IDENTIFYING TECHNOLOGIES TO IMPROVE REGIONAL WATER STEWARDSHIP

A CONFERENCE SERIES
FEATURING INTERSECTIONS OF TECHNOLOGY
AND WATER MANAGEMENT

NORTH – MIDDLE RIO GRANDE CORRIDOR

HOSTED BY THE UNIVERSITY OF NEW MEXICO

21 – 22 April 2004

PROCEEDINGS

Conference Series Chair: Dr. Roger L. Hagengruber, Director, UNM/OPST
Conference Series Co-Chair: Dr. James N. Bradbury, UNM/OPST
Site: Hilton Albuquerque Hotel
Co-Sponsors: UNM Office for Policy, Security, and Technology;
Los Alamos National Laboratory; and Sandia National Laboratories
Information: http://research.unm.edu/opst/#events

A Conference Series on

Identifying Technologies to Improve Regional Water Stewardship

"North - Middle Rio Grande Corridor" — 21 - 22 April 2004
Hosted by The University of New Mexico

Conference Chair: Dr. Roger L. Hagengruber; Co-Chair: Dr. James N. Bradbury;
Coordinator: Barbara L. Daniels
Conference Site: Hilton Albuquerque, 1901 University NE, Albuquerque, NM 87102
Conference Series organized by the UNM Office for Policy, Security, and Technology

General Information: http://research.unm.edu/opst/#events

Greetings:

We are pleased to welcome you to the first conference in the series on ***Identifying Technologies to Improve Regional Water Stewardship,*** which will explore the roles of existing and emerging technologies in improving the water environment of the Rio Grande Corridor from Colorado to Mexico. A major goal is identification of those technologies that could have the highest impact on understanding, managing, and ameliorating water issues related to availability, quality, and allocation to various categories of use. Particular emphasis will be placed, in this and future conferences, on technical areas and opportunities that draw from or contribute to the technology base of the universities, national laboratories, and industries located within the watershed of the river.

We are grateful for the support of the sponsors whose contributions are clearly essential for the success of this initial conference, focused on the North-Middle Rio Grande: UNM Office of the Vice Provost for Research; UNM Office for Policy, Security, and Technology; Los Alamos National Laboratory; and Sandia National Laboratories.

We appreciate the expertise and effort of the speakers and presenters in preparing their presentations and contributing to the success of this new conference series. A summary of this conference including recommendations generated will be prepared and distributed by the conference organizers. We look forward to building on these results during future conferences along the Rio Grande.

Sincerely,

Dr. Roger L. Hagengruber, Director
UNM Office for Policy, Security, and Technology

Dr. James N. Bradbury
UNM Office for Policy, Security, and Technology

PROSPECTUS

IDENTIFYING TECHNOLOGIES TO IMPROVE REGIONAL WATER STEWARDSHIP:
A CONFERENCE SERIES FEATURING INTERSECTIONS
OF TECHNOLOGY AND WATER MANAGEMENT

THEME: This conference series will explore the roles of existing and emerging technologies in improving the water environment of the Rio Grande Corridor from Colorado to Mexico. A major goal is identification of those technologies that could have the highest impact in understanding, managing, and ameliorating water issues such as those associated with availability, quality, and allocation to various categories of use. Particular emphasis will be placed on technical areas and opportunities that draw from or contribute to the technology base of the universities, national laboratories, and industries that are located within the watershed of the river. It is expected that a result of the conferences will be a framework that associates technologies with their potential usefulness, relative cost, technical risk, and current status or state of maturity. Such a framework would facilitate collaboration among regional institutions, regional and/or state strategic planning, and technology investment, and would also provide a valuable technical context for those involved in policy and planning.

BACKGROUND: The Rio Grande Corridor runs across three states and involves two countries. The river drains a region that generally has low precipitation, growing industrial development and population, limited and stressed stored water, and a very diverse historical water culture. Numerous conferences have focused on this water environment because the current situation is unstable and not easily managed, and the issues are likely moving from chronic to acute within a generation. Understandably, most of the conferences have placed emphasis on state and federal policy options, allocation and management strategies, and the diversity of other legal and technical areas associated with the problem. This conference series is not intended to address the entire range of issues and options associated with the Rio Grande Corridor water environment, but rather to examine the specific strategic options for technology to add to water availability and to optimize its use.

