NINTH ANNUAL REPORT

NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE

Fiscal Year July 1, 1972 - June 30, 1973

Issued under provisions of the

Water Resources Research Act of 1964 - P.L. 379-88

J. W. Clark, Director

New Mexico

Water Resources Research Institute

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NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE
July 1, 1972 - June 30, 1973

by

John W. Clark*

New Mexico is a water deficient area with respect to the availability of fresh water to meet the projected demands over the next fifty years. Except for small quantities of unused supplies in the Upper Colorado, Lower Colorado, and Canadian Basins, the surface supply is fully appropriated and is being beneficially used within the terms of international treaties, interstate compacts, court decrees, and State laws.

Although a large amount of ground water underlies the State, much of it is either of poor quality or too expensive to develop at present. In the areas where the ground water is of satisfactory quality and can be economically obtained, development and use is underway. The demands on the supply exceed the recharge in many areas, and ground water levels are declining.

As New Mexico grows there is increasing competition for water. The transfer in use from agriculture to other purposes is already underway.

The most pressing need for a significant portion of the State's population is for improved incomes and economic security. Chronic under-employment is endemic in parts of New Mexico. These factors, coupled with the growth orientation on the part of business and financial institutions, give rise to strong pressures for new industry and employment with minimal consideration for environmental amenities.

The environment versus economic-growth controversy in this region is more explosive in some ways than in other parts of the United States, for almost diametrically opposed in outlook to those looking for improved incomes is a class of people, including a substantial number of professionals and retirees, for whom this region is the last outpost of clear skies and open space; these people are ecologically aware, economically secure, and increasingly organized and vocal. Rural-oriented farming interests use similar ecology and social arguments against the shift from irrigated agriculture to residential use of valley lands.

Because New Mexico is primarily a semi-arid region, those few perennial streams within the State have considerably more influence upon the lives and livelihood of the region's inhabitants than any other element of the

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~~the Rio Grande Regional Environmental Project (RGREP). This study is to~~ physical environment. Therefore, any alteration, modification, or subtle change of this resource must be carefully evaluated.

Within this setting it is important that a plan be developed to determine how New Mexico's water supply needs might be met. This is the objective of the State Water Plan investigations which are currently underway by the Bureau of Reclamation and the New Mexico Interstate Stream Commission in cooperation with other Federal and State agencies. The main thrust of the New Mexico Water Resources Research Institute over the next five years is to contribute research information in support of this plan.

A principal project for this past year, A-041-NMEX, "Water Resource Problems and Research Needs of New Mexico" is scheduled for completion June 30, 1973. This study represents a major cooperative effort of the Institute, State and Federal water related agencies and other water-user groups to establish research priority needs for the State. These research needs, once established, will be made available to potential researchers. The problem is to better define State goals as they relate to water and to translate these goals into water research objectives. Because financial resources are limited, a considerable amount of coordination is necessary for maximum efficiency.

Another principal project, B-026-NMEX, "An Analytical Interdisciplinary Evaluation of the Utilization of the Water Resources of the Rio Grande" was completed March, 1973. This study represents a major cooperative effort of the three largest universities in New Mexico. The surface water supply of the Rio Grande Basin in New Mexico is fully appropriated and utilized. This is also the area of the State where the greatest population increase is projected, and consequently the municipal and industrial needs for water will be increasing more rapidly. The use of water in this Basin is limited by State law, the Rio Grande Compact, and the treaty with Mexico.

One of the key elements of this study was the use of a technical advisory committee composed of representatives from State and Federal agencies that have significant interest and management responsibilities in the Basin. Because of the technical advisory committee's participation throughout the project, many of the ideas and findings have had impact on development, planning, and the State Water Plan before the results were published. A U.S. Geological Survey proposal for a study of the water resources of the Mesilla Valley, New Mexico, has as its first objective:

> Evaluation of the usefulness of the mathematical model constructed by Richardson (1971). This can be done with data now in the report and should show if the model could form the basis for future use in design, operation, and management of the system. The model may also indicate areas of concentration in collect the basic data.

This model was developed as a subpart of project B-026-NMEX.

The Institute Director has exerted a considerable effort in support of

provide the basic data and information on which to base a regional management plan that will include appropriate implementation procedures. The region under consideration is the lands along both sides of the 285 river-miles of the Rio Grande from Elephant Butte Reservoir, New Mexico, where the surface water supply for the region is stored, downstream to Fort Quitman, Texas, where the last of this water is used. The river forms the boundary between the United States of America and the Republic of Mexico for 81 miles in the proposed project area and includes lands in two American states and one in Mexico. The problem is not merely one of drafting an apparently workable management plan, but is the considerably more complex problem of developing the background information and theory on which the plan is to be based. The New Mexico Water Resources Research Institute and the Texas Water Research Institute have been delegated the responsibility of developing the proposal for the environmental management plan for this interstate and international region, along with the responsibilities of coordinating the efforts of all of the universities in New Mexico and Texas in all phases of the project. Texas has authorized 2.5 million dollars in support of this project, and New Mexico is expected to make available approximately one million dollars starting July 1, 1972. It is planned that the Institute will help develop similar projects for other areas of New Mexico in the near future.

The New Mexico Water Resources Research Institute sponsored the Eighteenth Annual New Mexico Water Conference, host several water related meetings involving State and Federal agencies and other organizations, and participated in public meetings and hearings.

BACKGROUND OF THE INSTITUTE

The New Mexico State University Water Resources Research Institute was officially organized and approved by the New Mexico State University Board of Regents in February 1963. The Institute Office was opened on March 15, 1965 in the Agriculture Building on New Mexico State University campus.

The Water Resources Research Act, P.L. 88-379, approved by the President July 17, 1964, became effective for the first 14 institutes with $75,000 allotted to each for FY-1965 effective as of February 1, 1965. The allotment to each of the 51 state institutes, or centers, for FY-1966 was $87,500 and a similar amount to each institute for FY-1967. The FY-1968 allotment to each state was $100,000.

New Mexico State University application for designation as the Institute University was among the first applications sent to Washington, D. C. for approval, being filed September 18, 1964 and resubmitted November 25, 1964. Included in the application was a letter dated September 3, 1964 from the Governor to the Secretary of the Interior, designating New Mexico State University as the location for the New Mexico Water Resources Research Institute.

New Mexico Water Resources Research Institute was the first institute to be officially designated among the 14 institutes authorized as of February 1, 1965 to operate under provisions of Section 100 of the Act. The remaining 37 state institutes were approved for funding May 1, 1965.

The Institute is essentially a planning and coordinating activity for research and graduate training in the area of water resources representing all of the universities and colleges in the State of New Mexico. The objectives of the Institute may be stated as follows:

(a) To plan and coordinate the water resources research and training activities involving faculty and facilities of the various colleges and universities in the state.

(b) To arrange and conduct water resources research appropriate to the role and scope of the state's colleges and universities for the benefit of the state and the nation including those sponsored by

    (1) The Office of Water Resources Research
    (2) Other Federal agencies
    (3) State agencies
    (4) Quasi-public organizations
    (5) Industry

(c) To arrange for seminars and conferences involving persons having interest and responsibilities in the water problems of the state.

(d) To provide for publication and dissemination of the results of research conducted by the Institute and other information which bears upon the water resources of the state.

PROGRAM DEVELOPMENT AND REVIEW BOARD

This board originally was designated as the Executive Board. However, the new title, adopted in January 1967 more accurately describes its function. It recommends areas for research concentration, reviews and recommends the relative importance and quality of research proposals, reviews the technical procedures suggested, and recommends means by which certain phases of one project may be coordinated with work being done in other projects in the state. The Board also recommends the projects which qualify on a technical basis, and recommends the priority for project funding each year.

The Board includes scientists at New Mexico State University, the New Mexico Institute of Mining and Technology, and the University of New Mexico. Their names and respective disciplinary areas are:

Dr. Gary Hufbauer	- Economist, College of Arts and Sciences, University of New Mexico
Dr. Gerardo W. Gross	- Geophysist New Mexico Institute of Mining and Technology
Dr. A. A. Baltensperger	- Agronomist New Mexico State University
Dr. Fred Downs	- Economist New Mexico State University
Dr. Gale Billings	- Geologist New Mexico Institute of Mining and Technology
Prof. Albert Utton	- Professor of Law University of New Mexico
Prof. J. W. Clark	- Civil Engineer, Chairman and Director of Institute, NMSU - Ex-officio

The Board held two meetings during 1972-73 to consider research proposals and to discuss the total water resources research program. Also discussed was Operation and Publication objectives and procedures.

The procedure followed by the Board in reviewing project proposals is as follows:

1. All proposals are called and received by the Director's Office and copies are distributed to each member of the Review Board well in advance of scheduled meetings.

2. Each Principal Investigator is invited to appear before the Board to make a 10 minute statement on his proposal, with questions from the Board following his presentation. Usually one of these meetings is held at the University of New Mexico in Albuquerque, or New Mexico Institute of Mining and Technology, and the other at New Mexico State University, Las Cruces.

3. Following the hearings on all of the project extensions from the current year plus those proposed for the next fiscal year, the Board uses a rating process to select the order in which all worthy projects may be funded. Some projects usually receive outright rejections by the Board due to lack of water orientation or due to poor preparation and presentation.

4. From the group of projects recommended by the Board, the Director works up a schedule of funding which will fit within the money available. This procedure results in some quite acceptable projects not being accepted, due to lack of funds. Often there is considerable consultation between the Director and the Investigators and the Board members during the process of fitting projects into the limited budget.

INTERUNIVERSITY MEMORANDUM OF AGREEMENT

A memorandum of Agreement between the University of New Mexico, New Mexico Institute of Mining and Technology and New Mexico State University Water Resources Research Institute was entered into on the 8th day of July, 1966. The agreement forms a definite basis for accounting for the Federal and matching funds on the projects at the two institutions which have projects operating through the Water Resources Research Institute. The Agreement includes a copy of (1) Public Law 88-379, (2) Public Law 89-404 which Acts together established and funded the Water Resources Research Program, (3) Rules and Regulations pursuant to the Water Resources Research Act of 1964, (P.L. 88-379), (4) Policy Statement issued by the Office of Water Resources Research, and (5) a statement regarding Acknowledgement on Publications for use of Water Resources Research Act funds. A complete copy of the Agreement, including the several documents listed above, as signed by Presidents of each of the three universities involved was supplied to the Comptroller's Offices and the Office of Water Resources Research, and copies of the Agreement were made available to others as required in the project operations.

A supplement to the July 6, 1966 Agreement was signed effective July 1970 to provide for the administration and allocation of the State appropriations made by the 1970, 1971 and future Sessions of the New Mexico Legislature.

COOPERATION

Cooperation between Universities, State and Federal agencies, and others interested in water has been excellent. The use of a Technical Advisory Committee on a project by project basis has proved to be an effective mechanism for optimizing cooperation. The following Technical Advisory Committee on project B-026-NMEX has met on several occasions jointly with the three University study group:

Technical Advisory Committee - B-026-NMEX

Mr. Robert F. Stephens	U.S. Bureau of Sport Fisheries and Wildlife
Mr. William E. Hale	U.S. Geological Survey
Mr. T. A. Garrity	U.S Bureau of Indian Affairs
Mr. W. J. Anderson	U.S. Bureau of Land Management
Mr. James Kirby	U.S. Bureau of Reclamation
Mr. Rowland Fife	U.S. Bureau of Reclamation
Mr. Wayne Cunningham	Elephant Butte Irrigation District
Mr. Ralph Bell	U.S. Soil Conservation Service
Mr. Phil Mutz	New Mexico Interstate Stream Commission
Mr. Pete Metzner	Middle Rio Grande Council of Governments
Mr. Charles F. Youberg	Middle Rio Grande Council of Governments
Mr. Larry Bronaugh	U.S. Bureau of Indian Affairs
Mr. Mike Martinez	U.S. Bureau of Land Management
Mr. Edwin A. Lewis	U.S. Bureau of Reclamation
Mr. Robert Schembera	U.S. Bureau of Reclamation
Mr. Fred Allen	New Mexico State Engineer Office
Mr. Earl Sorensen	New Mexico State Engineer Office
Mr. Ed Gray	U.S. Soil Conservation Service
Mr. Clyde Wilson	U.S. Geological Survey

ANNUAL NEW MEXICO WATER CONFERENCE

The first Annual New Mexico Water Conference was held in 1956. Since then eighteen conferences have been held and the nineteenth is scheduled for April 5 and 6, 1974. The Director serves as the chairman of the Advisory Committee.

The Advisory Committee

Fred Thompson
N.M. Dept. of Game and Fish

S. E. Reynolds
N.M. State Engineer

Boyce C. Williams
Agronomy-Soils, NMSU

Kim Allen
N.M. Farm & Ranch Magazine

Frank B. Titus
Hydrologist, NMIMT

W. P. Stephens, Director
Department of Agriculture, NMSU

Ms. Mally Ribe
N.M. League of Women Voters

Rowland Fife, Area Engineer
U.S. Bureau of Reclamation

Lloyd A. Calhoun
N.M. Electric Service Company

Jesse V. Lunsford
Civil Engineering, NMSU

Wm. D. Hurst, Regional Forester
Forest Service, USDA

Eldon G. Hanson, Head
Agricultural Engineering, NMSU

Dr. Carl F. Tarlowski
N.M. Regional Health Director

Gary L. Cunningham
Biology Department, NMSU

Raw Cauwet
Information Services, NMSU

Ralph Charles
Middle Rio Grande Flood Control

Hoyt Pattison
N.M. Representative, Curry County

L. P. Reinig, Head, Engineering Department
Los Alamos Scientific Laboratories

Willis H. Ellis
Professor of Law, UNM

Rogers Aston
South Spring Foundation

James Kirby
Extension Service, NMSU

James Anderson, Director
N.M. Bureau of Land Management

Col. James L. Sutton
Corps of Engineers - U.S. Army

Charles M. Hohn
Extension Engineer, NMSU

Carrol Hunton
N.M. Farmers Home Administration

Gene O. Ott, Management Specialist
Extension Service, NMSU

Wm. E. Hale, District Chief
U.S. Geological Survey

Marion Strong
State Conservationist, SCS

Peter Hanagan, Executive Director
N.M. Oil and Gas Association

George R. Dawson, Head
Agricultural Economics, NMSU

H. E. Gary
Farmer, Rincon, N.M.

T. G. Gebhard, Jr.
Civil Engineering Dept., NMSU

Wayne P. Cunningham
Elephant Butte Irrigation District

John W. Clark, Director
Water Resources Research Institute

The Annual Water Conference serves a public service by bringing together 200 to 300 leaders each year to discuss water resources which are important to New Mexico and the Nation.

The water conferences are contributing materially to the growth and development of the Water Resources Research Institute and the Institute can greatly assist the water conference. Both are needed in the overall water research and development program in the State of New Mexico

The annual conference is planned and conducted by an interdisciplinary New Mexico State University Committee with the assistance of a statewide committee of 25 members serving as a Water Conference Advisory Committee. Much credit for the success of the conference goes to dedicated members of these two committees.

EXAMPLES OF RESEARCH FINDINGS AND THEIR APPLICATION TO WATER RESOURCE PROBLEMS

B-027-NMEX - A Comparison of Rates of Water Loss, Through Transpiration of Several New Mexico Phreatophyte Species

In the semi-arid regions of the southwestern United States, large quantities of water are presumably utilized by riparian vegetation. This high transpiration has been assumed because of the phreatophytic nature of the riparian vegetation. Phreatophytes are "plants that habitually grow where they can send their roots down to the water table, or the capillary fringe immediately overlying the water table, and are then able to obtain a perennial and secure supply of water." Recently, many of the earlier reports of extremely high water utilization by riparian vegetation have been questioned. The practice of clearing riparian vegetation to "salvage" water has also been questioned on both economic and environmental quality grounds. These authors pointed out that the value of riparian communities for recreation, erosion control, and wildlife habitat may, in an objective analysis, outweigh any benefits that might be derived from their eradication. Decisions concerning management of riparian communities cannot be made without accurate estimates of transpirational water use by the phreatophytic vegetation.

This project describes the development and use of a method for estimating transpirational water use by riparian plant communities.

B-015-NMEX - Irrigability Classification of New Mexico Lands as a Guide for Water Importation

Irrigation classification has been completed for all 32 New Mexico counties. The results of this research have been used to construct a map of suitability of New Mexico lands for irrigation. This map, which groups New Mexico lands into three classes--highly suitable, moderately suitable, and unsuitable--has been revised on the basis of the initial

review, and completed June 30, 1973. It will now become a part of the New Mexico Water Plan which is being prepared by the U. S. Bureau of Reclamation.

This work continues to supply informantion where none was previously available, and the demand for the published reports has been much greater than expected. Important areas of land which are well suited to irrigation as well as large areas which are not suitable continue to be shown. Additional information about soil characteristics and suitability for various uses adds greatly to the usefulness of the reports.

