

**Water Resources Research Institute
Annual Technical Report
FY 2010**

Introduction

This program report provides required information for projects funded with the 2010 base grant and mandatory non-federal matching funds. Some overlap in data may occur with our 2009 report because data collection is based on a July-June fiscal year rather than the March-February USGS Grant Award period.

The New Mexico Water Resources Research Institute (NMWRRI) was established in 1963 by the New Mexico State University Board of Regents, becoming one of the first of the 54 state institutes approved nationwide under the authorization of the 1964 Water Resources Research Act. It is considered to be the statewide nucleus for coordinating water resources research. Using the expertise of researchers in a variety of disciplines at state-supported universities, the institute is able to respond to the critical water needs of New Mexico and the region. It operates under the general advice of a Program Development and Review Board, whose membership includes faculty representatives as well as state and federal agency personnel.

The mission of the NMWRRI is to develop and disseminate knowledge that will assist the state, region, and nation in solving water resources problems. The institute encourages university faculty statewide to pursue critical areas of water resources research while providing training opportunities for students who will become our future water resources scientists, technicians, and managers. It provides an outlet for transferring research findings and other related information to keep water managers and the general public informed about new technology and research advances. The institute also maintains a unique infrastructure that links it with many federal, state, regional, and local entities to provide expertise and specialized assistance.

The institute maintains a dynamic program to transfer technical information from the producer to the user and the public. Technical publications, newsletters, conferences, press announcements, and presentations keep practitioners aware of new technology and research advances. The NMWRRI homepage (wrri.nmsu.edu) provides online information about the institute, newsletters, technical report series, requests for proposals, upcoming conferences and symposia, links to related entities, and the research reference library.

New Mexico is one of the driest states in the nation, averaging no more than 20 inches of precipitation a year, varying from about 6.5 inches in the Four Corners area to more than 30 inches in the high mountains. The relative humidity is low, resulting in a high rate of evaporation. Summer rain accounts for almost half of the annual precipitation other than in the high mountains. Widely varied precipitation contributes as much to a water allocation problem as water scarcity itself. To compound the situation, New Mexico, like much of the West, continues to suffer from drought. Water conservation measures continue to expand in municipalities throughout New Mexico to help ensure adequate public water supplies for residential and industrial use. Drought ordinances are in place in cities across the state, and county and municipal governments are working together to limit water use and reduce demand. The Drought Task Force, established in 2002 by New Mexico's governor, continues to monitor the situation.

During the past year, a strong La Niña event delivered dry conditions to New Mexico and 61 percent of the state is currently classified with extreme and exceptional drought. Dry conditions of this magnitude are rare-exceptional droughts and occur once in every 50 years. Drought impacts are many including farmers in the Elephant Butte Irrigation District receiving only three inches of water per acre this year, (whereas they typically receive 36 inches) requiring more groundwater pumping at a high cost.

Water problems in New Mexico, like in other western states, continue to revolve around three key issues: quality, quantity, and management. Because water resources are so limited, water quality and water resources management have taken on increasing importance. These concerns are interrelated and sufficiently complex so that the highest quality research is essential to solving them.

Research Program Introduction

The primary objective of the New Mexico Water Resources Research Institute is to maintain a balanced program of research that addresses water issues and problems critical to New Mexico, the region, and the nation. In administering this program, the institute relies on financial support from state appropriations, federal and state agencies, and the USGS Water Resources Research Institute Annual Base Program (USGS 104B).

To make the best use of limited resources, the institute has targeted four areas as high priority for funding: water conservation, planning and management; atmospheric, surface and groundwater relationships; water quality; and utilization of saline and other impaired waters. During the reporting period, two projects received funding from the 2010 Annual Base Program. These projects fit into the water conservation, planning and management category: "WRRI Information Transfer Program" and "Geographic Information System for Water Resources Planning." In addition, three projects received special funding through the USGS, "Transboundary Aquifer Assessment Program" (PL 109-448), "Monitoring and Forecasting Climate, Water and Land Use for Food Production in Afghanistan," and "Monitoring and Forecasting Climate, Water, and Land Use for Food Production and Business Development in Iraq."

During the reporting period, the NMWRRI administered a total of 10 projects dealing primarily with water planning and management issues. The total value of these projects was over \$1.8 million, including required cost sharing. Awards were made by the USGS, New Mexico Department of Agriculture, and from the institute's annual state appropriations. Dollar amounts per project award ranged from a small student research grant of \$4,953 to an international program effort of over \$868,000. During the reporting period, nine projects were conducted at New Mexico State University and one at New Mexico Highlands University. NMWRRI staff managed six projects.

Research projects administered by the NMWRRI utilized at least 12 students during the year including undergraduates, masters, and Ph.D. candidates in the disciplines of agricultural economics, civil engineering, geography, mathematics, and natural resource management.

Projects administered by the NM Water Resources Research Institute during the reporting period are listed below. Note that total award value is shown and includes both agency and cost sharing when appropriate, and can include multiyear funding.