Interestingly, the river that serves to graphically draw attention to the limits that water can place on the future of the region, also serves to help us see an exceptional strength of the region in the science and technology resources available. Groups of scientists at regional universities and national labs, state agencies, and private sector organizations are working on technical ideas to address the range of water management and utilization options. This conference series will provide a forum for reviewing that body of work as a whole rather than as parts and pieces of the much wider water conference context. The goal of such an approach is to develop a comprehensive picture of how and where specific technologies could be employed and how much resultant improvement could be expected in the regional water environment.

Rather than review all water-relevant technologies across the national technology base, this conference will let the specific problems of the Rio Grande Corridor and the resources of the regional technology community define and narrow the range of technologies addressed. The conference will begin with presentations to provide a description of what is currently known (quantified) or modeled in terms of water availability, quality, allocation, and use; the status of long-term projections for these data; and the identification of important gaps in knowledge. With this context established, technical presentations will be invited that will include comments on the relevance of the topic to management and sustainability of the water resource. The technical presentations and associated discussion will take the majority of the time at the conference. The final segment will include a panel and open discussion of priorities and options intended to lead to recommendations for action, investment, and strategy. Conclusions drawn from the conference will reflect consensus where it exists and the breadth and diversity of options where no obvious recommendation is apparent.

ORGANIZATION: It is proposed that a series of three or four conferences be held at different locations along the Rio Grande Corridor, each having an element of regional emphasis appropriate to the location. The themes of the Corridor's water and technology environments, however, will be common to all of the conferences. In this fashion, it is intended to address the local aspects of issues and opportunities while not losing sight of the interconnectedness of the various sections of the Corridor. The larger intent of multiple conferences is to identify and shape the collective relationship between the water environment of the elements of the corridor and technology capabilities and options appropriate to the institutions of the region. A final conference may be necessary to develop strategies and plans for instituting the recommended technologies that take into account local cultural, political, and economic considerations.

Each conference will be one and one-half days in duration and will have as its host a university in the area. For example, the area of the north and middle Rio Grande would be hosted by UNM; the middle-south corridor by NMT; the south corridor and NM/TX and possibly US/Mexico border area by NMSU and UTEP. The UNM Office of Policy, Security, and Technology (OPST) will organize and provide funding sufficient to underwrite the conference at UNM, which would initiate the theme and organizing structure proposed for this series. OPST will work with the other universities in sponsoring, hosting, and organizing additional conferences, and provide planning, conference support, and a portion of the funding. The first conference will be available at minimal cost to assure participation by all targeted communities.

The first conference is proposed for early in 2004. Other conferences in the series would follow at 4-6 month intervals. OPST will work with various organizations along the Corridor to identify an appropriate scope, technical presentations, and participants. For the initial conference, and in support of future conferences, OPST will seek organizations that wish to contribute resources or share sponsorship. Given additional resources, the scope of preparatory work, breadth of participation, or amount of deliberative assessment after the conference could be expanded commensurately. Additional resources would also support publication of the proceedings.

The presented papers will be limited to technological approaches to improving the water environment in the region, but it will be important to assess these approaches with an awareness of the legal, sociocultural, economic, and political aspects of this complex area. In this regard, persons knowledgeable about the diverse non-technical aspects of the regional water issues will be invited to participate so that these perspectives can be folded into evaluation of technologies as appropriate. Available public opinion survey data germane to the conference theme will be included wherever the data can contribute to increasing the effectiveness of recommendations for the future.

Each presentation will include time for questions, comments, and limited dialogue to encourage a creative atmosphere for collective strategy development. At this point, all sessions are planned to be consecutive, but parallel sessions would be an alternative if the scope of the conference were to be expanded.

PARTICIPANTS: Participants will be invited from universities, state, local, and federal governments, national laboratories, private sector organizations, and other groups involved with the water environment of the region.

PAPERS: Papers presented at the conference will be selected by a conference steering committee from nominations by sponsoring and participating organizations. Poster sessions may be available to offer a venue to all interested parties.

FUNDING & SUPPORT: UNM/OPST will provide funding and logistical support for the first conference and will assist in sponsoring successive conferences. Increased funding for the first and subsequent conferences may become available through additional sponsorships. A final conference may be needed to develop strategies and plans for implementing and enabling specific technologies recognizing the cultural, political, and economic aspects of the issues.