A-041-NMEX - Water Resource Problems and Research Needs of New Mexico

An inventory of the agencies, institutions, and organizations with water-related research interest has been completed. This inventory is used not only for the project, but by the Institute in its information dissemination activities. Key personnel of the following agencies have been interviewed to determine their water research needs and problems:

New Mexico State Forestry Department
North Central New Mexico Economic Development District
New Mexico Department of Development
Bureau of Land Management
New Mexico State Engineer Office
New Mexico State Planning Office
U.S. Army Corps of Engineers
Bureau of Reclamation
Middle Rio Grande Council of Governments
Soil Conservation Service
U.S. Geological Survey
Bureau of Indian Affairs
New Mexico State Land Office
New Mexico Game and Fish Department
New Mexico Municipal League

A mail questionnaire was distributed to about 75 irrigation water user associations and groups within the state.

B-026-NMEX - An Analytical Interdisciplinary Evaluation of the Utilization of the Water Resources of the Rio Grande Basin in New Mexico.

This project was designed to test the effects of transfers of water, land, and recreation on the economy of the several segments of the 400 mile long Rio Grande Valley from Colorado to Texas through New Mexico.

One of the major impacts of this study has been its influence on the state water plan. Information developed and questions raised by the various sub-phases of the project has either been used or produced modification in the plan as it is being developed. Because of the technical advisory committee's participation throughout the project, the results have been available prior to publication.

STATE'S CONTRIBUTION

Stucky Hall, a building to house the New Mexico Water Resources Research Institute, was completed in 1970. This building was built entirely with state bond money and is located on the New Mexico State University campus. The New Mexico Legislatures have appropriated the following amounts to the Institue for research support:

1970 - $104,000
1971 - $108,000
1972 - $113,000
1973 - $118,000

These funds are being used for matching funds and for state supported projects.

REGIONAL COOPERATION

The Institute is involved in two regional analysis of priority water resource problems: (1) Consortium of Water Institutes and Centers, Colorado River - Great Basin, including the states of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming, and (2) Southern Plains River Basin Region, Colorado, Arkansas, New Mexico, Louisiana, Oklahoma, Kansas, and Texas.

A regional proposal "Regional Water Management with Full Consumptive Use" has been submitted to OWRR in cooperation with the Texas Institute.

Contact has been made and a site visit arranged on July 6, 1973 for Mr. Willard C. Lewis, Special Assistant to the Secretary, Southwest Region, U. S. Department of the Interior, to visit our Institute and to discuss opportunities for consultation and collaboration with Interior field agencies.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. A-026-NMEX
NMSU Project No. 3109-138 and 3109-37
Agreement No. 14-31-0001- 3231
FCST-COWRR Research Category:

THE IMPACT OF WATER TECHNOLOGY ON THE HISTORY OF NEW MEXICO

Name and Location of University Where Project is Being Carried Out:

New Mexico Institute of Mining and Technology - Socorro, New Mexico

Proj. Began--Month: July ; Year: 1970 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
Paige W. Christiansen	Ph.D.	History
Susan Smith	B.A.	History

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
David M. Brown	B.S., M.S.	Geology and Hydrology
Vincent Chavez	undergraduate	History degree received in 1972-math
Catherine Clayton	undergraduate	History degree due 1973-basic science
Kevin Pearson	undergraduate	History major
Jesse Henderson	undergraduate	Computer Science
Kimberly Johnson	undergraduate	Mathematics
Roger Oase	undergraduate	Physics

A. Research Project Accomplishments

Collection of data relating to the historical processes involved in the quest for water resources in New Mexico from published sources, unpublished sources, government documents, and field observations. The results, when all of the material is synthesize, will be threefold:

1. A historical systhesis showing the role of water resource development as it related to the unfolding history of New Mexico. No such synthesis now exists.

2. A bibliography (anotated and critical) of materials relating to the history of water resources will be available to scholars and to laymen interested in water resource development.

3. Having the history will give to those in government or in the private sector a better understanding of the results of policy decisions in the past, cultural factors effecting those decisions, and a framework of precedent into which new policy decisions can be fitted.

The study shows, for example, that much of state and federal policy and expenditures on water resources have been in the areas of concentrated population or where commercial agriculture was able to absorb some of the cost. Similarly, application of scientific principles tended to follow the same pattern. Policy and expenditure and scientific application have lagged sadly in non-commercial areas, which, in New Mexico, means the Indian Pueblos and the Spanish village areas.

B. Publications

None

C. Project Status

The project is complete. A completion report is being printed.

D. Application of Research Results

Primary interest has been shown by hydrologists and geologists working in New Mexico, and by those state agencies involved in water resources work or evaluation.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. A-028-NMEX
NMSU Project No. 3109-39
Agreement No. 14-31-0001- 3231
FCST-COWRR Research Category:

SIMULATION OF COUPLED LEAKY AQUIFERS AND SURFACE-WATER SYSTEM

Name and Location of University Where Project is Being Carried Out:

New Mexico Institute of Mining and Technology - Socorro

Proj. Began--Month: July ; Year: 1970 | To Be Completed--Month: June ; Year: 1972

Principal Investigators	Degree	Discipline
Z. A. Saleem	Ph.D.	Groundwater Hydrology

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background

A. Research Project Accomplishments

Two types of models of ground water flow in multiaquifer systems were analyzed. In the first part of the completion report simulation of ground water flow in multiaquifer systems is developed. A system of nonlinear partial differential equations, isomorphic to ground water flow in the multiaquifer, are formulated in a finite difference form suitable for the line successive overrelaxation technique. The resulting system of differential equations is solved using an efficient algorithm. The algorithm serves as a means for solving the bit-ridiagonal system of differential equations representing flow in two aquifers simultaneously during only one iteration cycle. Storativity of the semi-confining layer can be considered indirectly or can be neglected. The results derived from the numerical simulator for the flow to wells in two coupled aquifers are in good agreement with analytical results for the system.

In the second part of the report, analytical models of steady ground water flow in a three-aquifer system are derived. The three-aquifer system consists of a valley area contining a shallow aquifer and a deep aquifer coupled through an aquitard, and a highland area containing an intake area aquifer. Four cases of the system are analyzed: in two cases, the vertical variations of

the hydraulic head in the shallow unconfined aquifer are assumed small; and for the other two cases, an approximate differential equation to describe the flow in the unconfined aquifer is presented. The analytical solutions were programmed for evaluation by a digital computer. The results show that a variation in the hydraulic characteristics of any one of the three aquifers affects the flow in all three aquifers and the leakage coefficient of the aquitard plays a key role in governing the flow in the system. The use of a weighted average depth of the flow profile facilitates the derivation of analytical solutions but its use yields results that are significantly different from the case where vertical variations can be neglected.

B. Publications

Paper on analytical models of steady ground water flow in a three-aquifer system accepted for publication. (Water Resources Research)

C. Project Status

Completed

D. Application of Research Results

Of potential use to organizations charged with water resource management, such as the Pecos Valley Artesian Conservancy District and the Interstate Stream Commission.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. A-030-NMEX
NMSU Project No. 3109-41
Agreement No. 14-31-0001- 3531
FCST-COWRR Research Category:

ENVIRONMENTAL CONTROLS ON GROUNDWATER CHEMISTRY:
I. THE EFFECT OF PHREATOPHYTES

Name and Location of University Where Project is Being Carried Out:

New Mexico Institute of Mining and Technology, Socorro

Proj. Began--Month: July ; Year: 1970 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
F. B. Titus	Ph.D.	Geology

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Charles E. Williams	M.S.	Geoscience
Daniel Blodgett	M.S.	Geoscience
Adel Baker	M.S.	Geoscience

A. Research Project Accomplishments

During the current fiscal year we have continued to study hydrologic and hydrochemical conditions at two phreatophyte groves in the Rio Grande valley near Socorro, one a mature cottonwood grove and the other a saltcedar grove. Data collected include water-level fluctuation, specific conductance of water, water chemistry, and the weather parameters that have allowed calculation of evaporation potential. Hydrologic and chemical data are obtained at 32 piezometers, divided equally between the two groves; the piezometers are in nests of four, with one piezometer bottoming at the water table and three bottoming at roughly 10-foot increments below the water. Each grove has a T-shaped array of nests, with nests separated by a few hundred yards.

Preliminary analysis of data indicates that specific electrical conductance (conductivity) of groundwater at all sample depths fluctuates markedly both diurnally and in response to longer-term factors. The diuranl changes are cyclic and have a magnitude of about 10 percent of the average conductivity.

The diurnal fluctuation of conductivity occurs in all piezometers in a nest, though the amplitude tends to decrease with depth, and the time of conductiv-

ity maxima and minima with respect to diurnal rise and fall of the water table varies rather regularly with depth. During daylight hours conductance is lowest. Our tentative conclusion is that at the water table conductivity changes are related to increased chemical concentration in the capillary zone (where most of the plant roots are located) coupled with induced upward flow due to water-table decline caused by transpiration. At night when the water table rises, it is suspected that the rise allows the concentrated water suspended in the capillary zone to be washed down into the zone of flowing groundwater, thereby causing an increase in conductivity of water sampled by the piezometers; this is particularly interesting in view of the fact that the normal diurnal water table rise is little more than 0.1 foot.

At depths of tens of feet below the water table this explanation can hardly apply because natural flow velocities are not sufficiently great to move shallow water to these depths at the required rate. A tentative explanation, which is not wholly satisfactory, may be that vertical components of gradient during daylight hours induce crossbedding flow bringing up less concentrated water from depth to the piezometers; whereas more nearly horizontal flow at night brings water to the piezometers that is more concentrated owing to the continuous dispersion and diffusion of salts downward from the water table.

B. Publications

None

C. Project Status

The project is complete and a completion report is being prepared.

D. Application of Research Results

None to date

E. Work Remaining and Progress Contemplated During the Next Year

Project is complete.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. 3109-49 A-038-NMEX NMSU Project No. Agreement No. 14-31-0001-3831 FCST-COWRR Research Category:	A STUDY OF THE CHEMICAL AND BIOLOGICAL CHARACTER OF RIO GRANDE WATER IN THE BOSQUE DEL APACHE REFUGE

Name and Location of University Where Project is Being Carried Out:

New Mexico Institute of Mining and Technology - Socorro, New Mexico

Proj. Began--Month: July ; Year: 1972 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
Dr. Donald K. Brandvold	Ph.D.	Biochemistry
Dr. James A. Brierley	Ph.D.	Microbiology
Dr. Carl J. Popp	Ph.D.	Inorganic Chemistry

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Don Baker, III	B.S., M.S.	Chemistry
Alan Branch		Biology
Donald Burns		Chemistry
Beatrice Cordova		Chemistry
David Davies	B.S.	Environmental Engineering

(See Attached Page)

A. Research Project Accomplishments

The project purpose was to study the effects of a waterfowl refuge on water quality using an interdisciplinary approach to monitor the physical, chemical, and biological character of the refuge. The study was undertaken on the Bosque del Apache Wildlife Refuge along the Rio Grande in Socorro County, New Mexico. A regular monthly monitoring program over the two-year study period was set up to collect and analyze water samples from eight points within the refuge. This was done to establish the base-line characteristics of the refuge waters and to enable detection of both seasonal and waterfowl-caused changes. The final results and conclusions are not yet available but will be presented in the Project Completion Report which is now in preparation. The types of water monitored were as follows; water entering the refuge, water leaving the refuge, Rio Grande water within the refuge which served as a control since it was not used in refuge management, swamp water, irrigation water, fishing pond water, and high-waterfowl-use temporary ponds. The large amount of data from the analyses has been computer-stored to facilitate handling of the data. The computer will: one, print out the data sheets by sampling station and date; perform regression analysis on the data to determine correlations; three, determine data averages and standard deviations for any time period within the study; and four, plot the data for a given station vs. time.

List of Student Assistants Employed in Project: 1971-1973

Student Assistants	Degree Held (if any)	Discipline or Academic Background
William Fetter		Mathematics
Christine Fox		Chemistry
Mark Johnson		Chemistry
David Jones, IV		Basic Sciences
Reland Kane	B.S.	Chemistry
Robert Knight		Computer Science
Etna Locklar		Computer Science
Michael Noce		Chemistry
Paul O'Neill		Geophysics
Navinghai Patel	B.S.	Chemistry
Bradley Phillip		Chemistry
Debra Rhodes		Environmental Science
Tom Robison		Chemistry
Charlotte Rogers	B.S.	Biology
Jerry Scott		Biology
Richard Tamura		Biology

The changes in water quality occurring in the waterfowl ponds have been determined. This is important since the ponds are emptied into the surface water system at the end of the waterfowl use season and the dilution effect on any contaminants will be determined as well as the fate of the nitrogeneous wastes produced by the waterfowl.

B. Publications

Baker, Don H., III, Carl J. Popp and Donald K. Brandvold, Student Paper entitled Mercury Uptake by Fish in Natural and Artificial Systems in "Proceedings of the Eighteenth Annual New Mexico Water Conference", New Mexico State University, Las Cruces, New Mexico. Paper presented April 5, 1973. "Proceedings" not yet published.

Popp, Carl J., Rollie Schafer, Don Baker, III, and Donald K. Brandvold, Mercury: Uptake by Fish from Low Concentrations in Natural Water, Submitted to Science, July 7, 1973.

Baker, Don H., III, "Mercury: Uptake by the Goldfish, Carassius auratus from Low Concentrations in Water and its Tissue Distribution", M.S. Thesis, Department of Chemistry, New Mexico Institute of Mining and Technology, Socorro, New Mexico, May 16, 1973.

Davies, David, "The Nitrogen Content of Water as a Result of Waterfowl Concentration on a Wildlife Refuge", M.S. Thesis in preparation.

We intent to publish the water quality and correlation results in appropriate journal(s) when the Project Completion Report is finished.

C. Project Status

The field work for the project was completed as of June 30, 1973. The data is now being computer-processed and the Project Completion Report is in preparation.

D. Application of Research Results

The results of this study will be available for use by the following agencies and individuals:

Office of Water Resources - The results of this study will be useful in two ways: one, since water in refuges of this type is generally reused, the refuge effects on the water will be known and measures can be taken to keep the quality sufficient for reuse; and two, the data can be used as a baseline or reference point for evaluating the relative quality of other similar waters in the arid southwestern part of the United States.

United States Department of the Interior - Data may help in regulation and operation of existing waterfowl refuges and in planning and development of new refuges.

Bureau of Sports Fisheries and Wildlife - Directly concerned with Waterfowl refuges.

Bosque del Apache National Wildlife Refuge - Socorro County, New Mexico. Since the study was conducted on this refuge, the refuge manager can use the results in planning future refuge operations.

Environmental Protection Agency - Since this agency is directly concerned with protection of our resources, this study will provide data for comparison with similar waters at the present time and serve as reference point for evaluating future water quality changes.

State of New Mexico Environmental Improvement Agency - The results of this study will provide information for regulation, control, and improvement of water quality in the Rio Grande which traverses the length of the state of New Mexico.

E. Work Remaining and Progress Completed During Next Year

Project completed June 30, 1973 - Data evaluation and completion report in progress.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. A-039-NMEX

NMSU Project No. 3109-50

Agreement No. 14-31-0001- 3831

FCST-COWRR Research Category:

HYDROLOGIC NUTRIENT CYCLE INTERACTIONS IN UNDISTURBED AND MAN-MANIPULATED ECOSYSTEMS (Watersheds)

Name and Location of University Where Project is Being Carried Out:

University of New Mexico - Albuquerque

Proj. Began--Month: July ; Year: 1972 | To Be Completed--Month: June ; Year: 73

Principal Investigators	Degree	Discipline
James R. Gosz	Ph.D.	Ecology

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Paul Krause	M.S.	Ecology
Wallace Covington	M.S.	Ecology

A. Research Project Accomplishments

The research involved natural levels of cations and NO_3 in stream water from a number of gaged watersheds having different vegetational communities. These communities ranged from alpine tundra and spruce-fir forests to pinyon-juniper forests. This range of communities also represents a range of environmental factors (i.e. temperature, precipitation, humidity, etc.). The bedrock of all watersheds is Embudo Granite.

Water quality differs in each of the watersheds. Concentrations increase as elevations decrease. In addition to an increase in concentration, variability also increases with a decrease in elevation. The reasons for the increase appear to be several. Increased evapotranspiration (concentration) can account for these increases. Evapotranspiration ranges from 63% to 98% on the watersheds. In fact, evapotranspiration could cause concentrations greater than those found. This suggests that there is some control, a dampening effect, exerted by the ecosystem. Evapotranspiration cannot explain the high concentration of Mg in one plot nor the high Ca, Mg, and Na concentrations in another watershed.