Effects of Copper Sulfate Treatment on Benthic Macroinvertebrates in Peterson Reservoir Sediments. WRRI Student Research Grant 09 (Daryl Williams, New Mexico Highlands University) \$4,953

Maintenance and Updates of the PdNWC Website and Web Mapping Application. Texas A&M U, \$5,588

New Mexico Pesticide Management Plan 2009-2010. Memorandum of Agreement with the New Mexico Department of Agriculture \$24,000

Lower Rio Grande Water Rights Value Project. NMSU and state funding, \$30,000

Information Transfer Program (Catherine Ortega Klett) 104B \$50,727

Geographical Information System for Water Resources Planning (Karl Wood) 104B \$24,864

Water Information Websites Phase II. SCERP \$66,523

Research Program Introduction

Transboundary Assessment Act Mesilla Basin Workplan. USGS \$100,044

Monitoring and Forecasting Climate, Water and Land Use for Food Production in Afghanistan. USGS \$698,640 (yr 3)

Monitoring and Forecasting Climate, Water, and Land Use for Food Production and Business Development in Iraq USGS \$868,069 (yr 1)

Award No. 08HQAG0146 Monitoring and Forecasting Climate, Water and Land Use for Food Production in Afghanistan

Basic Information

Title:	Award No. 08HQAG0146 Monitoring and Forecasting Climate, Water and Land Use for Food Production in Afghanistan
Project Number:	2008NM114S
Start Date:	9/22/2008
End Date:	9/21/2013
Funding Source:	Supplemental
Congressional District:	2
Research Category:	Climate and Hydrologic Processes
Focus Category:	None, None, None
Descriptors:	Afghanistan, crop growth, agriculture, economics
Principal Investigators:	M. Karl Wood, Frank Ward

Publications

1. Gregory Torell, 2010, Economic analysis for improved water management, food security, and rural livelihoods in Afghanistan's Balkh Basin, M.S. Thesis, NMSU Department of Agricultural Economics and Agricultural Business.
2. Gregory Torell, Balkh River Canal System, Afghanistan Decision Support (excel spreadsheet), posted on the web at <http://agecon.nmsu.edu/fward/water/>
3. Torell, G. and F.A. Ward, 2010, Improved Water Institutions for Food Security and Rural Livelihoods in Afghanistan's Balkh River Basin, International Journal of Water Resources Development, 26,4,613-637.

Description of problem and research objectives

This is the third year of a cooperative agreement with NMSU and USGS in support of the development of reducing food poverty through development of improved irrigation institutions in Afghanistan. Activities have focused on the application and development of techniques for monitoring the physical variables governing crop growth, such as timing and level of precipitation, evapotranspiration and temperature, along with human-related factors such as cropped area, agricultural inputs, and economic indicators.

These data have been integrated into an analysis of policy options for improving farm income, rural food security, and improved livelihoods. Recent work has developed and applied a framework to inform farmers, extension personnel, mirabs, and ministry personnel on uses of land and water resources in the Balkh River Basin to improve farm income and reduce food poverty.

A journal article is currently under review at the journal, *Agricultural Water Management* summarizing connections between irrigation institutions and food poverty in Afghanistan. The research examined the development of irrigation institutions that could contribute to reducing food poverty by improved water allocation among canals.

Description of methodology

Funding under Agromet has supported the following activities:

Installation of 113 weather observation sites: 1) all 113 observation sites are recording daily rain and snow; 2) 80 of 113 sites are reporting in addition to rain and snow on crops (wheat, rice, barley and maize) and pasture and grazing twice a month (fortnightly forms) including crop condition (all the weather adverse factors, shortage of inputs, weed, pests and diseases infestations) and crop phenological stages (including land preparation) in addition to areas planted (% of the total by agricultural zone), planting and harvesting dates in addition to the expected yields during the agricultural year and final obtained yields after the harvesting; and 3) of 113 sites, 21 sites are complete agrometeorological stations (three observations daily), with 19 classical stations recording 7 weather parameters and 5 automatic stations that can report on up to 20 weather parameters at daily step.

Using weather, hydrologic, agronomic, and economic data, several arrangements for allocating water through an existing network of irrigation canals were analyzed for their impacts on land and water use, farm profitability, and food security at both the canal and basin levels.

Description of principal findings and significance

Findings show that total water supply and institutional arrangements for allocating water during periods of shortages have important influences on farm income and food security. The methods used and results found provide a framework for informing decisions on the sustainable use of land and water for improved food security and rural livelihoods in the world's irrigated areas.

Award No. 08HQAG0117 Transboundary Aquifer Assessment Program

Basic Information

Title:	Award No. 08HQAG0117 Transboundary Aquifer Assessment Program
Project Number:	2008NM115S
Start Date:	4/1/2008
End Date:	5/31/2011
Funding Source:	Supplemental
Congressional District:	2
Research Category:	Ground-water Flow and Transport
Focus Category:	Groundwater, None, None
Descriptors:	aquifer assessment, Mesilla Basin, Hueco Bolson, GIS, database,
Principal Investigators:	M. Karl Wood