EXAMPLES OF TECHNOLOGIES

A. Technologies related to water source and supply
   - Dynamics of aquifer change (percolation rates, recharge rates, injection methods)
   - Radioisotope tagging to determine sources and destinations
   - Modeling of characteristics of surface water, ground water, watersheds
   - Flood control techniques
   - Weather modification

B. Technologies related to water distribution and storage
   - Leak detection and suppression
   - Evaporation reduction (surfactants)
   - Phreatophyte control

C. Technologies related to water quality
   - Field and facility-based real-time water quality sensors
   - Desalination techniques
   - Purification techniques
   - Geochemical modeling of contaminant flow, protection from agricultural pollutants
   - Security and protection of water resources (prevention, detection, response)

D. Technologies related to water use
   - Conservation and reclamation
   - Low-water use agriculture
   - Zero-net program (reducing water consumption in energy production)

E. Broader system-type technologies that could be important
   - Satellite and aerial imaging and analysis (GIS approaches to overlay of water
   - Quantity, quality, use data with demographic, environmental, socioeconomic data)
   - IT for collecting, managing, disseminating information
   - Public opinion poll data
   - Adaptive complex system methods, integrated modeling

EXECUTIVE SUMMARY

I. INTRODUCTION

A new conference series, "Identifying Technologies to Improve Regional Water Stewardship," was launched on April 21-22, 2004 in Albuquerque, NM with the initial conference focused on the north-middle Rio Grande Corridor. The conference was hosted by the University of New Mexico and organized by the UNM Office of Policy, Security, and Technology, under the Vice-Provost for Research. Co-sponsors included Los Alamos National Laboratory and Sandia National Laboratories. The thrust of the conference series is to bring together experts from universities, national laboratories, government, and the private sector to explore roles of existing and emerging technologies in improving the water environment of the Rio Grande Corridor. A major goal is identification of those technologies, individually or in combination, that could have the highest impact in understanding, managing, and ameliorating water issues, e.g., those associated with availability, quality, and allocation to various categories of use. One result of the conferences should be a framework that associates technologies with their potential usefulness, relative cost, technical risk, and current state of maturity. This framework will facilitate collaboration among regional institutions and provide a technological context for those involved in regional and/or state water management, planning, and policy development.

The proceedings of this conference, including program, abstracts, and visual aids, is attached. There were 120 registrants for the conference, which included six sessions, each covering an important component of water management; a concluding panel discussion provided the groundwork for developing recommendations. Summaries of the sessions are contained in Section II, a snapshot of the panel discussion in Section III, and views of the way forward as seen by the conference chairs in Section IV.

II. SESSION SUMMARIES

Session 1: Setting the Context

To open the conference, broad perspectives were presented from different governance sectors concerned with water management: international, national, state, and municipal. Clearly, the ingredients of the regional water management problem mirror those of the most complex international systems: jurisdictional and regulatory issues, economic and cultural diversity, growth problems, ecohydrological variability and uncertainty, and climatic pressures. Senator Domenici, in a video presentation, outlined his views on improving water stewardship both nationally and in our region. In New Mexico, the Office of State Engineer and the Interstate Stream Commission are jointly charged with administering water management. Typically in the upper-middle Rio Grande Valley about 35% of available water is used for agriculture, 35% is consumed in riparian habitat systems, 25% is "lost" due to evaporation, and 5% is used by the domestic-industrial sector. Acquiring and analyzing the many types of data necessary for characterizing water quality and quantity requires tools such as sensors, aerial photography, remote sensing, and flow measuring networks. Integration of data and models should be used to expedite the process of water rights adjudication, monitor water depletion and evapotranspiration, improve irrigation efficiency, and evaluate the potential of establishing water markets through banking and leasing arrangements. The City of Albuquerque is aggressively embarking on the Drinking Water Project, the largest public works project in its history, as studies have shown that about 50% of pumped ground water is not being replenished. This project will entail new challenges with respect to water quality and treatment, water conservation and reuse, and potential security issues.

A public opinion survey in New Mexico revealed that, despite limited knowledge about many water issues, the public is supportive of increased funding for technologies that could have a positive impact on improving the situation.

Session 2: Technologies Related to Water Conservation and Irrigation Efficiency

Several papers in this session explored the potential of growing forage using hydroponic (controlled environment) techniques for improved water conservation; three demonstration projects are underway in New Mexico. The water use is approximately a factor of 50 less than that required for growing traditional hay; a 144 m^2 greenhouse requires low construction/operation costs and can effect a saving of some 350 acre feet of water per year. Other new research uses lysimeters to determine more effective parameters for the timing, amount, and manner of water supplied to various crops in NM leading to significantly improved irrigation efficiency. Controlling evaporation was discussed from several points of view. Evaporation from large reservoirs (typically 20-30% of inflow) may be significantly reduced through application of recently developed environmentally benign molecular surfactants and biosurfactants. Finally, two reports emphasized the importance of accurate measurements of evaporation and transpiration in riparian areas (responsible for

65% of surface water depletion in middle Rio Grande Valley) to estimate the usefulness of restoration activities such as thinning and clearing and to evaluate existing multidimensional models such as the ET Toolbox.