Discharge has been shown to affect concentrations of elements in stream water as well as total losses of elements from the watershed. The upper watersheds break the linear trend suggesting a dampening effect or control exerted by the ecosystem. In general, correlations between concentration and instantaneous discharge over the entire year are non-significant or negative for all cations. This is a result of the large size and mixture of communities on most of the watersheds. Precipitation is greater at the highest elevations of a watershed. Since cation concentrations are low at high elevations the relatively large volume of good quality water from the upper portions of a watershed dilutes concentrations normally found at the lower elevations causing negative correlations. Correlations of concentration and discharge on small watersheds (e.g. a small pure aspen watershed recently gaged) show a negative correlation for Na but significant positive correlations for K and NO_3. Potassium and NO_3 concentrations are affected by time of year also. Concentrations tend to be higher during winter months and low during summer months suggesting biological regulation. This agrees well with data from watersheds in New Hampshire and North Carolina.

Calcium concentrations are not correlated with discharge for the entire year but the relationship also seems affected by time of year. During months with snow cover the correlation is non-significant. During snow-free months a significant negative correlation exists.

On the higher watersheds Na exceeds Mg but the relationship gradually changes until at lower watersheds Mg exceeds Na. Anions also show a corresponding shift with the major changes between HCO_3 and SO_4. Streams seem to change from a relatively high Na and HCO_3 system at high elevations to a relatively high Mg and SO_4 system at low elevations. We are initiating research to identify casual factors.

The title of the research proposal includes water quality as affected by man-manipulated ecosystems. Although several treatments are planned, to date the only one applied has been very minor: replacing a poma ski lift along the south boundary of one watershed. The construction period was during September and October of 1972. Using the stream chemistry data from adjacent watersheds we are able to identify an additional loss of Ca and Mg from the watershed as a result of the construction. The additional Ca loss amounted to 25% of the total Ca lost during September and October and 2% of the total Ca lost during the year. The additional Mg loss was 3% of the total Mg lost during the year.

In summary, the year's research has developed new questions as well as answers. Stream chemistry definitely changes over the elevational gradient. Some of this change is no doubt physical (e.g. evapotranspiration, differential weathering rates, saturation) but there is sufficient evidence to suggest a direct biological control over water quality and/or indirect biological control involving reactions in soil.

B. Publications

A paper was presented at the 1973 AIBS Annual Meeting at the University of Mass. entitled "Nutrient Budgets for several Vegetation Types in New Mexico". An abstract of that paper has been published in Bull. Ecol. Soc. Amer. 54: 20-21.

C. Project Status

The current project funding with OWRR has been completed, however, research is continuing. A completion report will be submitted to OWRR.

D. Application of Research Results

Both the U. S. Forest Service and U. S. Geological Survey have indicated an interest in this work. Water quality can be a valuable tool in evaluating land management activities.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. A-040-NMEX

NMSU Project No. 3109-51

Agreement No. 14-31-0001- 3831

FCST-COWRR Research Category:

ANALYSIS OF NUTRIENT SUPPLIES FOR ALGAE IN ELEPHANT BUTTE RESERVOIR AND AN ANALYSIS OF MERCURIALS IN THE ELEPHANT BUTTE ECOSYSTEM

Name and Location of University Where Project is Being Carried Out:

University of New Mexico - Albuquerque

Proj. Began--Month: July ; Year: 1972 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
John D. Garcia	Ph.D.	Biology
David E. Kidd	Ph.D.	Biology
Gordon V. Johnson	Ph.D.	Biology

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Susan R. Mazarr		Senior biology major

A. Research Project Accomplishments

Nitrate nitrogen, total dissolved phosphate and ortho phosphate were determined on membrane filtered water samples collected monthly from July, 1972 through July, 1973 at a station near the dam and at stations representing the upper end of the Reservoir. Nitrate nitrogen ranged from 0.23-0.94 mg N/liter for both sampling stations. Total dissolved phosphate ranged from 0.058-1.4 mg P/liter near the dam and from 0.07-2.0 mg P/liter at the upper Reservoir stations. Separation of the total dissolved phosphates into ortho, organic and condensed forms at several times during the year indicated that virtually all the phosphate was in the ortho and organic forms and negligible condensed (poly) phosphate was present. This indicates that Elephant Butte Reservoir did not contain significant amounts of undegraded phosphate compounds derived from detergents. The percentage of the total dissolved phosphate in the ortho form ranged from 0-100% with a mean of 29% near the dam and from 1.5%-84% with a mean of 23% at the upper end of the Reservoir.

Arguments are given which attempt to account for concentration in some higher trophic level species. There appears to be evidence which suggests that mercury levels are related to seasonal conditions. A bioamplification scheme and concentration factors are presented which describe the status of mercury concentrations in existing trophic levels. Recommendations regarding the potential hazards of Elephant Butte fish to human health are discussed.

B. Publications

Ph.D. Dissertation: Garcia, John D. 1973. A Study of Mercurials in the Elephant Butte Reservoir ecosystem. University of New Mexico, Albuquerque.

C. Project Status

Project completed June 30, 1973. Completion report being prepared.

D. Application of Research Results

The results of the mercury distribution study at Elephant Butte Reservoir were reported by Dr. John Garcia to the Arizona-New Mexico Division of the American Fisheries Society in Farmington, New Mexico in February, 1973. The results and recommendations of the mercury study at Elephant Butte Reservoir have been circulated by television, radio and newspapers throughout the state of New Mexico. A graduate student from the Fisheries Section, Department of Animal, Range, and Wildlife Science, New Mexico State University has requested that the reports from this study be made available to the Fisheries Section. The results of this investigation should be of value to various state agencies including the New Mexico Department of Game and Fish and the Environmental Improvement Agency as well as several federal agencies.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. A-041-NMEX
NMSU Project No. 3109-53
Agreement No. 14-31-0001- 3831
FCST-COWRR Research Category:

WATER RESOURCES PROBLEMS AND RESEARCH NEEDS OF NEW MEXICO

Name and Location of University Where Project is Being Carried Out:

New Mexico State University - Las Cruces

Proj. Began--Month: July ; Year: 1972 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
Bobby J. Creel	M.S.	Agricultural Economics

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background

A. Research Project Accomplishments

An inventory of the agencies, institutions, and organizations with water-related research interest has been completed. This inventory is used not only for the project, but by the Institute in its information dissemination activities. Key personnel of the following agencies have been interviewed to determine their water research needs and problems:

New Mexico State Forestry Department
North Central New Mexico Economic Development District
New Mexico Department of Development
Bureau of Land Management
New Mexico State Engineer Office
New Mexico State Planning Office
U.S. Army Corps of Engineers
Bureau of Reclamation
Middle Rio Grande Council of Governments
Soil Conservation Service
U.S. Geological Survey

Bureau of Indian Affairs
New Mexico State Land Office
New Mexico Game and Fish Department
New Mexico Municipal League

A mail questionnaire was distributed to about 75 irrigation water user associations and groups within the state.

B. Publications

None

C. Project Status

The project will continue into the next fiscal year. A number of key agency personnel have yet to be interviewed, due to scheduling difficulties.

D. Application of Research Results

All agency personnel interviewed have indicated a keen interest in the project. Cooperation has been excellent. The results will be used by the agency people in their planning and cooperative programs. The primary users will be the Institute and project investigators in developing a research program aimed at solving the priority water research problems of the state.

E. Work Remaining, and Progress Contemplated During Next Year

An additional 15-20 key agency personnel will be interviewed in the next year. This will complete the survey. The information developed will be compiled and priority water research needs developed with the aid of the agency personnel.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. A-042-NMEX

NMSU Project No. 3109-52

Agreement No. 14-31-0001- 3831

FCST-COWRR Research Category:

MEASUREMENT OF GROUNDWATER FLOW USING AN IN-SITU THERMAL PROBE

Name and Location of University Where Project is Being Carried Out:

New Mexico Institute of Mining and Technology - Socorro

Proj. Began--Month: July ; Year: 1972 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
Marshall Reiter	Ph. D.	Geophysics
Allan Sanford	Ph. D.	Geophysics

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Thomas Croxell	M.S.	Geophysics
Mark Dee	M.S.	Geophysics
Rodger Smith	B.S.	Geophysics

A. Research Accomplishments

A laboratory calibration of the thermal probe has been completed

B. Publications

None

C. Project Status

Completed and completion report turned in.

D. Application of Results

None until field calibration is completed.

E. Work Remaining, and Progress Contemplated During Next Year.

A field calibration program will continue under a new project.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. B-015-NMEX
NMSU Project No. 3109-109
Agreement No. 14-31-0001-3110
FCST-COWRR Research Category:

IRRIGABILITY CLASSIFICATION OF NEW MEXICO LANDS AS A GUIDE FOR WATER IMPORTATION - PHASE II

Name and Location of University Where Project is Being Carried Out:

New Mexico State University - Las Cruces

Proj. Began--Month: July ; Year: 1969 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
J. U. Anderson	Ph.D.	Soil Classification and Mineralogy
H. J. Maker	B.S.	Soil Classification

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background

A. Research Project Accomplishments

Reports dealing with the nature and distribution of soil associations, the nature and properties of these soils, and the suitability of these soils for irrigation and various other uses have been prepared for Colfax, Union, McKinley, Valencia, and Taos Counties, and the existing report for San Juan County has been revised. A map of suitability of New Mexico Lands for Irrigation has been reviewed in this office and by the Soil Conservation Service, the U.S. Bureau of Reclamation, and the Bureau of Indian Affairs, and is now being printed for inclusion in the New Mexico Water Plan and in a final report for this project.

B. Publications

Maker, H. J., J. M. Downs, and J. U. Anderson. 1972. Soil Associations and Land Classification for Irrigation, Sierra County. N. Mex. Agr. Exp. Sta. Res. Rpt. 233.

Maker, H. J., J. M. Downs, and J. U. Anderson. 1972. Soil Associations and Land Classification for Irrigation, Socorro County. N. Mex. Agr. Exp. Sta. Res. Rpt. 234.

Maker, H. J., P. S. Derr, and J. U. Anderson. 1972. Soil Associations and Land Classification for Irrigation, Otero County. N. Mex. Agr. Exp. Sta. Res. Rpt. 238.

Maker, H. J., G. W. Anderson, and J. U. Anderson. 1972. Soil Associations and Land Classification for Irrigation, Colfax County. N. Mex. Agr. Exp. Sta. Res. Rpt. 239.

Maker, H. J., W. B. Gallman, V. G. Link, and J. U. Anderson. 1973. Soil Associations and Land Classification for Irrigation, Guadalupe County. N. Mex. Agr. Exp. Sta. Res. Rpt. 246.

Maker, H. J., H. B. Maxwell, and J. U. Anderson. 1973. Soil Association and Land Classification for Irrigation, Union County. N. Mex. Agr. Exp. Sta. Res. Rpt. 250.

C. Project Status

Research in this project has been completed. However, reports of Rio Arriba and McKinley Counties are still in press, and those for Taos and Valencia Counties and a final report for the State are being reviewed.

D. Application of Research Results

This work has continued to show large areas of land suitable in irrigation, particularly in McKinley and Valencia Counties. It has also shown large areas which are not suitable for irrigation, even though some appear suitable on the basis of superficial observation. The demand for these reports continues to be high, and we are receiving many reports of use for broad area land use studies and for generalized information about soil conditions. This study is providing the information about suitability of soils for irrigation for the New Mexico Water Plan which is being provided by the U.S. Bureau of Reclamation.

E. Work Remaining, and Progress Contemplated During Next Year

Publication of the final four counties and a summary report for the State is planned.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. B-026-NMEX

NMSU Project No. 3109-117

Agreement No. 14-31-0001- 3617

FCST-COWRR Research Category:

AN ANALYTICAL INTERDISCIPLINARY EVALUATION OF THE UTILIZATION OF THE WATER RESOURCES OF THE RIO GRANDE IN NEW MEXICO

Name and Location of University Where Project is Being Carried Out:

New Mexico State University - Las Cruces, University of New Mexico - Albuquerque, New Mexico Institute of Mining and Technology - Socorro

Proj. Began--Month: July ; Year: 1971

To Be Completed--Month: Dec. 31 ; Year: 1973

Principal Investigators	Degree	Discipline
Robert R. Lansford	Ph.D.	Agricultural Economist
Shaul Ben-David	Ph.D.	Economist
Thomas G. Gebhard, Jr.	Ph.D.	Hydrologist
Bobby J. Creel	M.S.	Agricultural Economist
Willem Brutsaert	Ph.D.	Hydrologist

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Fred Roach	Ph.D.	Economics - UNM
Shao-Chih Way	Ph.D.	Hydrology - NMIMT
Gary L. Richardson	M.S.	Civil Engineering - NMSU
Numa Imara	Ph.D.	Civil Engineering - NMSU
Don D. Jones	Ph.D.	Civil Engineering - NMSU
Jesus Najera	Ph.D.	Hydrology - NMIMT
William R. Porter	M.S.	Economics - UNM
David Mishaeli	Ph.D.	Economics - UNM
C. L. Edwards	Ph.D.	Geophysics - NMIMT
Mohammed Q. Islam	Ph.D.	Civil Engineering - NMSU
Abdul Mohammed	Ph.D.	Civil Engineering - NMSU
Hugh Ryan	M.S.	Industrial Engineering - NMSU
John Uxer	M.S.	Industrial Engineering - NMSU
Willman Lim	M.S.	Industrial Engineering - NMSU
Mohd Sualeh Qurashi	M.S.	Industrial Engineering - NMSU

A. Research Project Accomplishments

An interdisciplinary approach to the solution of the water resource problems of the Rio Grande region in New Mexico was made possible by the integration of hydrology, geology, and engineering with economics. Research procedures developed to carry out this study were closely coordinated by the investigators to achieve the primary objective of evaluation of the social and economic impacts of alternative water-use policies.

A socio-economic model was developed to represent the New Mexico economy, with special emphasis placed upon the Rio Grande region. Inputs into the socio-economic model were obtained from separate studies covering the hydrological, agricultural, municipal, and industrial areas.

Three sets of alternatives were considered: 1) growth without a water constraint; 2) growth, holding surface water constraint; 3) growth, holding both surface and ground water constraint.

Without a water constraint, both production and depletions are expected to exhibit the largest increase (59.2 percent and 49.6 percent, respectively). When a surface water constraint is imposed, the value of production is reduced by only $5.6 million in the year 2000, and by $14.2 million in 2020; water depletions are expected to decrease about 27 percent by 2020. When a total water constraint is imposed, the value of production is decreased $2.7 million below that expected when using only a surface water constraint, and water depletions are reduced only slightly.

B. Publications

1. An Analytical Interdisciplinary Evaluation of the Utilization of the Water Resources of the Rio Grande in New Mexico, Robert R. Lansford, Shaul Ben-David, Thomas G. Gebhard, Jr., Willem Brutsaert, and Bobby J. Creel, New Mexico Water Resources Research Institute Report No. 020, March 1973.

2. An Analytical Interdisciplinary Evaluation of the Utilization of the Water Resources of the Rio Grande in New Mexico, Upper Rio Grande Region, Robert R. Lansford, Shaul Ben-David, Thomas G. Gebhard, Jr., Willem Brutsaert, and Bobby J. Creel, New Mexico Water Resources Research Institute Report No. 021 May 1973.

3. An Analytical Interdisciplinary Evaluation of the Utilization of the Water Resources of the Rio Grande in New Mexico, Middle Rio Grande Region, Robert R. Lansford, Shaul Ben-David, Thomas G. Gebhard, Jr., Willem Brutsaert, and Bobby J. Creel, New Mexico Water Resources Research Institute Report No. 022, May 1973.

4. An Analytical Interdisciplinary Evaluation of the Utilization of the Water Resources of the Rio Grande in New Mexico, Socorro Region, Robert R. Lansford, Shaul Ben-David, Thomas G. Gebhard, Jr., Willem Brutsaert, and Bobby J. Creel, New Mexico Water Resources Research Institute Report No. 023, May 1973.

5. An Analytical Interdisciplinary Evaluation of the Utilization of the Water Resources of the Rio Grande in New Mexico, Lower Rio Grande Region, Robert R. Lansford, Shaul Ben-David, Thomas G. Gebhard, Jr., Willem Brutsaert, and Bobby J. Creel, New Mexico Water Resources Research Institute Report No. 024, May 1973.

6. "An Interpretation of Water Use Data for the Rio Grande in New Mexico," Roach, F., and Shaul Ben-David, Proceedings of the Seventeenth Annual New Mexico Water Conference, New Mexico Water Resources Research Institute Report No. 007, New Mexico State University, August 1972, pp. 66-95.

7. "One Dimensional Dispersion in Steady-Nonuniform Flows," Numa Imara (Ph.D. Dissertation), Department of Civil Engineering, New Mexico State University, Las Cruces, New Mexico, December 1970, 172 pp. (unpublished).

8. One Dimensional Dispersion in Steady-Nonuniform Flows, Numa Imara and G. B. Gebhard, Engineering Experiment Station Report No. 69, New Mexico State University, Las Cruces, New Mexico, December 1970, 172 pp.

9. "An Economic Classification of the Irrigated Cropland in the Lower Rio Grande Basin, New Mexico," B. J. Creel, (Master's thesis), Department of Agricultural Economics, New Mexico State University, Las Cruces, New Mexico (unpublished), July 1971, 137 pp.