Publications

1. Hawley, John W. and Alfredo Granados-Olivas, 2008, Progress Report on Development of an Annotated Bibliography for Transboundary Aquifer Systems of the Mesilla Basin-Paso del Norte Area, New Mexico, Texas (USA), and Chihuahua (MEX), poster presented at the 2008 New Mexico Water Research Symposium, Socorro, NM, August 2008, Symposium Program and Abstracts.
2. Hawley, J.W., B.J. Creel, and B.V.N.P. Kambhammettu, 2009, Digital hydrogeologic-framework model of the San Francisco River basin, west-central New Mexico and east-central Arizona [abstract], Geological Society of America. Abstracts with Programs, 41(7) Session 58-T21 on CD ROM. ISSN 0016-7592.
3. Hawley, J.W., J.F. Kennedy, A. Granados-Olivas, and M.A. Ortiz, 2009, Hydrogeologic framework of the binational western Hueco Bolson-Paso del Norte area, Texas, New Mexico, and Chihuahua. NM Water Resources Research Institute, NM State University, Technical Completion Report 349. 45 p., with 2 plates on CD ROM. <ftp://wrrri.nmsu.edu/pub/hueco>
4. Monger, H.C., L.H., Gile, J.W. Hawley, and R.B. Grossman, 2009, The Desert Project: an analysis of aridland soil-geomorphic processes New Mexico State University Agricultural Experiment Station Bulletin 798. 76 p., <http://aces.nmsu.edu/pubs/research/weather-climate/>
5. Creel, B.J., 2010, Research Needs in the U.S. Portion of the Rio Grande Watershed, E.M. Ward and E.A. Barrantes (eds), Journal of Transboundary Water Resources, 01:31-42.
6. Schmid, W., J.P. King, and T. Maddock III, 2010, Conjunctive Surface-Water/Groundwater Model in the Southern Rincon Valley Using Modflow-2005 with the Farm Process, NM Water Resources Research Institute, New Mexico State University, Technical Completion Report No. 351, 65 pp.
7. Servicio Geologico Mexicano, Coordinacion General de Minería, and International Boundary and Water Commission, 2011, Hydrogeological Activities in the Conejos-Medanos/Mesilla Basin Aquifer, Chihuahua, Phase 1. Prepared for the Transboundary Aquifer Assessment Act Project under contract with the New Mexico Water Resources Research Institute and Texas Water Research Institute. Two volumes.
8. Kambhammettu, B.V.N.P., J.P. King and A. Praveena, 2011, Evaluation of mountain-front recharge estimation techniques for Southern New Mexico basins. International Journal of Water Resources and Environmental Engineering, 3(3):66-72.

Description of problem and research objectives

Rapid population growth in the United States-Mexico border region over the last decade has placed major strains on limited water supplies in the region. Rapid growth rates are expected to continue for at least several more decades. Water quantity and quality issues are likely to be the determining and limiting factors affecting future economic development, population growth, and human health in the border region. Increasing use of groundwater resources in the border region by municipal and other water users has raised serious questions concerning the long-term availability of the water supply.

Cooperation between the United States and Mexico in assessing and understanding transboundary aquifers is necessary for the successful management of shared groundwater resources by state and local authorities in the United States and appropriate authorities in Mexico, including management that avoids conflict between the United States and Mexico. While there have been some studies of binational groundwater resources along the United States-Mexico border, additional data and analyses are needed to develop an accurate understanding of the long-term availability of useable water supplies from transboundary aquifers.

The objectives of the Transboundary Aquifer Assessment Program is to collect and evaluate new and existing data to develop high-quality, comprehensive groundwater quantity and quality information and groundwater flow models for the Mesilla Basin aquifer in New Mexico, Texas, and Mexico.

Description of methodology

A review of all previously developed groundwater flow models was conducted last year. This year field studies were used to develop any additional data that are needed to define aquifer characteristics to the extent necessary to enable the development of groundwater flow models. Additional evaluations of all available data and publications relevant to the aquifer and produce a binational bibliography were conducted. The project utilized the geographic information system database that was created last year to better characterize the spatial and temporal aspects of the aquifer, with emphasis on a digital model of the hydrogeologic framework. The project also continued to expand existing agreements, as appropriate, between the authorities in the United States and Mexico to (1) conduct joint scientific investigations; (2) archive and share relevant data; and (3) carry out any other activities consistent with the program. A basin steering committee of local stakeholders was established to provide review and feedback on tasks and products.

Description of principal findings and significance

A bibliography of previous studies that was compiled in 2008 has been updated and reviewed by the USGS, New Mexico, and Texas team. This is an ongoing process as more literature is found and new literature is written. The basin-scale hydrogeologic framework model that was produced in 2005, including cross sections and model layer maps, was reviewed and updated with recent information and a new compilation of well-control data. Expansion of this model into Mexico has been proposed and is pending finalization of the binational agreement for conducting joint investigations and basic-data sharing. Mesilla Basin groundwater flow models developed in the last 20 years have been reviewed and evaluated for their possible future use and modification. This evaluation still needs collaborative input from the Mexican authorities before selection of the most appropriate flow model(s) for expansion into Mexico.

The regional hydrology model of the area released by the New Mexico State Engineer in 2007 has been updated through 2009. The new Farm Module feature of MODFLOW has been added to the model and runs are being done to compare the new version with the OSE version.

The basic binational-agreement documents related to conduct of joint investigations and data sharing were signed in August 2009; and specific final arrangements for agreement implementation are planned for completion in March-April 2010.