Session 3: Technologies for Evaluating Sources, Transport, and Hydrogeologic Architecture

The four papers in this session covered both numerical models for transport and flow and the investigation of groundwater transport using various kinds of tracers. The Interstate Stream Commission has developed a dynamically linked surface water and groundwater model to assist in making decisions in connection with efficient conveyance of water. Numerical subsurface flow models are used at Los Alamos National Laboratory to study how water moves through basins such as those near Albuquerque and Espanola. Tracer testing is providing new insights into groundwater flow characteristics and contaminant transport processes and could be very important for assessing water quality issues associated with contaminant migration. As a potential source of new water, cloud seeding is being evaluated by a group associated with the Region 3 Water Plan.

Session 4: Technologies Related to Water Quality: Measurement, Treatment, and Remediation

This session included seven papers covering such topics as treatments to reduce arsenic levels in groundwater, bioremediation of groundwater, and desalination technologies. The EPA reduction of the arsenic standard (50 to 10 ppm) could result in a very significant increase in water costs in some areas. The Arsenic Water Technology Partnership aims to move applicable technologies from the laboratory into field testing. A variety of treatment processes are being considered, e.g., coagulation/filtration, membranes, and ion exchange continuous flow. Also, biormediation can clean water by stimulating indigenous bacteria to chemically transform contaminants of concern into benign products. Bioremediation can be performed either ex situ (pump and treat) or in situ (e.g., borehole injection or infiltration trenches). Another area receiving attention is the remediation of co-produced water from the oil and gas industry. The economics of various approaches are being compared, taking into account operating plus capital costs. One promising method uses sorption of organics by zeolite, followed by air stripping and treatment by a bioreactor. A survey paper examined the status of desalination technology development and applications in NM. Worldwide about 1% of drinking water is derived from seawater using reverse osmosis systems. Studies are underway in NM to determine the best approaches for dealing with brackish aquifers although much cost reduction is necessary. Another presentation suggested that the problem of concentrate disposal resulting from inland desalination operations be converted into an asset with either specific recovered chemicals used as feedstock in various industries or production of electricity from solar brine ponds created with concentrate.

Session 5: Water Allocation and Use, Economic Issues, Evapotranspiration, and Ecosystem Monitoring

Two of the seven papers in this session examined the use of an integrated hydrologic-economic model for the Rio Grande Corridor that includes important physical science factors and also economic aspects of the region. The model has been used in an interactive manner with stakeholder participants including representatives of urban, agricultural, and environmental interests. For the San Luis Valley, a similar model was used to explore effects of changing crops and water allocations on the local economy and to obtain preliminary results on how a water-leasing market could develop. In another presentation the goals of the ZeroNet initiative were outlined, aimed at meeting New Mexico's increasing power demand with no increase in fresh water withdrawals. Techniques were proposed for using either treated or untreated produced water for cooling purposes. The final four papers contained descriptions of tools for ecosystem monitoring. Tunable Diode Laser Absorption Spectroscopy has been adapted for high-frequency measurements of carbon and oxygen isotope rations in CO_2 and water vapor. Such data can be used to determine how the efficiency of water use by plants, ecosystem carbon- water balance, and carbon storage respond to drought. Also, in the middle Rio Grande Basin measurements show that water evapotranspiration accounts for 20-50% of surface water depletions. Precise measurements of sound wave propagation (to determine wind speed) and water vapor content above the canopy measure the quantity of water that is transported away from the vegetation; the data are used to calculate the water lost from various kinds of forests and the amount that might be salvaged by thinning or removal of selected types of vegetation. Another tool for improving regional water stewardship is adaptive software (Genie) for generating new remote sensing image processing algorithms. Applications include high-resolution 12-type vegetation maps showing the effects of the Cerro Grande fire and the mapping of river and stream pollution associated with industrial and agricultural processes. Finally, a model was described that predicts minnow habitat availability, a function of water depth and velocity, in the Pecos River.