10. "Water Table Investigation in the Mesilla Valley," G. L. Richardson, (Master's thesis), Department of Civil Engineering, New Mexico State University, Las Cruces, New Mexico (unpublished), December 1971, 206 pp.

11. "Preliminary Ground Water Model of the Mesilla Valley," G. L. Richardson and T. G. Gebhard, Jr., Proceedings of the Seventeenth Annual New Mexico Water Conference, New Mexico Water Resources Research Institute Report No. 007, New Mexico State University, August 1972, pp. 44-65.

12. Water Table Investigations in the Mesilla Valley, G. L. Richardson, T. G. Gebhard, Jr., and W. F. Brutsaert, Engineering Experiment Station Technical Report 76, New Mexico State University, Las Cruces, New Mexico, March 1972, 206 pp.

C. Project Status

The project has been completed and a completion report submitted. All that is lacking is the printing of New Mexico Water Resources Research Institute Reports Nos. 021, 022, 023, and 024.

D. Application of Research Results

One of the key elements of this study was the use of a technical advisory committee composed of representatives from local, state and federal agencies. As data became available it was passed on to members of the technical advisory committee. Through the advisory committee some preliminary results have been used as inputs into the New Mexico State Water Plan; the "Upper Rio Grande Basin Water and Related Land Resources" by the U. S. Department of Agriculture River Basin Planning Group in Albuquerque; the Middle Rio Grande Council of Governments in their inventory of resources; U. S. Geological Survey, in the ground water investigation of the Mesilla Valley; Bureau of Reclamation in constructing enterprise budgets for the Upper Rio Grande Basin in connection with the San Juan-Chama Diversion.

The New Mexico Dairy Association has used the results of this project as a guide in determining the relocation of dairies in the Rio Grande Basin of New Mexico. Presently the dairies are located in the metropolitan area of Albuquerque. They would prefer to relocate in a rural area with sufficient water and feeds available. They are using the results of this study in making decisions on where to relocate.

E. Work Remaining

The only work remaining is the publication of New Mexico WRRI Reports 021, 022, 023, and 024. A manuscript is being prepared to submit a journal article to the Journal of Natural Resources.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. R-027-NMEX
NMSU Project No. 3109-120
Agreement No. 14-31-0001- 3618
FCST-COWRR Research Category:

A COMPARISON OF RATES OF WATER LOSS, THROUGH TRANSPIRATION OF SEVERAL SOUTHERN NEW MEXICO PHREATOPHYTE SPECIES

Name and Location of University Where Project is Being Carried Out:

New Mexico State University - Las Cruces

Proj. Began--Month: July ; Year: 1971 | To Be Completed--Month: Dec. 31 ; Year: 1972

Principal Investigators	Degree	Discipline
Gary L. Cunningham	Ph.D.	Botany

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Helen G. Wolfe	M.S.	Biology
Joseph G. Frasier	M.S.	Biology

A. Research Accomplishments

The research performed involved the development and use of a method of estimating transpirational water use by riparian plant communities. The method involves the development and use of mathematical models to predict transpiration rates on a leaf area basis from environmental data. These models were used in conjunction with leaf area estimates for a study stand to evaluate transpirational water use. The results indicate that differences exist among species. Species which are found in less disturbed stands tend to be much more conservative in their transpirational water use.

B. Publications

Manuscripts are currently being prepared for publication.

C. Project Status

The project has been completed and a completion report submitted.

D. Application of Results

The results of the project have not yet been applied.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. B-029-NMEX

NMSU Project No. 3109-132

Agreement No. 14-31-0001- 3619

FCST-COWRR Research Category:

UTILIZATION OF WATER IN A SEMI-ARID REGION

Name and Location of University Where Project is Being Carried Out:

New Mexico State University, Plains Branch Station, Clovis, New Mexico

Proj. Began--Month: July ; Year: 1971 | To Be Completed--Month: June ; Year: 1975

Principal Investigators	Degree	Discipline
H. D. Fuehring	Ph.D	Agronomy (soils)

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
None		

A. Research Project Accomplishments

To date, establishment of microwatersheds (25 to 75 percent of total area) for the purpose of harvesting rainwater for adjacent growing beds has resulted in very little crop yield increase (based on total area). 1971 was very dry during the first half with little opportunity for water harvest. The following months were wetter than normal with all plots receiving considerable moisture. During the past year (up to June 15, 1973), rainfall has been almost double the normal (15.9 inches) annual rainfall and again there has been little opportunity for differences. Preliminary work in 1969 and 1970 indicated some advantage for water harvest on grain sorghum and it is likely that a return to more normal rainfall patterns will show effects. The experiment must be run for several years in order to adequately sample the various seasonal climatic differences.

One year's results indicates it may be practical to use watershed areas wide enough to crop alternate years to wheat-fallow with continuous row crops grown in adjacent beds. However, 1972-73 has been extremely wet and further work will be required.

Sunflowers have shown considerable potential as a dryland summer row crop in the area.

It has been established that herbicides (atrazine and propazine) can be sprayed on watershed ridges to control weeds without adversely affecting yields of wheat, barley, or sunflowers.

Antitranspirant spray (atrazine at low rates) on grain sorghum increased grain yield considerably under conditions of high nitrogen application but decreased yields where nitrogen was low. More response to anti-transpirants would be expected in a dry year.

B. Publications

None

C. Status of Project

Two years work has been completed. The 1973 crops have been established.

D. Application of Research Results

Results will be needed when, or if, irrigation wells become depleted of water and area reverts to dryland farming. Principles involved will be applicable to other semiarid regions or for land now being dry-farmed in the area.

E. Work Remaining, and Progress Contemplated During Next Year

Crops for 1973 have been established and are growing well. These crops will be harvested and the 1974 crops established during next fiscal year.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. B-032-NMEX
NMSU Project No. 3109-139
Agreement No. 14-31-0001- 3620
FCST-COWRR Research Category:

ANALYSIS OF WATER CHARACTERISTICS OF MANUFACTURING INDUSTRIES AND THEIR ADAPTABILITY TO SEMI-ARID REGIONS

Name and Location of University Where Project is Being Carried Out:
New Mexico State University - Las Cruces
University of New Mexico - Albuquerque

Proj. Began--Month: July ; Year: 1971
To Be Completed--Month: Oct. ; Year: 1973

Principal Investigators	Degree	Discipline
Shaul Ben-David	Ph.D	Economics
Harry G. Folster	Ph.D.	Chemical Engineering

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Jerry Strange	B.S.	Chemical Engineering
Wayne Dunlap	B.S.	Chemical Engineering
Hsien-Yen Isao	B.S.	Chemical Engineering
Roger Melton	B.S.	Chemical Engineering
James Doty		Economics
Leland Griffin	B.S.	Chemical Engineering
Naheed Hassein	B.S.	Industrial Engineering
Judy Nelson	B.S.	Economics

A. Research Project Accomplishments

A study of water-using industries was undertaken to determine their potential for locating in semi-arid regions and to rank these industries by their favorable impact on the area. To achieve this end it was necessary to look at specific industries, their specific processes, and the engineering and economic restraints that determine water use. Because of the time limitations and the detailed nature of the analysis necessary, only certain heavy water using industries could be considered. Four industries were selected: petroleum refining, coal gasification, textile finishing, and pulp and paper production. Several criteria were used in making this selection. First priority was given to industries with a high likelihood of locating in New Mexico either due to natural resources or close proximity to markets. Second, industries were chosen which showed a large diversity in water use patterns and substitution choices. For example, petroleum processing uses 97 percent of its water requirements for cooling purposes while 85 percent of the water uses in the textile industry are process oriented. Another major consideration was the type of aqueous effluents and the potential for recovery of useable water.

B. Publications

None

C. Project Status

The present status of the project finds the petroleum processing segment essentially complete, coal gasification and the textile processing sections being evaluated, while the necessary information for the pulp and paper industry is still being collected.

D. Application of Research Results

Interest in a study of this nature has been expressed by state officials involved in determining the impact of industry upon the economy and environment of New Mexico. It is expected this report will serve as a model for groups making a determination of what types of water using industry to attempt to bring into semi-arid regions and, in particular, New Mexico.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. B-037-NMEX

NMSU Project No. 3109-142

Agreement No. 14-31-0001- 3951

FCST-COWRR Research Category:

AN INTERDISCIPLINARY ANALYSIS OF THE WATER RESOURCES OF THE HIGH PLAINS OF NEW MEXICO

Name and Location of University Where Project is Being Carried Out:

New Mexico State University - Las Cruces
New Mexico Institute of Mining and Technology - Socorro

Proj. Began--Month: July ; Year: 1972

To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
Robert R. Lansford	Ph.D.	Agricultural Economics
Willem Brutsaert	Ph.D.	Hydrology
Frank B. Titus	Ph.D.	Geohydrology
Bobby J. Creel	M.S.	Agricultural Economics

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Charles M. Hudson	B.S.	Agricultural Economics - NMSU
Roger D. Latham	M.S.	Agricultural Economics - NMSU
George Hoffman	B.S.	Hydrology - NMIMT
Adan Flores	B.S.	Hydrology - NMIMT
Walter Loo	B.S.	Hydrology - NMIMT

A. Research Project Accomplishments

Data has been collected to generate a mathematical ground water model on a township grid basis for the area of the High Plains of New Mexico south of the Canadian River. Final computer runs are currently being carried out for this section. The data compilation has been immense. The project has been slowed because most of the data in the area north of the Canadian River is in an unpublished form. Care has been taken in obtaining the necessary unpublished data because of increased state interest in the High Plains of New Mexico for the State Water Plan.

B. Publications

None

C. Project Status

The project will continue until December 31, 1973 without additional funds.

D. Application of Research Results

None at present, but some input is expected into the State Water Plan.

E. Work Remaining, and Progress Contemplated

The ground water model will be completed and incorporated into an economic model of the High Plains. The area south of the Canadian River will be analyzed in terms of a linear programming model of the region's economy, and the area north of the Canadian River will be similarly analyzed. Two publications are expected to be completed by December 31, 1973, one for the region south of the Canadian River and one for the region north of the Canadian River.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. B-038-NMEX 3109-140

NMSU Project No.

Agreement No. 14-31-0001-3914

FCST-COWRR Research Category:

AQUIFER PARAMETERS BY A CHEMICAL TRACER TECHNIQUE

Name and Location of University Where Project is Being Carried Out:

New Mexico Institute of Mining and Technology, Socorro, New Mexico 87801

Proj. Began--Month: July ; Year: 1972 | To Be Completed--Month: June ; Year: 1974

Principal Investigators	Degree	Discipline
A. Mercado	Ph.D.	Geochemistry
G. Billings	Ph.D.	Geochemistry
G. W. Gross	Ph.D.	Geophysics
V. LeFebre	Ph.D.	Chemistry

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Tom Neff		Computer Science
Larry Holt	B.S. - Chemistry M.S. - Geology	Geochemistry

A. Research Project Accomplishments

A kinetic model for the dissolution of multimineral assemblages was derived with special emphasis on the simultaneous dissolution of calcite, dolomite, and gypsum in carbonate aquifers. Observed supersaturation of ground water samples with respect to calcite and dolomite is explained by kinetic competition among dissolving minerals. The validity of the kinetic model was verified by laboratory experiments involving the dissolution of calcite, gypsum, and calcite plus gypsum.

A general differential equation, describing the dissolution of minerals and the transport of their products in porous media, was derived and simplified. The numerical solution of the equation, which represents the hydrogeochemical model of a given aquifer, is based on the transformation of aquifer space coordinates into time coordinates of "tracing-points" moving along ground water streamlines, followed by an inverse transformation which yields theoretical water quality maps.

The model was then computerized and verified with the experimental data.

Next, the applicability of the computerized model was tested with hydrogeochemical data from the limestone aquifer of central Florida. This aquifer was chosen because of its relatively straightforward hydrological conditions and because it has been extensively studied by hydrological, chemical, and Carbon 14 dating methods. It was concluded that curves of chemical composition vs. age, (obtained from hydrologic computations) in one part of the aquifer, can be successfully applied to other parts of the same aquifer where only chemical analyses are available. Available Carbon 14 data in this aquifer were then compared with the chemical ages and shown to deviate significantly from hydrologic estimates. This deviation was explained on the basis of dissolution-precipitation kinetics.

Application of this model to the Roswell basin has met with only partial success. Difficulties were encountered because of the greater complexity of the Roswell aquifer system (leakage between different members, disturbance by irrigation returns, mineralogical complexity); lack of suitable chemical (water quality) data; very high rates that invalidate some of the mathematical assumptions of the model. As a consequence, the agreement between chemical ages and tritium dating ages is poor (for discussion of the latter see Rabinowitz and Gross, WRRI Report 016, 1972). The results do, however, very clearly show the direction to be taken in the second phase of the study.

B. Publications

A. Mercado: The Kinetics of Mineral Dissolution in Aquifers and Their Use For Hydrologic Investigations. Ph.D. Dissertation. New Mexico Institute of Mining and Technology, Socorro, 1972.

C. Project Status

A kinetic hydrogeochemical model has been developed for the Roswell ground water aquifer. Present work is aimed at improving the agreement between predictions based on the model and field measurements. Also the mathematical development of the model has been clarified.

Field measurements are being made to determine the chemical composition of the ground water throughout the Roswell basin and in particular in the recharge area on the west side of the basin. These measurements are needed to both calibrate the model and to supply field data against which model predictions can be compared. Techniques have been developed for the measurement of H^+, Ca^{++}, and HCO^-_3 in the field.

Soil samples taken from various locations and depths in the field are leached in the laboratory to determine the characteristic depths at which the recharge water is saturated with respect to calcite and gypsum.

Armored calcite crystals which form the druse linings of vugs found in core samples from the basin are tested to determine the calcite precipitation rate in the aquifer.

In the original mathematical development of the model, certain assumptions had to be made in order to arrive at an equation describing the chemical composition of the ground water as a function of distance traveled along a streamline in the aquifer. This equation has been rederived without using any arbitrary assumptions and is shown to be true in the absence of dispersion for all flow conditions.

D. Application of Research Results

This work has not reached the stage where it could be readily applied.

E. Work Remaining and Progress Contemplated During Next Year

The previously described field and laboratory measurements will be continued. Field determinations will be expanded to include chloride and sulfate ions using potentiometric techniques that are now being developed. In addition, attempts will be made to determine transient chemical changes in the ground water caused by pumping. These changes will be measured in the well being pumped and in wells adjacent to the pumping well.

The mathematical model will be generalized to include hydrodynamic dispersion. The aquifer will be modelled as a limestone and dolomite continuum containing discrete deposits of gypsum and anhydrite. Ground water, after passing through an anhydrite or gypsum deposit, will lose calcium by precipitation on the calcite vug linings. The increased sulfate ion concentration will be diluted by hydrodynamic dispersion. Parameters characterizing the dispersion process will be inferred from the transient chemical changes measured in the field.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. C-4060

NMSU Project No. 5700-311

Agreement No. 14-31-0001- 9012

FCST-COWRR Research Category:

REDUCTION OF PEAK WATER CONSUMPTION IN URBAN AREAS

Name and Location of University Where Project is Being Carried Out:

New Mexico State University, Las Cruces

Proj. Began--Month: July ; Year: 1972

To Be Completed--Month: June ; Year: 1974

Principal Investigators	Degree	Discipline
D. J. Cotter	Ph.D.	Horticulture
D. B. Croft	Ph.D.	Psychologist
J. W. Clark	C.E.	Sanitary Engineer
B. R. Corley	B.S.	Horticulture

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
J. T. Hughes	M.S.	Botany
Joyce Blanton	M.S.	Education
Elbert Graves	B.S	Biology
Fabian Chavez, III	B.S.	Horticulture

A. Research Project Accomplishments

The major thrust of activities has been upon identifying salient attributes of residental landscapes which can be rated by observers and are related to the esthetic quality of the landscape.

A survey of the literature was completed in the fields of art, landscape design, architecture, and psychology in order to find relevant publications which provide a research base for constructing the observation instrument. Several sources were identified and a number of basic constructs were used in guiding the generation of specific items that can be rated by observers.

In summary, the progress to date on the development of the Residential Landscape Esthetics Observation instrument has been focused upon identifying the attributes of landscapes which are rateable and provide breadth to adequately represent the domain of landscape beauty.

B. Publications

Chavez, Fabian III. Landscape and Water Usage. Paper presented to American Society for Horticultural Science, St. Paul, Minn., August 28, 1972.

Chavez, Fabian III and D. J. Cotter. A Study of Water Used on Urban Landscapes. Paper presented to New Mexico Water Conference, April 6, 1973. Proceedings to be published.

C. Project Status

The project will continue through August 31, 1974.

D. Application of Research Results

The project has only been operating ten months and it is too early for results to be usable.