USGS Award No. G10AC00516 Monitoring and Forecasting Climate, Water, and Land Use for Food Production and Business Development in Iraq

Basic Information

Title:	USGS Award No. G10AC00516 Monitoring and Forecasting Climate, Water, and Land Use for Food Production and Business Development in Iraq
Project Number:	2010NM123S
Start Date:	9/1/2010
End Date:	8/31/2015
Funding Source:	Supplemental
Congressional District:	2
Research Category:	Climate and Hydrologic Processes
Focus Category:	Drought, Water Use, Management and Planning
Descriptors:	Forecasting, Climate, Water Use, Land Use, Agriculture, Drought
Principal Investigators:	M. Karl Wood, Frank Ward

Publications

There are no publications.

Description of problem and research objectives

This program supports the Iraq Water, Agriculture, geospatial data infrastructure and Technology Transfer Program. Streamflows in the Tigris-Euphrates Rivers in Iraq have declined in recent years, and an important policy debate centers in the most economically viable measures for making more economical and business use of those reduced flows in Iraq. The objective of this project is to explore the development of innovative irrigation institutions for allocating water and water rights among water users in Iraq in order to secure more economically productive uses of water in the Tigris-Euphrates basins.

Overall Agromet project objectives are:

- Install Agro-meteorological stations throughout the country
- Set up an operational agro meteorological database and information system functioning efficiently, including all the relevant data (historical and recent)
- Carry out agro climatic analyses for major agro meteorological parameters.
- Provide timely, accurate, and reliable data for decision makers, government agencies, international forces, and national and international NGOs.
- Assist the Iraq Government in their efforts to collect and analyze meteorological and agricultural data as it relates to crop production, irrigation, water supply, energy, dust storms, and aviation.
- Create a transition plan for future implementation by Iraq government officials.
- Play a key role in the institutional capacity building and training of Iraqis in the field of agro- and hydro-meteorology.

Description of methodology

- A. Collecting agro-meteorological data for water and crop monitoring and forecasting
- B. Collecting meteorological data for dust storm forecasting
- C. Development of crop monitoring and production estimating tools
- D. Temperature and photoperiod inputs to yield estimation
- E. Development of hydroeconomic policy analytic tools
- F. Improved rainfall forecasts
- G. Improved understanding of relations between snowpack and streamflow
- H. Teach short courses in Iraq on the development and use of hydroeconomic spreadsheet models to support policy analysis of irrigation water management in Iraq.

Description of principal findings and significance

A simple spreadsheet model is being planned for development for analyzing irrigation policy choices in cooperation with Iraqi counterparts in the Iraq ministry of water resources. A short course to apply the spreadsheet decision model has been scheduled to be presented in the early summer to selected stakeholders in Erbeal, Iraq. Watershed policy models are currently under development for the Amu Darya basin for which it is hoped that methods can be transferred to address policy debates on the Tigris-Euphrates in Iraq.

Information Transfer Program Introduction

The New Mexico Water Resources Research Institute maintains an active program to transfer technical information from the producer to the user and the public. Technical publications, newsletters, conferences, symposia, press announcements, and presentations keep practitioners aware of new technology and research advances. The WRII homepage (wrii.nmsu.edu) provides online information about the institute's newsletters, technical report series, requests for proposals, upcoming conferences and symposia, and the research reference library. All 55 past annual water conference proceedings have full-text viewing via the institute's homepage. Other federal and state servers, such as the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, USGS, and National Weather Service are linked to the WRII homepage.

Geographic Information System for Water Resources Research Planning

Basic Information

Title:	Geographic Information System for Water Resources Research Planning
Project Number:	2002NM1B
Start Date:	3/1/2010
End Date:	2/28/2011
Funding Source:	104B
Congressional District:	Second
Research Category:	Not Applicable
Focus Category:	Management and Planning, Conservation, Water Quality
Descriptors:	
Principal Investigators:	M. Karl Wood

Publications

1. Hawley, J.W. and J.F. Kennedy, 2004, Creation of a Digital Hydrogeologic Framework Model of the Mesilla Basin and Southern Jornada del Muerto Basin. New Mexico, Water Resources Research Institute, Technical Completion Report No. 332, New Mexico State University, Las Cruces, New Mexico. 105 p., with 7 plates and appendix on CD ROM.
2. Van Schoik, R., C. Brown, E. Lelea, and A. Conner, 2004, Barriers and Bridges: Managing Water in the U.S.-Mexican Border Region, Environment, 46:1.
3. Connell, S.D., J.W. Hawley, and D.W. Love, 2005, Late Cenozoic drainage development in the southeastern Basin and Range of New Mexico, southeasternmost Arizona, and western Texas, in S.G. Lucas, G. Morgan, K.E. Zeigler, eds., 2005, New Mexico's Ice Ages: New Mexico Museum of Natural History & Science Bulletin No. 28, p. 125-150.
4. Hawley, J.W., 2005, Five million years of landscape evolution in New Mexico: An overview based on two centuries of geomorphic conceptual-model development, in S.G. Lucas, G. Morgan, and K.E. Zeigler, K.E. eds, 2005, New Mexico's Ice Ages: New Mexico Museum of Natural History & Science Bulletin No. 28, p. 9-93.
5. Pazzaglia, F.J. and J.W. Hawley, 2004, Neogene (rift flank) and Quaternary geology and geomorphology, in G.H. Mack, G.H., and K.J. Giles, eds., The Geology of New Mexico: A geologic history: New Mexico Geological Society, Special Publication 11, p. 407-438.
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8. Kennedy, J.F., 2004, Application of GIS and Remote Sensing Methods to the Paleohydrogeography of the Paso del Norte Region, Ph.D. Dissertation, Department of Geological Studies, University of Texas at El Paso, El Paso, TX, variously paged.
9. Hawley, J.W. and J.F. Kennedy. 2004 (2005), Creation of a Digital Hydrogeologic Framework Model of the Mesilla Basin and Southern Jornada del Muerto Basin. New Mexico Water Resources Research Institute; prepared for Lower Rio Grande Water Users Organization; Technical Completion Report 332, 105 p., with plates and appendix on CD ROM (including June 2005 Addendum extending model