Session 6: Tools and Technologies for Multidisciplinary Data Integration, Modeling, and System Studies

The final session of the conference contained seven papers devoted to multidisciplinary/system studies. The Center for Rapid Environmental Assessment and Terrain evaluation will acquire and integrate real-time remotely sensed data from satellites to provide rapid assessment of changing environmental conditions in NM including water, vegetation, soil, climate, and disease occurrences. Another tool is the Resource Geographic Information System (RGIS), which currently has 1-m resolution digital orthophotos, land-use/land-cover maps, and archived data on climate, geology, hydrology, and Rio Grande channel and acequias. The Upper Rio Grande Water Operations Model is a set of daily time-step, river and

reservoir models, developed with historical hydrologic data, to yield "what-if" scenarios for daily reservoir operations and long-term planning. Another tool is based on an ecohydrological perspective that couples water, plant, and nutrient interactions with hydrological data and explores feedback from the biotic cycle to the water cycle. A Water Research Technical Assistance Office for the Espanola Basin is drawing together and disseminating information about drought, hydrology and geology studies, water supply, wastewater collection and treatment, water quality, and water allocation in that area. Finally, some ambitious and potentially valuable studies are underway aimed at using system dynamics frameworks for integrating natural and social processes important to watershed management, beginning with a three-county region in north-central NM. The challenge is to balance a highly variable water supply among the demands posed by urban development, irrigated agriculture, river/reservoir evaporation, and riparian/in-stream uses. In a related study, the disparate systems of hydrology, ecology, climate, demographics, economics, policy, and law are being incorporated into a decision model to quantify the complex dynamics between water supply and demand. Simplified models will be used for public outreach and stakeholder input.

III. PANEL DISCUSSION HIGHLIGHTS

A group of water management experts participated in a wide-ranging panel discussion concerning the role of technology in NM water stewardship. An overarching observation of the panel was that there are multiple drivers for new technologies including the funding climate, regulatory changes (e.g., arsenic standards), environmental issues (e.g., endangered species), legal settlements (e.g., Indian water disputes), and, of course, the severity/duration of the drought. In response to these drivers new technologies are developed and made available, e.g., to improve irrigation efficiency and other types of conservation; to effect treatment and remediation of brackish and polluted water; and to measure in real time water quality and quantity characteristics at a variety of locations throughout the watershed. Cost-effectiveness and time-scale for implementation need to be analyzed for determining priorities. Multidisciplinary approaches and models need to be emphasized that address the interconnectedness of technology, hydrology, legal and environmental issues, and socioeconomic factors. Many types of data need to be integrated into a whole basin view of a very complex ecosystem. Water banking is an attractive, and perhaps necessary, option but requires the availability and assessment of many types of information. Behavior and consumption patterns can be modified through "bottom-up" versus "top-down" management if the stockholders and public are kept informed through appropriate communication tools that help them understand the consequences of various water management scenarios.

IV. RECOMMENDATIONS ON THE WAY FORWARD

A detailed framework for evaluating the various technology options in terms of overall effectiveness for improving water stewardship in the Rio Grande Corridor requires study of the remainder of the Corridor. However, it seems worthwhile to consider some preliminary recommendations based on this very productive conference. Those of a more general nature are listed first; more focused recommendations directed toward specific technologies follow.

GENERAL RECOMMENDATIONS

(1) *Many codes and models separately and partially describe various aspects of the water environment.*

Develop a flexible and comprehensive water code/model that explores equitably providing and allocating sufficient quantity while protecting quality and ecosystems. We must manage water quality and quantity conjunctively, integrating water planning with land use planning. To satisfactorily represent the interconnectedness and complexity of our regional water system, the model should incorporate surface and groundwater budgets, evapotranspiration forecasts, demographics, economic considerations, and separated types of allocation (municipal, industrial, agricultural, environmental). Economic effects of water banking scenarios and variations in allocation (e.g., optimal cropping) need to be included. Such integrated, multidisciplinary, stakeholder-sensitive models will provide useful tools for engaging and educating policy makers, stakeholders, and the public.

(2) *The public is concerned but not well informed about water issues.*

Formulate and communicate in a better fashion to the public and stakeholders relative differences between alternative water scenarios, including possible risks, legal issues, and societal concerns; provide more venues to involve stakeholders in the decision-making process. Such interactions will promote upward diffusion of cooperation rather than top-down management. It is important to carefully track and understand public opinion on water issues using well-designed interviews and surveys.