E. Work Remaining, and Progress Contemplated During Next Year

Specific objectives remaining are:

1. To evaluate techniques for reducing aggregate consumptive water use of landscape plantings.

2. To comparatively evaluate the esthetic characteristics of water saving landscape plans.

3. To quantitatively determine the effect of water conservation practices on water consumptive use of landscapes encompassing varying degrees of water saving.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No.

NMSU Project No. GLM - 5700-308

Agreement No. 14-31-0001-

FCST-COWRR Research Category:

QUALITY AND QUANTITY OF RETURN FLOW AS INFLUENCED BY TRICKLE AND SURFACE IRRIGATION

Name and Location of University Where Project is Being Carried Out:

New Mexico State University - Las Cruces

Proj. Began--Month:_____; Year:_____ | To Be Completed--Month:_____; Year:_____

Principal Investigators	Degree	Discipline
Peter J. Wierenga	Ph.D.	Soil Physics
Ted C. Patterson	M.S.	Agricultural Engineering

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Don McClanahan	B.S.	Agricultural Engineering
Ron van de Pol	B.S.	Soil Science
Bill Hackett	B.S.	Agronomy
Susan Gomez	B.S.	Chemistry
Fran Hackett	B.S.	Mathematics

A. Research Project Accomplishments

The first year of a three-year study on the quality and quantity of drainage return flow as influenced by trickle and surface irrigation was completed.

Cotton yields were not significantly affected by the efficiency of the surface irrigation system. The differences in yield due to percent depletion were small, although there appeared to be a trend toward higher yields with increasing percent depletion. Cotton yields from the trickle plots were considerably higher than from the surface irrigated plots, and less water was used per unit of cotton produced.

Measurements of soil salinity in the surface plots showed no significant effect as a result of irrigation efficiency. It appears that even the 100 percent efficiency treatment had adequate leaching of salts out of the soil profile. Movement of salts around the trickle system emitters was monitored.

Measurements of the hydraulic gradients below the root zone also showed a downward gradient of all surface irrigated plots during the growing season, indicating seepage losses from all treatments. The quality of the water percolating to the subsoil varied greatly from plot to plot. The average salt content of the deep percolation water was about 10X as high as in the applied irrigation water.

B. Publications

Wierenga, P. J. and T. C. Patterson. 1973. Irrigation return flow studies in the Mesilla Valley. In Managing Irrigated Agriculture to Improve Water Quality. Proceedings National Conference on Managing Irrigated Agriculture to Improve Water QuaLity. May 16-18, 1972.

Wierenga, P. J. 1973. Irrigation management and its effect on the quality of drainage return flow. Abstract in Science and Man in the Americas, Desert and Arid Lands Central Theme, AAAS, Mexico City, June 20-July 4, 1973.

C. Project Status

Not completed.

D. Application of Research Results

EPA, Bureau of Reclamation

E. Work Remaining, and Progress Contemplated During Next Year

Two more growing seasons need to be completed on this project.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No.

NMSU Project No. 3109-134

Agreement No. 14-31-0001-

FCST-COWRR Research Category:

CROPLAND USES AND AGRICULTURAL WATER DEPLETIONS IN NEW MEXICO

Name and Location of University Where Project is Being Carried Out:

New Mexico State University - Las Cruces

Proj. Began--Month: July ; Year: 1972 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
Robert R. Lansford	Ph.D.	Agricultural Economics
Bobby J. Creel	M.S.	Agricultural Economics

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Roger D. Latham	M.S.	Agricultural Economics

A. Research Project Accomplishments

A survey was conducted to determine the use of irrigated cropland in 1972, in cooperation with the Statistical Reporting Service, Soil Conservation Service, and Agricultural Stabilization and Conservation Service (all of the U.S. Department of Agriculture), New Mexico Cooperative Extension Service, New Mexico State Engineer Office, and the New Mexico State Department of Agriculture.

The major irrigated crops in New Mexico in 1972 were: alfalfa, 235,412 acres; sorghum, 211,840 acres; and cotton, 158,400 acres. Relative to the 1971 planted acreage, alfalfa and cotton increased by 4,000 acres and sorghum decreased by 17,600 acres. These three crops accounted for approximately 48 percent of the total cropland in the state in 1972.

The diversions and depletions for irrigation water in New Mexico were estimated by the Blaney-Criddle method as used by Henderson and Sorensen. There were 1,036,270 cropped irrigated acres in 1971. The consumptive irrigation requirements during 1971 were approximately 1.5 million acre-feet; incidental

depletions were approximately 171,000 acre-feet; and total depletions, approximately 1.7 million acre-feet. The total diversions were approximately 3.1 million acre-feet, or 3.05 acre-feet per cropped acre.

In 1972 there were 1,036,920 cropped irrigated acres which was an increase of only 650 acres. Therefore, the consumptive irrigation requirements for 1972 were very similar but slightly lower than those requirements of 1971. The irrigation requirements decreased by about 1,100 acre-feet and the total depletions increased by about 7,000 acre-feet relative to 1971. This was due to the increased average precipitation in the state during 1972. The average precipitation in New Mexico in 1972 was 16.52 inches and in 1971 the average precipitation was 13.2. This average increase of 3.3 inches would explain the decrease in consumptive irrigation requirements. The change in the crop mix from 1971 to 1972 and the slight acreage increase would also explain the changes in the requirements and depletions.

B. Publications

Lansford, Robert R. and Roger D. Latham, "Planted Cropland Acreage in New Mexico in 1971 and 1972," New Mexico Agriculture--1972, New Mexico Agricultural Experiment Station Research Report___, New Mexico State University, Las Cruces, New Mexico (at the editor's).

Lansford, Robert R., Roger D. Latham, and Bobby J. Creel, "Irrigation Water Diversions and Depletions," New Mexico Agriculture--1972, New Mexico Agricultural Experiment Station Research Report____, New Mexico State University, Las Cruces, New Mexico (at the editor's).

C. Project Status

The project has been extended for one year. All work has been completed for the current fiscal year except for the publication which is at the editor's but should be available in July or August.

D. Application of Research Results

The Statistical Reporting Service of the U.S. Department of Agriculture and the New Mexico State Department of Agriculture use the data in preparing state and county estimates of agricultural crops in New Mexico. Data generated from this project have been used in the New Mexico State Water Plan. Basic agricultural data such as these are used by many organizations and firms. Agricultural seed firms are anxious for this type of data (see attached letter).

E. Work Remaining

Cropland uses and agricultural depletions and diversions will be estimated for the 1973 crop year in December 1973, using the same techniques as for previous years.

DEKALB
AgResearch, Inc.

May 18, 1973

Dr. Robert Lansford
New Mexico State University
Agricultural Economics Department
Las Cruces, New Mexico 88001

Dear Dr. Lansford:

On April 4 we wrote requesting information as to the planted acreages of corn and sorghum by county for 1972. If it was available, we requested a breakdown by irrigated and non-irrigated acreages.

As of this date, we have not heard from you and are wondering if this information will be available shortly. Please let us know or, if possible, send us a copy.

Thank you.

Sincerely,

Elmer Monson

Elmer Monson
Manager, Market Planning

ph

GENERAL OFFICES: SYCAMORE ROAD, DEKALB, ILLINOIS 60115
TELEPHONE 815 758-3461 CABLE ADDRESS: "DEKALBCO" TELEX 267-342

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No.

NMSU Project No. 3109-135

Agreement No. 14-31-0001-

FCST-COWRR Research Category:

THE DETERMINATION AND ORIGIN OF LEAD IN SURFACE AND GROUND WATERS OF NORTHEASTERN NEW MEXICO

Name and Location of University Where Project is Being Carried Out:

Highlands University - Las Vegas

Proj. Began--Month: July ; Year: 1972 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
Sigfredo Maestas	Ph.D	Chemistry
Anthony F. Gallegos	Ph.D.	Radioecology

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Theresa C. de Baca	B.A.	Biology
Felix Miera	B.A.	Biology
Donald H. Vigil	B.S.	Chemistry

A. Research Project Accomplishments

The major project accomplishments to date include: (1) the development of suitable sampling techniques for water, aquatic species, biological samples, and soil for the determination of contents of lead in these; (2) development of suitable analytical techniques for the determination of lead in water, biological materials, and soils, and (3) the organization of data for suitable comparison with data from other sources for the determination of the origin and fate of lead in the food chain.

The primary conclusion to be drawn from sampling experiments performed for this laboratory to date is that seasonal variations in northern New Mexico affect the concentration of Pb in water and hence in biological samples considerably more than any other perturbation due to man (such as mining, combustion, etc.) or to nature. The area of concern in this project is vast, covering almost one-fourth of the State. For this reason systematic sampling of a select group of streams and lakes in the area of the Pecos Wilderness is being conducted. More sporadic sampling is conducted in the remainder of the northeast quadrant of the State.

Methods of analysis which have been developed or modified for adoption in this laboratory include atomic absorption spectroscopic methods with the carbon furnace for analysis of most samples. In addition, referee methods based on new electrochemical techniques have been developed and are used often in preference to the more popular atomic absorption methods.

Analytical data obtained to date, when correlated with sampling information and with data from other sources, indicate that as much as 90 percent of all lead in natural waters results from atmospheric deposition either with precipitation or by impaction from air. This conclusion bears verification by methods which are discussed later in this report.

B. Publications

Analytical methods developed in this laboratory for analysis of Pb fish tissue and bone were reported at the October meeting of the New Mexico Academy of Science. The abstract appears in the Bulletin of the New Mexico Academy of Science, to be published.

Analytical data for the content of lead in aquatic species were reported at the annual meeting of the Rocky Mountain Section of the American Academy of Science in Lubbock, Texas in April, 1973.

C. Project Status

This project will continue in progress in the next fiscal year.

D. Application of Research Results

The New Mexico Environmental Institute has in its data bank a complete description of this project. It is anticipated that data of environmental concern resulting from this project will subsequently become a part of the Institute's collection for dissemination to the public.

Nuclear Defense Research Corp. of New Mexico has requested that it be sent information resulting from this project.

E. Work Remaining, and Progress Contemplated During Next Year

It is expected that sampling techniques, analytical methods, and analytical and radiochemical data resulting from work in this laboratory will lead to the development of an ecological portrait of the origin and fate of lead in natural waters in northeastern New Mexico. The inclusion of additional analytical data in the next year will contribute substantially to the statistical treatment for the elucidation of the origin of lead in samples analyzed. The development of suitable means for the determination of

Pb-210/Pb ratios will enable the verification of conclusions, arrived upon by statistical evaluation of analytical data, regarding the origin of lead in waters.

An understanding of the origin of lead in waters and knowledge concerning its distribution will contribute to the understanding of analytical data to be obtained for other heavy metals (Fe, Cd, V, and Cr, for example) in the same waters. Thus it is hoped that the transport mechanism of heavy metals in natural water systems will be better understood.

ANNUAL REPORT -- TITLE I PROJECT

OWRR Project No. 3109-136

NMSU Project No.

Agreement No. 14-31-0001-

FCST-COWRR Research Category:

PREDICTING THE QUALITY OF IRRIGATION RETURN FLOW

Name and Location of University Where Project is Being Carried Out:

New Mexico State University - Las Cruces

Proj. Began--Month: July ; Year: 1972 | To Be Completed--Month: June ; Year: 1973

Principal Investigators	Degree	Discipline
Peter J. Wierenga	Ph.D.	Soil Physics

Student Assistants 1/	Degree Held (if any)	Discipline or Academic Background
Rein van Genuchten	M.S.	Soil Physics, Soil-Plant Water Relations
Susan Gomez	B.S.	Chemistry

A. Research Project Accomplishments

During the past year extensive laboratory experiments were performed to study the movement of chloride ions and titrated water through 30-cm long soil columns. The laboratory observations on chloride and titrated movement were compared with predicted values, using a S/360 CSMP computer simulation model. It was found that the use of a computer model introduced considerable numerical, or artificial dispersion. As a result the computed effluent data appeared much more dispersed or spread out than the observed effluent data. A careful mathematical analysis of the computer model showed that corrections were necessary, dependent on the pore water velocity, the layer thickness used in the computer model and the time increment used in the calculations. A stability analysis of the model was also performed. It appears that with the problem of the numerical dispersion solved, the model can now be used to describe the movement of various solute through uniform or layered soils during both steady and nonsteady state conditions.

B. Publications

van Genuchten, M. Th., J. M. Davidson, and P. J. Wierenga. 1973. An evaluation of kinetic and equilibrium equations for the prediction of pesticide movement through porous media. SSSA Proc. 37:(accepted for publication).

van Genuchten, M. Th., and P. J. Wierenga. 1973. Simulation of solute movement in soils. Submitted for publication in Water Resources Research Journal.

C. Project Status

Project will be completed June 30, 1974.

D. Application of Research Results

Interest in the solute simulation model was expressed by Dr. R. E. Green, Soils Department, University of Hawaii, Dr. J. M. Davidson, Oklahoma State University, and by Dr. K. Cassel, North Dakota State University, who is using the model for analyzing greenhouse column experiments.

E. Work Remaining, and Progress Contemplated During Next Year

During the coming year, the model will be tested on a field plot irrigated with water of known composition. Data have been gathered on the hydraulic properties of the soil. Triplicate tensiometers and suction cups have been installed at 15 cm depth intervals from 30 to 120 cm below the soil surface. The changes in composition of the soil solution will be monitored during repeated irrigations. Observed changes in chemical composition will be compared with those predicted using the computer model.

ANNUAL REPORT - TRAINING AND EDUCATION ASPECTS
OF THE WATER RESEARCH PROGRAM UNDER P.L. 88-379

Name of University:
(or College) New Mexico State University

SUBMIT THE INFORMATION SPECIFIED BELOW FOR THE UNIVERSITY AT WHICH THE WATER RESOURCES RESEARCH INSTITUTE OR CENTER APPROVED UNDER P.L. 88-379 IS LOCATED, AND FOR OTHER UNIVERSITIES WITH WHICH THE INSTITUTE OR CENTER IS COOPERATING. KEEP THE STATISTICS ON ENROLLMENTS, NUMBER OF STUDENTS GRADUATING, EMPLOYMENT STATUS OF GRADUTES, NEW COURCES, ETC., SEPARATE FOR EACH UNIVERSITY. IT IS RECOGNIZED CERTAIN OF THE REQUESTED DATA ON STUDENTS MAY NOT BE READILY AVAILABLE. IF SO, PROVIDE BEST ESTIMATE FIGURES. IN OW-9, DATA ON STUDENTS ARE REQUESTED ONLY FOR THOSE STUDENTS WHO RECEIVED EMPLOYMENT AS RESEARCH PROJECT OR PROGRAM ASSISTANTS THROUGH THE P.L. 88-379 PROGRAM. IF EXTRA SPACE IS NEEDED, ADD PAGES AND NUMBER EACH CONTINUATION ITEM IN THE ORDER SHOWN BELOW.

A. During period since last annual report was submitted provide information on: (See footnote 1/ below.)

(1) New water resources related courses developed. (Give title, state whether interdisciplinary, and give brief description of course. Please indicate if any of these were outgrowths of P.L. 88-379 program activities.)

None

(2) Water resources related staff members added to fill new positions. (List highest degree obtained and scientific discipline. Indicate which ones received any salary from P.L. 88-379 funds. Do not list staff replacements.)

None

1/ Our intent here is to obtain information on improved academic capability for water resources research and training. Indicate for each position, research facility or other item, whether support was provided in whole or in part through P.L. 88-379 funds, or from other sources; however, also list improvements supported by State or other funds.

A. (Continued)

(3) Water resources related staff members employed to replace those who retired, died, or moved. (List highest degree obtained and scientific discipline. Indicate which ones received any salary from P.L. 88-379 funds.)

None

(4) New water resources research and training facilities other than research equipment items. (Include only major facilities such as new laboratories, buildings, etc.)

None

(5) Interdepartmental interuniversity or regional agreements consummated with respect to improved research and training capabilities. (To be answered only by institutes under P.L. 88-379. If copies of such institute-related agreements have not been provided OWRR, please provide.)

Regional Agreement consummated with WRRI Centers in Arkansas, Louisiana, Oklahoma, Colorado, Texas, and Kansas for the High Plains Region - proposal submitted.

Regional Agreement consummated with WRRI Centers in Colorado, Arizona, California, Wyoming, Utah and Nevada - proposal submitted.

Regional Proposal submitted with WRRI Center at Texas A&M to OWRR - Proposal pending.

B. Number of students receiving employment as research project or program assistants through the P.L. 88-379 program. (Include only those students, both continuing and graduating, paid wholly or in part with P.L. 88-379 funds during the past fiscal year.)

Category of Students		No. by Scientific Discipline or Major Field of Study (Engineering, Biology, Economics, etc. 2/ Scientific Discipline of Student	Number
(1) Undergraduates		History	4
Chemical Engineering	5	Computer Science	2
Industrial Engineering	1	Mathematics	1
Agricultural Economics	1	Physics	1
Hydrology	3	Biology	5
Horticulture	1	Chemistry	4
		Economics	2
		Environmental Engr.	1
		Geophysics	1
(2) Master's Students		Geology	1
		Chemistry	1
Botany	1	Ecology	2
		Geophysics	2
		Civil Engineering	1
		Economics	1
		Ind. Engineering	3
		Biology	2
		Agricultural Economics	2
		Geochemistry	1
		Education	1

2/ This refers to educational background prior to employment as research assistant on P.L. 88-379 projects--not to departments in which projects are being conducted.