Geographic Information System for Water Resources Research Planning

- into Rincon Valley and adjacent areas).
10. King, J.P., J.W. Hawley, J.W. Hernandez, J.F. Kennedy and E.L. Martinez. 2006. Study of Potential Water Salvage on the Tucumcari Project Arch Hurley Conservancy District: Phase I. A pre-appraisal-level study of the potential amount of saved-water and the costs of alternative methods of reducing carriage losses from district canals. New Mexico Water Resources Research Institute, Technical Completion Report No. 335, with plates and appendices on CD ROM.
 11. Hawley, J.W., J.F. Kennedy, and M. Ortiz. 2005. Digital hydrogeologic-framework model of the western Hueco Bolson area, Texas and Chihuahua. New Mexico Water Resources Research Institute, New Mexico State University. Project Completion Report, prepared for California State University-Los Angeles (CSULA Purchase Order CGA46120/NMSU Acct # 20050644), 45 p., 2 plates.
 12. Creel, B.J., J.W. Hawley, J.F. Kennedy, and A. Granados-Olivas. 2006. Groundwater resources of the New Mexico-Texas-Chihuahua border region. *New Mexico Journal of Science*. 46:11-29.
 13. Granados-Olivas, A., C. Brown, J. Greenlee, B. Creel, J.W. Hawley, J.F. Kennedy, O. Dena-Ornelas, and B. Hurd. 2006. Geographic information systems at the Paso del Norte region: The academic accomplishments and challenges for a transboundary water resources GIS cooperation. *New Mexico Journal of Science*. 46:45-56.
 14. Kennedy, J.F., R.P. Langford, and J.W. Hawley. 2006. Using GIS and Remote Sensing to Reconstruct Late Quaternary and Early Holocene Paleo-Hydrography Using Climate Data and Modern Topography: An example from the Southwestern US. *Computers and Geosciences*. In press.
 15. Kennedy, J.F., R.P. Langford, and J.W. Hawley. 2006. Estimating a Water-Balance Equation for a Playa in the Tularosa Basin of Southern New Mexico. *Computers and Geosciences*. In press.
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 17. Ortiz, Marquita. 2007. The Impacts of Land Use Change on Water Resources and Traditional Acequia Culture in Northcentral New Mexico. Master's thesis, Department of Geography, New Mexico State University, Las Cruces, NM.
 18. Alfredo Granados-Olivas, Erick Sanchez-Flores, Antonio De la Mora-Covarrubias, Servio Tulio De la Cruz, Gerardo Reyes-Macías, Francisco Llera-Pacheco, Javier Chavez, Bobby Creel, and Christopher Brown, 2008, Roadmap of Geospatial Education in Mexico, ASPRS 2008 Annual Conference Portland, Oregon, April 28-May 2, 2008.
 19. Glaze, Susanna, Bobby J. Creel, Casey Gomez and Royce Stevens, 2008, Rio Grande Basin Initiative Interactive Mapping for New Mexico, In Proceedings of the 2008 AWRA Spring Specialty Conference, San Mateo, CA, March 17-19, 2008.
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 21. Hawley, J.W. and Kernodle, J.M., 2008, Early contributions to arid-zone hydrogeology in the eastern Basin and Range region Historical Note: *Ground Water*, 46(3), 510-516.
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Geographic Information System for Water Resources Research Planning

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25. Hawley, J.W., and Kennedy, J.F., 2008, Digital hydrogeologic models of basin-fill aquifer systems in the southwestern New Mexico border region A powerful tool for binational water-resources management: American Institute of Professional Geologists 45th Annual Meeting AIPG-AHS-3rd IPGC Symposium, Flagstaff, AZ, Program-Poster Abstract, p. 48.
26. Monger, H. C., Gile, L.H., Hawley, J.W., and Grossman, R.B., 2008, The Desert Project An analysis of arid land soil-geomorphic processes, in Topical Session T17. Integration of soils and geomorphology in deserts: A tribute to the 50 years of soils research of Dan Yaalon: Geological Society of America/Soil Science Society of America-Joint Meeting, GSA Abstract with Programs, 40(6).
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Geographic Information System for Water Resources Research Planning

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Problem and Research Objectives

The New Mexico Water Resources Research Institute has become the focal point for geographic information system (GIS) data and information concerning water resources in New Mexico. It combines database management with digital mapping into spatial-tabular data models. These models are powerful tools for representing and manipulating earth-science information.

As use of geographic information systems has grown and presented new opportunities, it also has raised a number of new issues and problems. Of increasing concern is the management of a growing collection of spatial data sets and applications programs. These data sets and programs are very expensive to produce but relatively easy to share, so there is a great incentive to avoid duplicating production efforts. The trend clearly is toward managing these elements in distributed spatial libraries.

