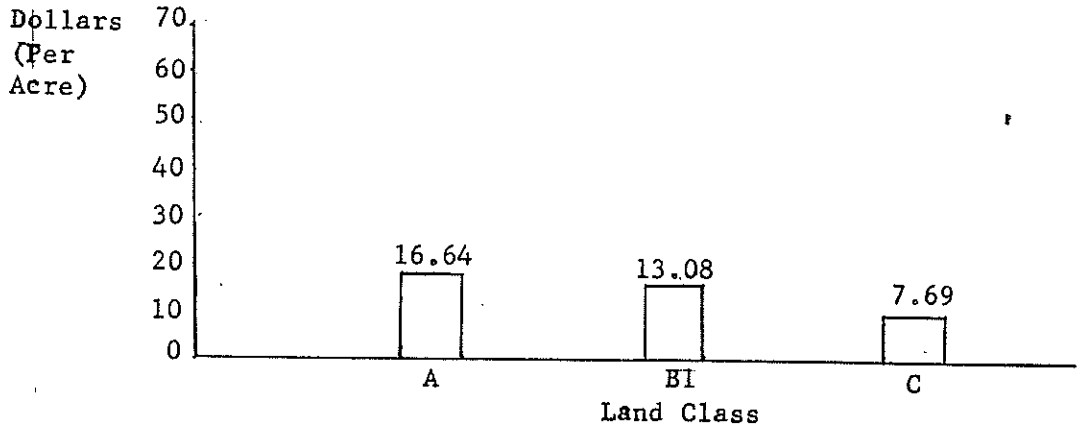

Chart 2 compares the net repayment capacity per acre on farms 120 acres in size by classes of land in the Elephant Butte area of the Lower Rio Grande. The general productivity of the classes of land is indicated by the following average yields.

	Yield Per Acre By Land Class			
	A	B	C	D
Cotton Bales	2	1.5	1.0	.75
Alfalfa Tons	5.0	4.0	4.5	3.0

The Class A farm of 120 acres produces a positive net repayment per farm of about $8,000 (66.74 x 120) while the Class D farm produces a negative net repayment of -$4923 (-$41.03 x 120). This means that a 120 acre farm on good soil provides the family the minimum essentials plus the money to pay for the farm and something in addition. The family on the poor soil can not pay the water charges, the farm, or even receive the minimum essentials for family living.

Chart 3 gives a similar comparison for farms on the Navajo irrigation projects in northwestern New Mexico. The general productivity of the land classes is indicated by the following average yields.

		Yield Per Acre by Class of Land		
		A	B	C
Alfalfa	Tons	4.0	3.5	3.5
Barley	Bu.	40.0	40.0	30.0

The difference between the grades of land is not so great in the Navajo area as in Elephant Butte. However, the Class A farm will produce a net repayment of about $2000 above minimum requirements while the Class C farm will produce about $925.00. From these amounts according to the budgeting process used, the farmer would pay water charges before having anything additional for himself, above the minimum requirements. The water charges would consume about 1/2 of the net of the Class C farm.

The Charts, 1, 2 and 3 point out graphically the importance of developing adequate size farm units and only the best lands for irrigation. Farmers on good land with a reasonable size farm have an opportunity to make a good living and pay project costs. Farmers on poor lands or on units which are too small, not only can not pay project costs but after a few years of extreme hardship, will likely lose the farm and leave it for some other farmer to take it over and go through the same process.

Reasonable sized units, and highly productive soils are "musts" if farmers on irrigation project developments are to succeed.