B. (Continued)

Category of Students	No. by Scientific Discipline or Major Field of Study (Engineering, Biology, Economics, etc.)	
	Scientific Discipline of Student	Number
(3) Doctoral Students	Economics	2
	Hydrology	2
	Civil Engineering	4
	Geophysics	1
(4) Postdoctoral Students	Geochemistry	1

C. Employment status of majors in water-related fields who graduated during the school year ending about June and who receive P.L. 88-379 support.

EMPLOYMENT STATUS	CATEGORY OF SCHOOL YEAR GRADUATE BY DEGREE OBTAINED			
	Bachelor's Degree	Master's Degree	Doctoral Degree	Total
1. No. employed in water-related positions in: Total----				
Federal Agencies----------	(4)	(2)	(2)	(8)
State & Local Agencies--------	(3)	(5)	(0)	(8)
University or College---------	(0)	(0)	(4)	(4)
Other - Including private enterprise----------	(6)	(4)	(3)	(13)
2. No. graduates returning to school for advanced degree----------	4	2	0	6
3. No. going into military service----------	2	0	0	2
4. No. unemployed or working in other fields----------	0	0	0	0
5. No. status unknown----------	3	5	0	8
6. Totals----------	22	18	9	49

D. Type of employment of those school year graduates who received P.L. 88-379 support and who are known to have gone into water-related positions. (Number should agree with total listed under item 1 of the preceding paragraph "C". Graduates enrolled for further course work or training should not be listed here as employed.)

Number of Graduates Engaged in Water-Related Work In:	CATEGORY OF SCHOOL YEAR GRADUATE BY DEGREE OBTAINED			
	Bachelor's Degree	Master's Degree	Doctoral Degree	Total
1A. Federal Agencies:				
a. Primarily Research			1	1
b. Primarily Planning				
c. Primarily Development	2	1		3
d. Primarily Operations	2			2
e. Primarily Management				
f. Other or not known		1	1	2
1B. State & Local Agencies:				
a. Primarily Research				
b. Primarily Planning	1	1		2
c. Primarily Development		1		1
d. Primarily Operations	1			1
e. Primarily Management	1	2		3
f. Other or not known				
1C. University or College: 3/				
a. Primarily Teaching			3	3
b. Primarily Research			1	1
c. Primarily Research & Teaching				
d. Other or not known				
1D. Other - Including Private Enterprise:				
a. Primarily Research		1	1	2
b. Primarily Planning	1			1
c. Primarily Development	2			2
d. Primarily Operations	1	1		2
e. Primarily Management		1		1
f. Other or not known	2	1	2	5
Totals	13	11	9	33

Selected summary of above data -- from the "Total" column:

Research (1Aa, 1Ba, 1Cb, 1Cc& 1Da)	4
Planning (1Ab, 1Bb & 1Db)	3
Development (1Ac, 1Bc & 1Dc)	6
Operations (1Ad, 1Bd & 1Dd)	5
Management (1Ae, 1Be, & 1De)	2

3/Do not include here students working as research assistants and receiving course credits.

E. Identify by name and discipline and briefly describe instances, if any, in which the institute program, in the past year, has resulted in individuals, other thsn students, doing research or teaching in the water resources field, who, previously, were not involved in water work.

None

F. Cite any instances you know of, in which individuals who previously served as student research assistants on P.L. 88-379 projects, are now serving as professional investigators of P.L. 88-379 projects following graduation. Do not include individuals reported in this category last year or before.

None

NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE

NEW MEXICO STATE UNIVERSITY

NINTH ANNUAL FINANCIAL REPORT

ANNUAL ALLOTMENT PROJECTS

and

MATCHING GRANT PROJECTS

FOR THE PERIOD

July 1, 1972 - June 30, 1973

TABLE OF CONTENTS

FY 1973 ANNUAL REPORT -- ANNUAL ALLOTMENT (Sec. 100) PROJECT

State where institute is located: New Mexico Report as of June 30, 1973

OWRR Project No. A-038-NMEX

NMSU Project No. 3109-49

Annual Allotment Agreement No. 14-31-0001-3831

Project Title:

THE STUDY OF THE CHEMICAL AND BIOLOGICAL CHARACTER OF THE RIO GRANDE WATER IN THE BOSQUE DEL APACHE REFUGE

Principal Investigator(s)

J. Brandvold, J. A. Brierly, C. J. Popp

Project Began--Month: July Yr: 19 72

Scheduled Completion--Month: June Yr: 1973

Cost Categories to Which FY 1973 Federal Sec. 100 Funds Applied			Amount Budgeted FY 1973	Actual Expenditures FY 1973
A. SALARIES & WAGES: TOTAL			11,893.00	10,742.82
Prin. Investigator	No. 3	Man-yrs .25	(4,753.00)	(4,753.00)
Other Prof. Staff	No.	Man-yrs	(4,000.00)	( )
Grad. Student Assistants- (Includes Student Technicians)	No. 1	Man-yrs .40	( )	(3,000.00)
Undergrad. Student Assistants - (Includes Student Technicians)	No. 9	Man-yrs .83	(500.00)	(2,989.82)
Technicians & Others- (Non-Students)	No.	Man-yrs	(2,640.00)	( )
B. NON-EXPENDABLE PROPERTY: TOTAL-				
C. EXPENDABLE PROPERTY:(Supplies,Materials, etc.)TOTAL-			1,000.00	1,386.54
D. OTHER COSTS (SPECIFY):(Travel,ADP Svcs.,etc.) TOTAL-			2,673.00	3,436.64
Travel			(140.00)	(170.00)
Computer			(500.00)	(1,315.55)
Employee Benefits			(618.00)	(536.09)
Publication and Information Dissemination			(1,415.00)	(1,415.00)
			( )	( )
E. TOTALS:-			15,566.00	15,566.00

Form OWI-2
1973

State where institute is located: New Mexico Report as of June 30, 1973

OWRR Project No. A-039-NMEX

NMSU Project No. 3109-50

Annual Allotment Agreement No. 14-31-0001- 3831

Project Title:

HYDROLOGIC NUTRIENT CYCLE INTERACTIONS IN UNDISTURBED AND MAN-MANIPULATED ECOSYSTEMS (Watersheds)

Principal Investigator(s)

James R. Gosz

Project Began--Month: July Yr: 19 72

Scheduled Completion--Month: June Yr: 19 73

Cost Categories to Which FY 1973 Federal Sec. 100 Funds Applied	Amount Budgeted FY 1973	Actual Expenditures FY 1973
A. SALARIES & WAGES: TOTAL	9,550.00	9,550.00
Prin. Investigator - No. 1 Man-yrs .48	(7,150.00)	(7,150.00)
Other Prof. Staff - No. 1 Man-yrs .01	( )	(194.42)
Grad. Student Assistants (Includes Student Technicians) - No. 2 Man-yrs .29	(2,400.00)	(2,205.58)
Undergrad. Student Assistants (Includes Student Technicians) - No. Man-yrs	( )	( )
Technicians & Others (Non-Students) - No. Man-yrs	( )	( )
B. NON-EXPENDABLE PROPERTY: TOTAL		
C. EXPENDABLE PROPERTY: (Supplies, Materials, etc.) TOTAL	200.00	200.00
D. OTHER COSTS (SPECIFY): (Travel, ADP Svcs., etc.) TOTAL	2,330.00	2,330.00
Travel	(300.00)	(300.00)
Employee Benefits	(930.00)	(930.00)
Publication and Information Dissemination	(1,100.00)	(1,100.00)
	( )	( )
	( )	( )
E. TOTALS:	12,080.00	12,080.00

State where institute is located: New Mexico Report as of June 30, 1973

OWRR Project No. A-040-NMEX

NMSU Project No. 3109-51

Annual Allotment Agreement No. 14-31-0001-3831

Project Title:
ANALYSIS OF NUTRIENT SUPPLIES FOR ALGAE IN ELEPHANT BUTTE RESERVOIR AND AN ANALYSIS OF MERCURIALS IN THE ELEPHANT BUTTE ECOSYSTEM

Principal Investigator(s)
John D. Garcia, David E. Kidd
Gordon V. Johnson

Project Began--Month: July Yr: 1972

Scheduled Completion--Month: June Yr: 1973

Cost Categories to Which FY 1973 Federal Sec. 100 Funds Applied	Amount Budgeted FY 1973	Actual Expenditures FY 1973
A. SALARIES & WAGES: TOTAL	10,447.00	10,447.00
Prin. Investigator - No. 2 Man-yrs .41	(3,707.00)	(6,181.30)
Other Prof. Staff - No. 1 Man-yrs .17	(4,500.00)	(2,552.77)
Grad. Student Assistants (Includes Student Technicians) - No. 1 Man-yrs .23	(2,240.00)	(1,712.93)
Undergrad. Student Assistants (Includes Student Technicians) - No. Man-yrs	( )	( )
Technicians & Others (Non-Students) - No. Man-yrs	( )	( )
B. NON-EXPENDABLE PROPERTY: TOTAL		
C. EXPENDABLE PROPERTY: (Supplies, Materials, etc.) TOTAL	656.00	669.00
D. OTHER COSTS (SPECIFY): (Travel, ADP Svcs., etc.) TOTAL	2,627.00	2,614.00
Travel	(432.00)	(432.00)
Boat Rental	(465.00)	(452.00)
Employee Benefits	(482.00)	(482.00)
Publication and Information Dissemination	(1,248.00)	(1,248.00)
	( )	( )
E. TOTALS:	13,730.00	13,730.00

Form OWI-2
1973

State where institute is located: New Mexico Report as of June 30, 1973

OWRR Project No. A-041-NMEX

NMSU Project No. 3109-53

Annual Allotment Agreement No. 14-31-0001-3831

Project Title:

WATER RESOURCES AND RESEARCH NEEDS OF NEW MEXICO

Principal Investigator(s)

B. J. Creel

Project Began--Month: July Yr: 1972

Scheduled Completion--Month: June Yr: 1973

Cost Categories to Which FY 1973 Federal Sec. 100 Funds Applied	Amount Budgeted FY 1973	Actual Expenditures FY 1973
A. SALARIES & WAGES: TOTAL	6,000.00	6,011.66
Prin. Investigator - No. 1 Man-yrs .50	(6,000.00)	(6,008.16)
Other Prof. Staff - No. Man-yrs	( )	( )
Grad. Student Assistants (Includes Student Technicians) - No. Man-yrs	( )	( )
Undergrad. Student Assistants (Includes Student Technicians) - No. Man-yrs	( )	( )
Technicians & Others (Non-Students) - No. 1 Man-yrs .01	( )	(3.50)
B. NON-EXPENDABLE PROPERTY: TOTAL		
C. EXPENDABLE PROPERTY: (Supplies, Materials, etc.) TOTAL	500.00	514.70
D. OTHER COSTS (SPECIFY): (Travel, ADP Svcs., etc.) TOTAL	3,780.00	3,615.97
Travel	(1,500.00)	(1,398.49)
Publication and Information Dissemination	(1,500.00)	(1,500.00)
Employee Benefits	(780.00)	(705.00)
Communications	( )	(12.48)
	( )	( )
E. TOTALS:	10,280.00	10,142.33

State where institute is located: New Mexico Report as of June 30, 1973

OWRR Project No. A-042-NMEX

NMSU Project No. 3109-52

Annual Allotment Agreement No. 14-31-0001-3831

Project Title:

MEASUREMENT OF GROUNDWATER FLOW USING AN IN-SITU THERMAL PROBE

Principal Investigator(s)

Marshall Reiter
Allan Sanford

Project Began--Month: July Yr: 1972

Scheduled Completion--Month: June Yr: 1973

Cost Categories to Which FY 1973 Federal Sec. 100 Funds Applied	Amount Budgeted FY 1973	Actual Expenditures FY 1973
A. SALARIES & WAGES: TOTAL	7,650.00	6,461.39
Prin. Investigator - No. 2 Man-yrs .15	(2,250.00)	(2,250.00)
Other Prof. Staff - No. Man-yrs	( )	( )
Grad. Student Assistants - (Includes Student Technicians) No. 3 Man-yrs .53	(4,400.00)	(3,961.39)
Undergrad. Student Assistants - (Includes Student Technicians) No. Man-yrs	( )	( )
Technicians & Others - (Non-Students) No. 1 Man-yrs .05	(1,000.00)	(250.00)
B. NON-EXPENDABLE PROPERTY: TOTAL	1,000.00	2,553.40
C. EXPENDABLE PROPERTY: (Supplies, Materials, etc.) TOTAL	200.00	204.89
D. OTHER COSTS (SPECIFY): (Travel, ADP Svcs., etc.) TOTAL	1,680.00	1,310.32
Travel	(300.00)	( )
Employee Benefits	(423.00)	(279.50)
Publication and Information Dissemination	(957.00)	(957.00)
Computer	( )	(73.82)
	( )	( )
E. TOTALS:	10,530.00	10,530.00

FY 1973 ANNUAL REPORT -- FOR THE INSTITUTE DIRECTOR'S OFFICE

State where institute is located: New Mexico Report as of June 30, 1973

Director's Name:	Annual Allotment Agreement No. 14-31-0001- 3831
John W. Clark	

Cost Categories to Which FY 1973 Federal Sec. 100 Funds Applied	Amount Budgeted FY 1973	Actual Expenditures FY 1973
A. SALARIES & WAGES: TOTAL - - - - - - - - - - - - - - - - - -	26,345.00	26,475.60
Institute Director:- - - - - - - - - - - - - Man-yrs: .70	(19,291.00)	(18,555.60)
Other Prof. Staff: - - - - - - - - No. ____ - Man-yrs: ____	( )	( )
Graduate Student Assistants: - - No. ____ - Man-yrs: ____ (Includes Student Technicians)	( )	( )
Undergrad. Student Assistants: - No. ____ - Man-yrs: ____ (Includes Student Technicians)	( )	( )
Technicians & Others:- - - - - - No. 1 - Man-yrs: 1.00 (Non-Students)	(7,054.00)	(7,920.00)
B. NON-EXPENDABLE PROPERTY: TOTAL- - - - - - - - - - - - - -	1,500.00	1,070.18
C. EXPENDABLE PROPERTY: (Supplies, Materials, etc.) TOTAL - -	1,400.00	827.25
D. OTHER COSTS (SPECIFY): (Travel, ADP Svcs., etc.) TOTAL - -	8,569.00	9,578.64
Travel - -	(2,200.00)	(2,567.04)
Communications - -	(1,700.00)	(1,573.83)
Maintenance - -	(150.00)	(240.67)
Employee Benefits - -	(2,569.00)	(2,721.24)
Information Dissemination, Printing & Duplicating - -	(1,950.00)	(2,011.97)
Periodicals - Other - -	( )	(463.89)
_____ - -	( )	( )
E. TOTALS:- -	37,814.00	37,951.67

Estimated Functional Distribution of FY 1973 Allotment (Sec. 100) Funds Expended for Operation of the Office of the Institute Director

1.	Research program (P.L. 88-379) planning and development, including review and analysis of research project proposals - - -	$ 14,500
2.	Coordinating the approved Institute P.L. 88-379 research and related training activities, including evaluation of progress, coordination with State agencies, etc.- - - - - - - - - -	$ 11,000
3.	Water research and training program symposia relating to current or projected P.L. 88-379 activity but not directly associated with (or included in) the budgets of specific projects -	$ 1,000
4.	Information Dissemination Activities	$ 8,500
5.	Research Conferences	$ 1,000
6.		
7.		
8.	Administrative expenses, including such housekeeping activities as the preparation of Institute time and attendance reports, requisitioning miscellaneous office supplies and equipment, operating Institute mails and files systems, general Institute record keeping, etc. - - - - - - -	$ 1,951.67 1/
	TOTAL Expenses for the Institute Director's Office - - - -	$ 37,951.67 2/

1/ If a cost of the Institute Director's Office can be attributed to a research program activity, such as described in items 1, 2, and 3 above, then that cost should be included in that program activity and not as "administrative expenses". For example, that portion of the Institute Director's salary cost, as well as related stenographic-clerical costs, that are attributable to program planning and development activity of the Office of the Institute Director should be included in item 1 above rather than in item 8 above.

2/ This dollar figure should be equal to the total "actual expenditures FY 1973 as shown in line "E" of Form OW-3, FY 1973 Annual Report--For the Institute Director's Office.