The primary objective of the project is to increase availability and accessibility of water resource information to support water resource planning and management in the state. The first task provides spatial data library accessibility. This task maintains arrangements and establishes those necessary to provide access to spatial data maintained by other agencies and organizations. The second task, spatial data development, evaluates needs, establishes priorities, and undertakes development of spatial data that is otherwise unavailable. These efforts will be coordinated with cooperating agencies and organizations to ensure no duplication of effort and to establish guidelines for coverages and priorities. The principal investigators maintain, update as necessary, and make the data available to cooperating agencies and organizations through both formal and informal arrangements to facilitate water resource planning activities.

Methodology

A number of cooperative data sharing agreements have been entered into with state, federal, and local agencies and organizations to facilitate access and to develop spatial data. Others will be pursued as necessary. Research funded by the NMWRRI in many cases results in the development of data that can be represented in a spatial form and thus can contribute to the state data pool. Projects that have such a potential are adjusted as necessary to meet this secondary purpose.

The NMWRRI maintains a GIS laboratory consisting of computer workstations; data storage devices; input/output devices; software for mapping and analysis (ARC/Info); database development and visualization; and network systems. The laboratory is connected via fiber to the New Mexico State University computer network and thereby to the Internet. The NMWRRI also maintains an Internet web server site through which both spatial and tabular water resource data can be provided.

Principal Findings

Various research activities are supported by the system for water resources planning in the state. The New Mexico Interstate Stream Commission provides grants to regional groups to support water resources planning. NMWRRI continues to be utilized by the NM Interstate Stream Commission to provide GIS mapping products for use in their plans and in public outreach. NMWRRI has helped many regional groups with GIS mapping products for use in their plans and in public outreach efforts.

Additionally, support has been given to the New Mexico/Texas Water Commission and various public entities of southern New Mexico for their planning activities. GIS mapping support is also provided to the Lower Rio Grande Water Users Organization.

This sophisticated mapping and geo-spatial database management system, originally designed to support WRRI-funded research activities, is now being used for external research grants (e.g., Creation of a Digital Hydrogeologic Framework Model of the Mesilla Basin and Southern Jornada del Muerto Basin; creation of maps for the purpose of water planning funded by the New Mexico Interstate Stream Commission; and pesticide management planning in the state funded by the New Mexico Department of Agriculture) by water resources management and planning agencies in the state. A research grant resulted in the creation of a regional geographic information system to support water planning in the Paso del Norte borderland area of the southwestern United States.

During the reporting period, projects funded through the GIS lab were sponsored by the New Mexico Department of Agriculture, the USGS, the Southwest Consortium for Environmental Research & Policy, and the National Park Service.

This is an ongoing project with new data continually being added to the database and assistance being given to produce specific GIS products upon request. Continued funding is anticipated from annual state appropriations as well as pending agency awards.

Information Transfer Program

Basic Information

Title:	Information Transfer Program
Project Number:	2002NM3B
Start Date:	3/1/2010
End Date:	2/28/2011
Funding Source:	104B
Congressional District:	Second
Research Category:	Not Applicable
Focus Category:	Education, Management and Planning, None
Descriptors:	
Principal Investigators:	Cathy T. Ortega Klett, Bobby J. Creel

Publications

1. Smith, G.B. and K.H. Oshima, 2004, Development of a Laser-Based Detection System for Water-Borne Pathogens. New Mexico Water Resources Research Institute, Technical Completion Report No. 331, New Mexico State University, Las Cruces, New Mexico, 10 pp.
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Information Transfer Program

35. Khandan, N.N. and V.G. Gude. 2010. Sustainable Recovery of Potable Water from Saline Waters. New Mexico Water Resources Research Institute, Technical Completion Report No. 355, NMSU, Las Cruces, New Mexico. 20 pp.
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38. Wood, M.K., and J. Mosely. 2010. Hydrologic and Vegetal Responses to Prescribed Burning and Herbicidal Treatment of Broom Snakeweed on Blue Grama Rangeland in New Mexico. New Mexico Resources Research Institute, Miscellaneous Report No. M31, NMSU, Las Cruces, New Mexico. 20 pp.
39. Wood, M.K., and B. Racher. 2010. Recovery of Habitat for Gila Trout and Livestock Grazing Following Wildfire in Main Diamond Creek in the Black Range of Southwestern New Mexico. New Mexico Resources Research Institute, Miscellaneous Report No. M30, NMSU, Las Cruces, New Mexico. 20 pp.
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Statement of Critical Water Problem

The New Mexico Water Resources Research Institute's Information Transfer Program is designed to bring the results of its research projects to the public and to educate New Mexicans on the critical water issues of the state, region, and nation. Different sectors of the public are targeted for each of its activities.

Statement of Results and Benefits

The program goal is to provide people with water information appropriate to their level of training and interest. Information transfer activities are funded primarily from non-federal sources. Responsibilities for different segments of the program have been assigned to various professional and support staff at the institute.