SUMMARY SHEET FOR FY 1973 ANNUAL ALLOTMENT PROGRAM (SEC. 100) EXPENDITURES

Summary of information from forms OWR-2 and OWR-3 covering Institute Director's Office and annual allotment program projects utilizing FY 1973 allotment program (Sec. 100) funds

State: New Mexico — Total no. of allotment projects underway, FY 1973: 5
Of these, indicate no. completed during year, if any: 5 1/

Annual Allotment Agreement No. (FY1973): 14-31-0001 - 3831

Cost Categories to Which FY1973 Federal Sec. 100 Funds Applied	Amount Budgeted FY 1973	Actual Expenditures FY 1973
A. SALARIES & WAGES: TOTAL	71,885.00	69,688.47
Institute Director - Man-yrs .70	(19,291.00)	(18,555.60)
Principal Investigators- No. 9 Man-yrs 1.79	(23,860.00)	(26,342.46)
Other Professional Staff - No. 2 Man-yrs .18	(8,500.00)	(2,747.19)
Graduate Student Assistants- No. 7 Man-yrs 1.45 (Includes Student Technicians)	(9,040.00)	(10,879.90)
Undergrad.Student Assistants:- No. 9 Man-yrs .83 (Includes Student Technicians)	(500.00)	(2,989.82)
Technicians & Others - No. 3 Man-yrs 1.05 (Non-students)	(10,694.00)	(8,173.50)
B. NON-EXPENDABLE PROPERTY: TOTAL	2,500.00	3,623.58
C. EXPENDABLE PROPERTY:(Supplies,Materials,etc.)-TOTAL	3,956.00	3,802.38
D. OTHER COSTS (SPECIFY):(Travel,ADP Svcs.,etc.)-TOTAL	21,659.00	22,885.57
Travel	(4,872.00)	(4,867.53)
Communications	1,700.00	1,586.31
Maintenance	(150.00)	(240.67)
Computer	(500.00)	(1,389.37)
Periodicals - Others		463.89
Boat Rental	(465.00)	452.00)
Publication and Information Dissemination	(8,170.00)	8,231.97)
Employee Benefits	(5,802.00)	(5,653.83)
E. TOTALS 2/	100,000.00	100,000.00

1/ The OWRR Project numbers for completed annual allotment projects are as follows:

A-038-NMEX; A-039-NMEX; A-040-NMEX; A-041-NMEX; A-042-NMEX

2/ Ordinarily, the Total of "Amount Budgeted FY1973" should equal the total FY allotment.

FY 1973 ANNUAL REPORT -- ESTIMATE OF NON-FEDERAL CONTRIBUTIONS
(Relating to Annual Allotment Program)

State: New Mexico Report covering FY 1973

The legislative history leading to passage of the Water Resources Research Act of 1964 emphasizes the importance of State-Federal cooperation in the conduct of the program and indicates that there will be substantial amounts of non-Federal cost participation in the FY 1973 research and training activities carried out pursuant to your institute's FY 1973 annual allotment, Sec. 100, program.

The following types of non-Federal cost participation items are suggested for your consideration. Use these, or others, as you deem appropriate.

1. Estimate non-Federal contributions to salaries and wages of professional staff who participated in the FY 1973 annual allotment, Sec. 100, program:- $ 47,000

2. Estimated non-Federal contribution to indirect costs and employee fringe benefits relating to the FY 1973 annual allotment, Sec. 100, program:- $ 30,000

3. Estimated FY 1973 fair-use-value non-Federal contribution relating to equipment, facilities, etc., used in the FY 1973 annual allotment, Sec. 100, program: - - - - - - - - - - - - - - - - - - - $ 78,000

4. State Appropriation to WRRI in addition to the above amounts - - - - - - $ 118,000

5.

6.

7.

TOTAL - $ 273,000

Form OW-6
1973

FY 1973 ANNUAL REPORT - MATCHING GRANT (SEC. 101) PROJECT

State where institute located: New Mexico Report as of June 30, 1973

OWRR Proj. No. B-015-NMEX
NMSU Proj. No. 3109-109
Matching Grant Agreement Number 14-31-0001-3110
Total Federal Amount of the M.G.A. -- $14,920.00

Project Title:
IRRIGABILITY CLASSIFICATION OF NEW MEXICO LANDS

Principal Investigator(s): J. U. Anderson

Proj. Began-Mo: July ;Yr:19 69 ; Actual or Scheduled Completion--Mo: June ;Yr:19 73

Cost Categories Man-Year Information FY 1973 1/	Expenditures in FY 1973		
	Federal $	Non-Fed.$	Total $
A. SALARIES & WAGES: TOTAL	3,995.22	1,292.70	5,287.92
Principal Investigator(s)	(3,995.22)	(908.78)	(4,904.00)
No: 1 Man-Years: .27			
Other Professional Staff:	( )	( )	( )
No: Man-Years:			
Graduate Student Assistants:	( )	( )	( )
(Includes Student Technicians)			
No: 2 Man-Years:			
Undergrad. Student Assistants	( )	(383.92)	(383.92)
(Includes Student Technicians)			
No: Man-Years:			
Technicians & Others	( )	( )	( )
(Non-students)			
No: Man-Years:			
B. NON-EXPENDABLE PROPERTY			
C. EXPENDABLE PROPERTY: (Supplies, Materials)		8.59	8.59
D. OTHER COSTS (SPECIFY): TOTAL (Travel, Indirect costs, Etc.)		2,693.92	2,693.92
Travel	( )	(25.00)	(25.00)
Duplication	( )	(2.34)	(2.34)
Employee Benefits	( )	(551.41)	(551.41)
Overhead 40% x 5,287.92	( )	(2,115.17)	(2,115.17)
E. TOTALS FOR FY 1973	3,995.22	3,995.21	7,990.43

F. Cumulative Total Project Expenditures from Start of Project to June 30, 1973 -- Federal-$14,920.00 Non-Fed.$14,920.00

1/ Man-Years relate to time paid from Federal funds only.

Form OWR-7 1973

FY 1973 ANNUAL REPORT - MATCHING GRANT (SEC. 101) PROJECT

State where institute located: New Mexico Report as of June 30, 1973

OWRR Proj. No. B- 026-NMEX
NMSU Proj. No. 3109-117
Matching Grant Agreement Number 14-31-0001- 3617
Total Federal Amount of the M.G.A. -- $ 40,000

Project Title:
AN ANALYTICAL INTERDISCIPLINARY EVALUATION OF THE UTILIZATION OF THE WATER RESOURCES OF THE RIO GRANDE IN NEW MEXICO

Principal Investigator(s): T. G. Gebhard, Jr., R. R. Lansford, B. J. Creel, W. Brutsaert, Shaul Ben-David

Proj. Began-Mo: July ;Yr:1971 ; Actual or Scheduled Completion--Mo: June ;Yr:1973

Cost Categories Man-Year Information FY 1973 1/	Expenditures in FY 1973 Federal $	 Non-Fed.$	 Total $
A. SALARIES & WAGES: TOTAL	1,984.05	861.66	2,845.71
Principal Investigator(s) No: 1 Man-Years: .02	(390.00)	(( )	(390.00)
Other Professional Staff: No: Man-Years:	( )	( )	( )
Graduate Student Assistants: (Includes Student Technicians) No: 1 Man-Years: .11	(851.76)	(198.24)	(1,050.00)
Undergrad. Student Assistants (Includes Student Technicians) No: 3 Man-Years: .06	(229.20)	( )	(229.20)
Technicians & Others (Non-students) No: 2 Man-Years: .11	(513.09)	(663.42)	(1,176.51)
B. NON-EXPENDABLE PROPERTY			
C. EXPENDABLE PROPERTY: (Supplies, Materials)		140.60	140.60
D. OTHER COSTS (SPECIFY): TOTAL (Travel, Indirect costs, Etc.)		3,151.94	3,151.94
Travel	( )	(767.30)	(767.30)
Communications	( )	(23.10)	(23.10)
Publication-Duplication Computer	( )	862.15 (137.96)	862.15 (137.96)
Employee Benefits Overhead 41% x 2845.71	( )	194.69 (1,166.74)	194.69 (1,166.74)
E. TOTALS FOR FY 1973:	1,984.05	4,154.20	6,138.25

F. Cumulative Total Project Expenditures from Start of Project to June 30, 1973 - - Federal-$ 40,000.00 Non-Fed.$ 42,170.14

1/ Man-Years relate to time paid from Federal funds only.

Form OM-7
1973

FY 1973 ANNUAL REPORT - MATCHING GRANT (SEC. 101) PROJECT

State where institute located: New Mexico Report as of June 30, 1973

OWRR Proj. No. B- 027-NMEX
NMSU Proj. No. 3109-120
Matching Grant Agreement Number 14-31-0001- 3618
Total Federal Amount of the M.G.A. -- $ 10,476.00

Project Title:
A COMPARISON OF RATES OF WATER LOSS THROUGH TRANSPIRATION OF SEVERAL NEW MEXICO PHREATOPHYTE SPECIES

Principal Investigator(s):
Gary L. Cunningham

Proj. Began-Mo: July ;Yr:1971 ; Actual or Scheduled Completion--Mo: June ;Yr:1973

Cost Categories Man-Year Information FY 1973 1/	Expenditures in FY 1973 Federal $	Non-Fed.$	Total $
A. SALARIES & WAGES: TOTAL	1,752.01		1,752.01
Principal Investigator(s)	( )	( )	( )
No:___ Man-Years:___			
Other Professional Staff:	(280.00)	( )	(280.00)
No:1 Man-Years:.02			
Graduate Student Assistants:	( )	( )	( )
(Includes Student Technicians)			
No:___ Man-Years:___			
Undergrad. Student Assistants-	(1,320.63)	( )	(1,320.63)
(Includes Student Technicians)			
No:5 Man-Years:.36			
Technicians & Others	151.38 ( )	( )	151.38 ( )
(Non-students)			
No:2 Man-Years:.03			
B. NON-EXPENDABLE PROPERTY			
C. EXPENDABLE PROPERTY:	136.80	119.44	256.24
(Supplies, Materials)			
D. OTHER COSTS (SPECIFY): TOTAL		1,769.37	1,769.37
(Travel, Indirect costs, Etc.)			
Travel	( )	(7.40)	(7.40)
Computer	( )	(487.07)	(487.07)
Publication-Duplication	( )	(536.40)	(536.40)
Employee Benefits	( )	(20.17	20.17
Indirect Cost 41% x 1752.01		718.33)	718.33)
E. TOTALS FOR FY 1973:	1,888.81	1,888.81	3,777.62

F. Cumulative Total Project Expenditures from Start of Project to June 30, 1973 -- Federal-$ 10,476.00 Non-Fed.$ 10,476.00

1/ Man-Years relate to time paid from Federal funds only.

Form OM-7
1973

FY 1973 ANNUAL REPORT - MATCHING GRANT (SEC. 101) PROJECT

State where institute located: New Mexico Report as of June 30, 1973

OWRR Proj. No. B- 029-NMEX
NMSU Proj. No. 3109-119, 3109-132
Matching Grant Agreement Number 14-31-0001- 3619
Total Federal Amount of the M.G.A. -- $ 14,686

Project Title:
UTILIZATION OF WATER IN A SEMI-ARID REGION

Principal Investigator(s):
H. D. Fuehring

Proj. Began-Mo: July ;Yr:19 71; Actual or Scheduled Completion--Mo: June ;Yr:19 75

Cost Categories Man-Year Information FY 1973 1/	Expenditures in FY 1973 Federal $	 Non-Fed.$	 Total $
A. SALARIES & WAGES: TOTAL	4,208.00	669.43	4,877.43
Principal Investigator(s)	(3,288.00)	( )	(3,288.00)
No: 1 Man-Years: .22 Other Professional Staff:	( )	( )	( )
No: Man-Years: Graduate Student Assistants:	( )	( )	( )
(Includes Student Technicians) No: Man-Years: Undergrad. Student Assistants	( )	( )	( )
(Includes Student Technicians) No: Man-Years: Technicians & Others	(920.00)	(669.43)	(1,589.43)
(Non-students) No: 2 Man-Years: .20			
B. NON-EXPENDABLE PROPERTY		1,011.33	1,011.33
C. EXPENDABLE PROPERTY: (Supplies, Materials)		472.30	472.30
D. OTHER COSTS (SPECIFY): TOTAL (Travel, Indirect costs,Etc.)		3,074.42	3,074.42
Travel	( )	(365.50)	(365.50)
Computer	( )	(74.52)	(74.52)
Maintenance	( )	(71.91)	(71.91)
Employee Benefits Indirect Cost-41% x 4,877.43	( )	562.75 (1,999.74)	562.75 (1,999.74)
E. TOTALS FOR FY 1973:	4,208.00	5,227.48	9,435.48

F. Cumulative Total Project Expenditures from Start of Project to June 30, 1973 -- Federal-$ 8,416.00 Non-Fed.$ 10,276.51

1/ Man-Years relate to time paid from Federal funds only.

Form OWR-7 1973

FY 1973 ANNUAL REPORT - MATCHING GRANT (SEC. 101) PROJECT

State where institute located: New Mexico Report as of June 30, 1973

OWRR Proj. No. B-032-NMEX
NMSU Proj. No. 3109-118 & 3109-139
Matching Grant Agreement Number 14-31-0001-3620
Total Federal Amount of the M.C.A. -- $20,000

Project Title:

ANALYSIS OF THE CHARACTERISTICS OF MANUFACTURING INDUSTRIES AND THEIR ADAPTABILITY TO SEMI-ARID REGIONS

Principal Investigator(s): Harry G. Folster, Shaul Ben-David

Proj. Began-Mo: July ;Yr:19 71; Actual or Scheduled Completion--Mo: Dec. ;Yr:19 73

Cost Categories Man-Year Information FY 1973 1/	Expenditures in FY 1973 Federal $	 Non-Fed.$	 Total $
A. SALARIES & WAGES: TOTAL	7,983.75	2,327.26	10,308.01
Principal Investigator(s)	(5,017.53)	(313.68)	(4,703.85)
No: 2 Man-Years: .33			
Other Professional Staff:	( )	( )	( )
No: Man-Years:			
Graduate Student Assistants:	(2,735.78)	(1,664.22)	(4,400.00)
(Includes Student Technicians)			
No: 2 Man-Years: .36			
Undergrad. Student Assistants-	(221.08)	(973.72)	(1,194.80)
(Includes Student Technicians)			
No: 2 Man-Years: .06			
Technicians & Others	(9.36)	( )	(9.36)
(Non-students)			
No: 1 Man-Years: -			
B. NON-EXPENDABLE PROPERTY			
C. EXPENDABLE PROPERTY: (Supplies, Materials)	55.85	280.68	336.53
D. OTHER COSTS (SPECIFY): TOTAL (Travel, Indirect costs, Etc.)		5,434.74	5,434.74
Travel	( )	(682.55)	(682.55)
Printing-Duplication	( )	(31.40)	(31.40)
Employee Benefits	( )	(494.50)	(494.50)
Overhead 41% x 10,308.01	( )	(4,226.29)	(4,226.29)
E. TOTALS FOR FY 1973:	8,039.60	8,039.68	16,079.28

F. Cumulative Total Project Expenditures from Start of Project to June 30, 1973 - - Federal-$ 17,165.83 Non-Fed.$ 17,165.92

1/ Man-Years relate to time paid from Federal funds only.

Form OWR-7 1973

FY 1973 ANNUAL REPORT - MATCHING GRANT (SEC. 101) PROJECT

State where institute located: New Mexico Report as of June 30, 1973

OWRR Proj. No. B-037-NMEX
NMSU Proj. No. 3109-142
Matching Grant Agreement Number 14-31-0001-3951
Total Federal Amount of the M.G.A. -- $ 26,500

Project Title:
AN INTERDISCIPLINARY ANALYSIS OF THE WATER RESOURCES OF THE HIGH PLAINS OF NEW MEXICO

Principal Investigator(s): R. R. Lansford, B. J. Creel, Willem Brutsaert, Frank Titus

Proj. Began-Mo: July ;Yr:1972; Actual or Scheduled Completion--Mo: Dec. ;Yr:1973

Cost Categories Man-Year Information FY 1973 1/	Expenditures in FY 1973 Federal $	Non-Fed.$	Total $
A. SALARIES & WAGES: TOTAL	22,376.33	3,944.59	26,320.92
Principal Investigator(s)	(11,178.01)	( )	(11,178.01)
No:3 Man-Years:.75			
Other Professional Staff:	(4,401.30)	( )	(4,401.30)
No:1 Man-Years:.29			
Graduate Student Assistants:	(6,168.12)	(2,515.16)	(8,683.28)
(Includes Student Technicians)			
No:3 Man-Years:.82			
Undergrad. Student Assistants-	(328.90)	(581.43)	(910.33)
(Includes Student Technicians)			
No:7 Man-Years:.09	300.00	848.00	1,148.00
Technicians & Others	( )	( )	( )
(Non-students)			
No:1 Man-Years:.06			
B. NON-EXPENDABLE PROPERTY-		100.00	100.00
C. EXPENDABLE PROPERTY:		638.52	638.52
(Supplies, Materials)			
D. OTHER COSTS (SPECIFY): TOTAL		18,539.05	18,539.05
(Travel, Indirect costs, Etc.)			
Travel	( )	1,785.00	1,785.00
Duplication and Printing		5.82	5.82
Communications		160.00	160.00
Maintenance	( )	22.62	22.62
Computer		2,385.09	2,385.09
Publication and Info. Dissemination	( )	1,500.00	1,500.00
Employee Benefits		1,888.95	1,888.95
Indirect Cost 41% x 26,320.92	( )	10,791.57	10,791.57
E. TOTALS FOR FY 1973:	22,376.33	23,222.16	45,598.49

F. Cumulative Total Project Expenditures from Start of Project to June 30, 1973 -- Federal-$ 22,376.33 Non-Fed.$ 23,222.16

1/ Man-Years relate to time paid from Federal funds only.