Nature, Scope, and Objectives

The primary methods for information transfer are conferences, publications, audio/visual presentations, and available information on the institute's website. For the past 55 years, the NMWRRI has sponsored the Annual New Mexico Water Conference focusing on a topic of importance to the New Mexico water community, usually policy oriented. The annual conference is held in different locations around the state in the fall. Most of the conference participants are water resources practitioners working for state, federal, or local agencies, although some members of the general public and of academia also attend. Average attendance ranges between 150 and 200 people, depending on the location and topic of the conference. A couple years ago, the New Mexico State Engineer called the WRRI annual conference the premier water meeting in the state. The WRRI began hosting a technical research symposium in 2002 and the annual event has become the focal meeting for researchers from around the state and region to share their water-related research and demonstration projects. Many students attend the symposium and present posters and oral presentations.

Publications include technical completion reports resulting from NMWRRI-sponsored projects, special in-house publications, and conference proceedings. The institute has published more than 385 technical and miscellaneous reports. The peer reviewed technical completion reports are directed toward water professionals working in disciplines related to the research projects. All technical reports are now available via the NMWRRI website in full text. Those interested in a particular report are able to print off the Internet instead of ordering a hard copy of the report. WRRI water conference proceedings for the past 55 years are also available online in full text.

A quarterly newsletter, *The Divining Rod*, focuses on research and current water issues. It is emailed to approximately 1,600 readers and hard copies are sent to about 200 readers. The newsletter is available on the WRRI homepage.

A reference room, housed at the institute, contains over 11,000 documents and is used frequently by faculty, students, and others. A complete catalog of holdings can be searched through the NMWRRI homepage on the Internet, along with an extensive water resources and information system database.

WRRI's homepage (<http://wrrri.nmsu.edu>) provides online information about the institute's newsletters, technical report series, requests for proposals, upcoming programs, and the research reference library. All WRRI reports are available for viewing online via the institute's website. The website, created in 1995, is updated on a regular basis and continues to be a focal point of information on New Mexico's water resources with many links to other related sites such as the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, USGS, and National Weather Service. In recent years, the WRRI website received an average of over 6,000 inquiries per month.

WRRI has developed a state-of-the-art geographic information system on water resources in New Mexico and has become the focal point for GIS data and information concerning water resources in the state. It combines database management with digital mapping into spatial-tabular data models. These models are powerful tools for representing and manipulating earth-science information. The primary objective of the system is to increase availability and accessibility of water resource information to support water resource planning and management in the state. Efforts are coordinated with cooperating agencies and organizations to ensure no duplication of effort and to establish guidelines for coverages and priorities. The staff maintains, updates as necessary, and makes the data available to cooperating agencies and organizations through both formal and informal arrangements to facilitate water resource planning activities.

The institute director is invited frequently to speak at local, regional, and national conferences and workshops in addition to serving on a number of committees that focus on water resources.

Accomplishments

The 55th Annual New Mexico Water Conference was held in Las Cruces at New Mexico State University. The conference theme was, "Water Needs in the Next Decade: How Will Institutions Evolve to Meet Our Water Needs in the Next Decade?" and was attended by about 150 participants. A full proceedings of the conference is in production and will be available on the WRRI website. All conference participants will receive a copy on CD.

The NMWRRI coordinated the 2010 New Mexico Water Research Symposium on the campus of New Mexico Tech, in Socorro. The one-day symposium was co-sponsored by Sandia National Laboratories, Los Alamos National Laboratory, New Mexico's three state universities, the Office of the State Engineer, New Mexico Interstate Stream Commission, and the AWRA-New Mexico section. Forty oral presentations were given and 32 posters displayed. This year, a special presentation on resource interdependence was made by Howard Passell of Sandia National Laboratories. Over 120 participants including 45 students from throughout New Mexico, Arizona, and west Texas attended. Twenty-four students gave oral presentations and 18 students presented posters.

The WRRI co-sponsored the Spring and Fall 2010 New Mexico State University Water Lecture Series, a monthly seminar with attendance averaging about 100.

The institute's publications for the period included five technical reports: "Simulation of

Groundwater Flow in the Southern Jornada Del Muerto Basin, Dona Ana County, New Mexico," "Digital Hydrogeologic-Framework Model of the San Francisco River Basin, West-Central New Mexico and East-Central Arizona," "Sustainable Recovery of Potable Water from Saline Waters," "Analysis of Water Rights Prices in New Mexico's Lower Rio Grande Basin," and "Estimating Water Use Through Satellite Remote Sensing." Two miscellaneous reports were also published, "Hydrologic and Vegetal Responses to Prescribed Burning and Herbicidal Treatment of Broom Snakeweed on Blue Grama Rangeland in New Mexico" and "Recovery of Habitat for Gila Trout and Livestock Grazing Following Wildfire in Main Diamond Creek in the Black Range of Southwestern New Mexico." The 55th Annual New Mexico Water Conference proceedings is being produced in hardcopy and on CD. NMWRRI technical completion reports are available at no charge while supplies last. A copy charge is assessed if the report is out of print or has been reprinted.

The institute's website averages over 45,000 webpage hits each month. It averages over 400 online requests for publications from its technical and miscellaneous report series and about an average of 100 hits per month of its proceedings series each month. Because of the ability to view and print all institute publications online, the WRRI is averaging only a few requests for hard copies of specific publications each month via postal mail or visits to the institute. Requests online have more than quadrupled in the past three years.