Form 0.I-7 1973

FY 1973 ANNUAL REPORT - MATCHING GRANT (SEC. 101) PROJECT

State where institute located: New Mexico Report as of June 30, 1973

OWRR Proj. No. B- 038-NMEX
NMSU Proj. No. 3109-140
Matching Grant Agreement Number 14-31-0001- 3914
Total Federal Amount of the M.G.A. -- $ 17,445.00

Project Title:

AQUIFER PARAMETERS BY A CHEMICAL TRACER TECHNIQUE

Principal Investigator(s): Abraham Mercado, Gale K. Billings, G. W. Gross

Proj. Began-Mo: July ;Yr:19 72; Actual or Scheduled Completion--Mo: June ;Yr:19 74

Cost Categories Man-Year Information FY 1973 1/	Expenditures in FY 1973 Federal $	Non-Fed.$	Total $
A. SALARIES & WAGES: TOTAL	8,254.92	2,397.25	10,652.17
Principal Investigator(s) No: 2 Man-Years: .20	(2,933.95)	(1,239.97)	(4,173.92)
Other Professional Staff: No: Man-Years:	( )	( )	( )
Graduate Student Assistants: (Includes Student Technicians) No: 3 Man-Years: .66	(5,000.97)	(52.78)	(5,053.75)
Undergrad. Student Assistants- (Includes Student Technicians) No: 5 Man-Years: .08	(320.00)	(420.00)	(740.00)
Technicians & Others (Non-students) No: Man-Years:	( )	684.50 ( )	684.50 ( )
B. NON-EXPENDABLE PROPERTY			
C. EXPENDABLE PROPERTY: (Supplies, Materials)		447.59	447.59
D. OTHER COSTS (SPECIFY): TOTAL (Travel, Indirect costs, Etc.)		5,410.07	5,410.07
Travel	( )	(214.00)	(214.00)
Machine Shop	( )	(238.56)	(238.56)
Employee Benefits	( )	(590.11)	(590.11)
Indirect Cost-41% x 10,652.17	( )	(4,367.40)	(4,367.40)
E. TOTALS FOR FY 1973:	8,254.92	8,254.91	16,509.83

F. Cumulative Total Project Expenditures from Start of Project to June 30, 1973 -- Federal-$ 8,254.92 Non-Fed.$ 8,254.91

1/ Man-Years relate to time paid from Federal funds only.

Form O.J-7 1973

SUMMARY SHEET FOR MATCHING GRANT (Sec. 101) PROGRAM ACTIVITIES - FY 1973

This sheet provides summary information covering all Sec. 101 projects in progress during FY 1973 using FY 1973 or prior years Sec. 101 funds. Hence, it is a summarization of information set forth on the separate project report forms OW-7

State: New Mexico Total No. of Sec. 101 Projects in Progress During FY 1973 7

Cost Categories Man-Year Information FY 1973	Expenditures in FY-1973		
	Federal	Non-Fed.	Total
A. SALARIES & WAGES: TOTAL - - - - - - - -	50,554.28	11,489.89	62,044.17
Principal Investigator(s)- - - - - - - - No. 10 Man-Years: 1.79	(26,802.71)	(1,835.07)	(28,637.78)
Other Professional Staff:- - - - - - - - No. 2 Man-Years: .31	(4,681.30)	( )	(4,681.30)
Graduate Student Assistants: - - - - - - Includes Student Technicians No. 11 Man-Years: 1.95	(14,756.63)	(4,430.40)	(19,187.03)
Undergrad. Student Assistants: - - - - - Includes student technicians No. 22 Man-Years: .65	(2,419.81)	(2,359.07)	(4,778.88)
Technicians & Others:- - - - - - - - - - Non-students No. 8 Man-Years: .40	(1,893.83)	(2,865.35)	(4,759.18)
B. NON-EXPENDABLE PROPERTY: - - - - - - - -		1,111.33	1,111.33
C. EXPENDABLE PROPERTY: - - - - - - - - - -	192.65	2,107.72	2,300.37
D. OTHER COSTS (SPECIFY): TOTAL - - - - - -		40,073.51	40,073.51
Travel- - - - - - - - - - - - - - - - - -	( )	(3,846.75)	(3,846.75)
Indirect (overhead) - - - - - - - - - - -	(//////////)	(25,385.24)	(25,385.24)
Employee benefits - - - - - - - - - - - -	(//////////)	(4,302.58)	(4,302.58)
Duplicating - Printing	( )	(39.56)	(39.56)
Publication - Information Dissemination	( )	(2,898.55)	(2,898.55)
Communications	( )	(183.10)	(183.10)
Machine Shop	( )	(238.56)	(238.56)
Computer	( )	(3,084.64)	(3,084.64)
Maintenance	( )	(94.53)	(94.53)
Other Miscellaneous Costs: - - - - - - - -	( )	( )	( )
E. TOTALS FOR FY 1973 :- - - - - - - - - - - -	50,746.93	54,782.45	105,529.38

F. Cumulative Total Sec. 101 Expenditures from Start of Projects to June 30, 1973: -Federal--$ 50,746.93 ; Non-Fed-$ 54,782.45

Form OWI-26-1973

Annual Report - Title II Project

OWRR Project Number: C- 2165	Funding Agreement Number: 14-31-0001- 3376	Report as of: July 31, 1972

Name of Performing Organization:	Title of Project:
Water Resources Research Institute New Mexico State University Box 3167 Las Cruces, New Mexico 88003	SOIL AND MANAGEMENT OF SALINITY CONTROL

Status of Project as of Reporting Date: Completed [X]: In Progress [ ]

Total Est. Proj. Cost: Fed. Funds: $ 89,817.00 ; Non-Fed. Funds (if any): $ 6,700.00

Project Cost Information (7/1/71 through 7/31/72) 1/

Cost Categories 2/	Supported From: Federal Funds	Non-Fed. Funds 3/
Direct Salaries and Wages	$ 24,702.59	$ 1,900.00
Employee Benefits (if not included elsewhere)	1,742.13	225.00
Use, Rental or Depreciation Costs Included as Direct Charges		
Non-Expendable Equipment	3,105.90	
Expendable Equipment, Material & Supplies	1,292.37	200.00
Travel Costs Included as Direct Charges	704.25	200.00
Other Direct Charges (Specify): Computer	500.00	
Publication - Duplication	449.68	
Communications	186.00	
Maintenance - Repairs	830.02	
Consultant	75.00	
Indirect Costs	10,128.06	740.00
Other Costs (Specify):		
Other expenses		135.00
TOTALS	43,716.00	3,400.00

1/ If necessary, project costs may be estimated.
2/ Whenever possible, provide costs for categories listed. If cost categories other than those shown above are used, provide concise explanations as may be deemed necessary to insure proper understanding of the content of such costs.
3/ Estimates for "Non-Fed. Funds" ($ value of non-Federal contributions) should be provided if non-Federal contributions were contemplated by the funding agreement.

Comments:

Form CW-27-1973

Annual Report - Title II Project

CWRR Project Number: C-2165	Funding Agreement Number: 14-31-0001-3376	Date of Report: July 31, 1972

Name of Performing Organization:

Water Resources Research Institute
New Mexico State University
Box 3167
Las Cruces, New Mexico 88003

Title of Project:

SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL

Project Personnel and Student Training Information

Surnames of:	Degree (If Any)	Scientific Discipline or Academic Background
Principal Investigator(s):		
Wierenga	Ph.D.	Agronomy
Professional Associates:		
Gomez	B.S.	Chemistry
Student Assistants (if any): 1/		
Westcot	M.S.	Agronomy
Dane	M.S.	Agronomy
Brown	B.S.	Mechanical Engineering

1/Includes research assistants who are currently registered as university or college students. State research institutes participating in the Title I program should include (incorporate) Title II student information in Form CW-9 used for Title I reporting.

Training of Water Resource Scientists and Engineers. In the space below, and as may be appropriate, provide statements of the extent to which currently registered college and university students participated as research assistants on the project. Objective is to indicate how the P.L. 88-379 program is contributing to the training of water resource scientists and engineers -- a principal objective of the Act.

ANNUAL REPORT - TITLE II PROJECT

Name of Reporting Official: J. W. Clark

Date of Report: July 31, 1972

Name of Performing Organization:

Water Resources Research Institute
New Mexico State University
Box 3167
Las Cruces, New Mexico 88003

OWRR Project Number: C-2165

Funding Agreement Number: 14-31-0001-3370

FCST Research Category as Shown on NRP: _____

Title of Project:

SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL

Principal Investigator(s):

A. RESEARCH PERFORMANCE AND APPLICATION OF RESULTS. In the space below, using additional sheets as necessary, provide information relating to the three items listed below. Normally, 500 or less words should be adequate. Lay language preferred.

(1) Research Accomplished. Describe research accomplished and the findings, results and conclusions relating thereto.

(2) Application of Results. Provide examples of application of research results, when possible, or statements as to how the findings may be useful in water management or conservation.

(3) Work Remaining. Provide statements of work remaining to be accomplished. (Note: If the project was completed during the fiscal year ending June 30, 1973 and a final report has been submitted, please make reference to this fact but complete items A-(1), A-(2), and C of this form CW-28 and also forms CW-26 and CW-27 to assist OWRR in compiling annual report information.)

(1) Research Accomplished

A computer model was constructed for water and salt movement under unsaturated soil water conditions. An important part of the model development was testing it with data. This study presents, in addition to the computer model, a large amount of data on movement of salts and pesticides through soil columns. In addition to data on total salts, data are presented on the movement of individual anions and cations since both the concentration and the ratio of the various ions in the drainage water need to be known for predictive purposes.

(2) Application of Results

These data provide much needed information on the behavior of these various ions during movement through a soil profile, and allow extensive testing of existing and future models on salt movement in a calcareous soil.

(3) Work Remaining

The project was completed on July 31, 1972 and technical completion report prepared and submitted.

ANNUAL REPORT - TITLE II PROJECT (Cont'd)

OWRR Research Project Number: C-2165 | Date of Report: July 31, 1972

Title of Project:

SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL

B. Project-Related Publications. In the space below, provide a listing by title, author, volume, page number, etc., of project-related publications or reports issued, and papers prepared. (Complete & accurate citations will be greatly appreciated.) Do not include unpublished progress reports submitted to OWRR pursuant to provisions of the funding agreement.

Dane, J. H., "Effect of Hysteresis on the Prediction of Infiltration, Redistribution and Drainage of Water in Large Soil Columns," Unpublished Master's Thesis, Agronomy Department, New Mexico State University, June 1972.

Westcot, D. E., "Simultaneous Transfer of Heat and Water Vapor in a Closed Soil System", Agronomy Department, New Mexico State University, June 1972.

Wierenga, P. J., "Simulation of Water and Chloride Movement in Soil," Agron. Abst. ASA, 1971.

Wierenga, P. J., O'Connor, G. A., and Dregne, H. E., "Soil and Water Management for Salinity Control", New Mexico Water Resources Research Institute Report No. 018, Technical Completion Report Project No. 14-01-0001-1973, 14-31-0001-3148, and 14-31-0001-3376, New Mexico State University, Las Cruces, New Mexico, December 1972.

Form OW-26-1973

Annual Report - Title II Project

OWRR Project Number: C- 4060	Funding Agreement Number: 14-31-0001- 9012	Report as of: June 30, 1973

Name of Performing Organization:

Water Resources Research Institute
New Mexico State University
Box 3167
Las Cruces, New Mexico 88003

Title of Project:

Reduction of Peak Water Consumption in Urban Areas

Status of Project as of Reporting Date: Completed [ ]: In Progress [X]

Total Est. Proj. Cost: Fed. Funds: $ 82,467.00 ; Non-Fed. Funds (if any): $ 9,034.00

Project Cost Information (7/1/72 through 6/30/73) 1/

Cost Categories 2/	Supported From: Federal Funds	Non-Fed. Funds 3/
Direct Salaries and Wages	$ 19,063.07	$ 2,100.00
Employee Benefits (if not included elsewhere)	1,483.06	163.00
Use, Rental or Depreciation Costs Included as Direct Charges	None	
Non-Expendable Equipment	943.20	
Expendable Equipment, Material & Supplies	762.40	100.00
Travel Costs Included as Direct Charges	3.00	100.00
Other Direct Charges (Specify):		
Indirect Costs	7,815.86	861.00
Other Costs (Specify):		
TOTALS	30,070.59	3,324.00

1/ If necessary, project costs may be estimated.
2/ Whenever possible, provide costs for categories listed. If cost categories other than those shown above are used, provide concise explanations as may be deemed necessary to insure proper understanding of the content of such costs.
3/ Estimates for "Non-Fed. Funds" ($ value of non-Federal contributions) should be provided if non-Federal contributions were contemplated by the funding agreement.

Comments:

Form CW-27-1973

Annual Report - Title II Project

CWRR Project Number: C- 4060	Funding Agreement Number: 14-31-0001- 9012	Date of Report: August 16, 1973

Name of Performing Organization:

Water Resources Research Institute
New Mexico State University
Box 3167
Las Cruces, New Mexico 88003

Title of Project:

Reduction of Peak Water Consumption in Urban Areas

Project Personnel and Student Training Information

Surnames of:	Degree (If Any)	Scientific Discipline or Academic Background
Principal Investigator(s):		
Cotter	Ph.D.	Vegetable Physiology
Professional Associates:		
Clark	C.E.	Civil Engineering
Croft	Ph.D.	Research and Design
Corley	B.S.	Horticulture
Gravels	B.S.	Biology
Student Assistants (if any): 1/		
Hughes	B.S. M.S.	Botany Plant Ecology
Blanton	M.S.	Education

1/Includes research assistants who are currently registered as university or college students. State research institutes participating in the Title I program should include (incorporate) Title II student information in Form CW-9 used for Title I reporting.

Training of Water Resource Scientists and Enginsers. In the space below, and as may be appropriate, provide statements of the extent to which currently registered college and university students participated as research assistants on the project. Objective is to indicate how the P.L. 88-379 program is contributing to the training of water resource scientists and engineers -- a principal objective of the Act.

ANNUAL REPORT - TITLE II PROJECT

Name of Reporting Official: John W. Clark

Date of Report: August 16, 1973

Name of Performing Organization:

Water Resources Research Institute
New Mexico State University
Box 3167
Las Cruces, New Mexico 88003

OWRR Project Number: C- 4060

Funding Agreement Number: 14-31-0001-9012

FCST Research Category as Shown on URP:

Title of Project:

REDUCTION OF PEAK WATER CONSUMPTION IN URBAN AREAS

Principal Investigator(s): Dr. Donald J. Cotter

A. RESEARCH PERFORMANCE AND APPLICATION OF RESULTS. In the space below, using additional sheets as necessary, provide information relating to the three items listed below. Normally, 500 or less words should be adequate. Lay language preferred.

(1) Research Accomplished. Describe research accomplished and the findings, results and conclusions relating thereto.

(2) Application of Results. Provide examples of application of research results, when possible, or statements as to how the findings may be useful in water management or conservation.

(3) Work Remaining. Provide statements of work remaining to be accomplished. (Note: If the project was completed during the fiscal year ending June 30, 1973 and a final report has been submitted, please make reference to this fact but complete items A-(1), A-(2), and C of this form OW-28 and also forms OW-26 and OW-27 to assist OWRR in compiling annual report information.)

(1) Research Accomplished

The major thrust of activities has been upon identifying salient attributes of residental landscapes which can be rated by observers and are related to the esthetic quality of the landscape.

A survey of the literature was completed in the fields of art, landscape design, architecture, and psychology in order to find relevant publications which provide a research base for constructing the observation instrument. Several sources were identified and a number of basic constructs were used in guiding the generation of specific items that can be rated by observers.

In summary, the progress to date on the development of the Residential Landscape Esthetics Observation instrument has been focused upon identifying the attributes of landscapes which are rateable and provide breadth to adequately represent the domain of landscape beauty.

(2) Application of Results

The project has only been operating ten months and it is too early for results to be usable.

(3) Work Remaining

Specific objectives remaining are:

1. to evaluate techniques for reducing aggregate consumptive water use of landscape plantings;

2. to comparatively evaluate the esthetic characteristics of water saving landscape plans;

3. to quantitatively determine the effect of water conservation practices on water consumptive use of landscapes encompassing varying degrees of water saving.