The institute's quarterly newsletter, *The Divining Rod*, is an eight- to sixteen-page newsletter that focuses on research projects administered by the NMWRRI and on current water issues in New Mexico. It provides information on upcoming conferences, seminars, and workshops; describes new grants and newly released publications; and provides general information on new developments in water resources research and management. Each issue is available on the NMWRRI's homepage. Hard copies of the newsletter are distributed to approximately 200 readers and about 1,600 readers receive it via email with a pdf of the newsletter attached. To become more cost-effective and to save resources, the institute recently moved to distributing the newsletter primarily via email. During the reporting period, the institute published three 12-page issues of *The Divining Rod*. The newsletter received an average of 150 hits per month online during the reporting period. Online usage of the WRRI's reference room averages over 350 requests per month.

The institute's director participates in local, state, and national conferences and workshops and speaks before many groups. The institute's director is an active member of the National Institutes for Water Resources and the Universities Council on Water Resources and will help in the planning of their 2012 national meeting. The NMWRRI staff also regularly provides expertise for solving specific problems and general concerns. They play a central role in planning for the water future of the region by cooperating with a host of water resources entities throughout the state and region, particularly in the Paso del Norte area.

The Information Transfer Program is an ongoing program with no particular timelines.

USGS Summer Intern Program

None.

Student Support					
Category	Section 104 Base Grant	Section 104 NCGP Award	NIWR-USGS Internship	Supplemental Awards	Total
Undergraduate	1	0	0	5	6
Masters	1	0	0	4	5
Ph.D.	0	0	0	1	1
Post-Doc.	0	0	0	0	0
Total	2	0	0	10	12

Notable Awards and Achievements

New Mexico State University Chemical Engineering Professor, Shuguang Deng, was the recipient of a \$2.346 million grant funded by the Air Force to study better ways to grow algae to be refined into algal biofuel. Dr. Deng received a two-year WRRRI seed grant to study solar desalination of brackish water using membrane distillation processes. He also supervised several WRRRI student research grants.

Dr. Nimala Khandan, professor of civil engineering at New Mexico State University was named the first holder of the Ed and Harold Foreman Endowed Chair in Civil Engineering at NMSU. A WRRRI seed grant recipient, WRRRI published his technical completion report in September 2010 entitled, "Sustainable Recovery of Potable Water from Saline Waters." Dr. Khandan has supervised several WRRRI student grant recipients.

John Hawley, long-time consulting associate with the New Mexico WRRRI, reviewed the article, "Transboundary Groundwater Policy: Developing Approaches in the Western and Southwestern United States" by Deborah L. Hathaway. The article appeared in the Journal of the American Water Resources Association in February 2011. The article cited several articles published by the NM WRRRI or written by WRRRI staff including John Hawley, Bobby J. Creel, and John F. Kennedy.

New Mexico State University College of Agricultural, Consumer, and Environmental Sciences Deans Award for Research Excellence, 2010, was awarded to Gregory Torell, a master's degree student working on the supplemental award entitled "Monitoring and Forecasting Climate, Water and Land Use for Food Production in Afghanistan." Principal investigator, Professor Frank Ward, will teach a related course in Valencia, Spain in May-June 2010 entitled, "Water Policy Analysis through Hydroeconomic Models."

Publications from Prior Years

1. 2006NM41B ("Mitigation of Membrane Biofouling by Harnessing Bacterial Cannibalism (Huang)") - Articles in Refereed Scientific Journals - Evdokimov, N.M. and S.V. Slambrouck, P. Heffeter, L. Tu, B. Le Calv, D. Lamoral-Theys, C.J. Hooten, P.Y. Uglinskii, S. Rogeli, R. Kiss, W.F.A. Steelant, W. Berger, J.J. Yang, C.G. Bologna, A. Kornienko, I.V. Magedov, 2011, Structural Simplification of Bioactive Natural Products with Multicomponent Synthesis 3 Fused Uracil-Containing Heterocycles as Novel Topoisomerase-Targeting Agents, *Journal Medical Chemistry*, 54(7)2012-2021.
2. 2006NM41B ("Mitigation of Membrane Biofouling by Harnessing Bacterial Cannibalism (Huang)") - Articles in Refereed Scientific Journals - Frolova, L.V. and N.M. Evdokimov, k. Hayden, I. Malik, S. Rogeli, A. Kornienko, I.V. Magedov, 2011, One-Pot Multicomponent Synthesis of Diversely Substituted 2-Aminopyrroles: a Short General Synthesis of Rigidins A, B, C, and D, *Organic Letters*, American 13(5)1118-1121.
3. 2000NM7G ("Institutional Adjustments for Coping with Prolonged and Severe Drought in the Rio Grande Basin") - Articles in Refereed Scientific Journals - De Mouche, L., S. Landfair, and F.A. Ward, 2011, Water Right Prices in the Rio Grande: Analysis and Policy Implications, *International Journal of Water Resources Development* (0790-0627), 27(2)291-314
4. 2000NM7G ("Institutional Adjustments for Coping with Prolonged and Severe Drought in the Rio Grande Basin") - Articles in Refereed Scientific Journals - Torell, G.L., F.A. Ward, and G.L. Torell, 2010, Improved Water Institutions for Food Security and Rural Livelihoods in Afghanistan's Balkh River Basin, *International Journal of Water Resources Development*, (0790-0627), 26(4)613-637.
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