(3) *Water problems are complex, interdisciplinary, and long-term.*

Develop and fund programs to encourage and train young scientists in the many components of good water management including hydrology, economics, law, sociology, and environmental **science.**

(4) *Too many water-related committees, agencies, task forces exist, with overlapping activities and responsibilities.*

Form a regional water planning/management oversight board with representatives of the scientific, modeling, legal, environmental protection, and socioeconomic communities to provide periodic review and oversight of water planning and management progress. This group should nurture coordination and consolidation of human resources and ensure that authority is coupled with responsibility and accountability.

SPECIFIC RECOMMENDATIONS

(1) Examine commonality, linkage, embedding options for consolidating the many models and codes that apply to water stewardship. These include URGWOM, Riverware, MRG groundwater model, POWERSim, ET Toolbox, etc. Some standardization and integration should permit better intercomparisons and ultimately provide a more efficient and comprehensive approach.

(2) Increase the use of remote sensing and GIS tools (multispectral scanners, LIDAR, radar, 1-m spatial resolution capability) to provide, where feasible and useful, direct mapping of water bodies and streams; classification of agricultural, natural, and other land uses in the watershed; detection of pollution and invasive species; measurement of soil moisture, snow cover, humidity, temperature, winds, evapotranspiration characteristics. Machine learning and intelligent searching of signals and images need to be employed for increased efficiency of assessment. Remote sensing data often need to be received, processed, distributed on the web with turn around times of hours rather than days or weeks. Seven-day weather prediction would be a boon to good water management.

(3) Explore evaporation reduction using environmentally benign biological surfactants or other materials and optimize the technique for mid-size reservoir use (Elephant Butte). Although estimated implementation costs are still rather high, so is the value of future water saved. Underground water storage achieved through percolation into the aquifer could be cost effective in some areas and should receive continued study.

(4) Increase water conservation by expanding hydroponic green forage projects, which can provide a factor of 50 saving in water over growing hay. Construction/operating costs are relatively low; since 50% of NM agricultural water is used to produce livestock forage, controlled environment agriculture should yield very significant savings with its year-round production, modularity, and scalability.

(5) Develop cost-effective, large-scale techniques for groundwater remediation of polluted/contaminated water, such as high-efficiency filtration, adsorption columns, or bioreactors to remove arsenic, nitrates, or organics from oil- and gas-produced water.

(6) Continue research on desalination systems, using both reverse osmosis and distillation, as they are potentially important for accessing water from the region's brackish aquifers; one aim should be to reduce the cost (now something like $700/acre-ft) by at least a factor of 5. Address disposal of salts in terms of economic possibilities (e.g. sale, electricity production from brine ponds) as well as environmental constraints.

(7) Develop and apply technologies for better measurement (both accuracy and time resolution) of plant and ecosystem carbon-water balance to understand response to drought and provide better management of ecosystems. Tunable diode laser absorption spectroscopy shows promise in this regard. Better measurements of water loss from riparian vegetation can be achieved with three-dimensional sonic eddy covariance at carefully selected stations. Short- term (minutes) and long-term data (months) are desired.

(8) Maintain work at a modest level on cloud seeding as a source of new water. Costs need to be realistically compared with desalination and various remediation approaches.

(9) Establish a field sensor laboratory to develop, test, and apply new, inexpensive, real time sensors to acquire data on sediment concentrations and characteristics, microbial quality, organic pollutants, and radioactive species.

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Conference Series is organized by the UNM Office for Policy, Security, and Technology

General Information: http://research.unm.edu/opst/#events

21 April, Wednesday: Continental Breakfast/Check-in (Colorado Room)		**7:30 – 8:30 AM**
Introduction / Overview	Roger L. Hagengruber, UNM Office for Policy, Security, & Technology	8:15 – 8:30
Welcome	Terry L. Yates, Vice Provost for Research, UNM	8:30 – 8:45
Water & Public Opinion in New Mexico	Roger L. Hagengruber, UNM/OPST	8:45 – 9:25
AM BREAK	COLORADO ROOM	9:25 – 9:40
SESSION 1: SETTING THE CONTEXT (Moderator: Roger L. Hagengruber, UNM)		
Guest Speaker: *International Aspects of Water Management*	Michael E. Campana, University of New Mexico	9:40 – 10:20
Guest Speaker: *Role of Technology for NM Water Management: State Perspective*	Rolf Schmidt-Petersen, NM Interstate Stream Commission	10:20 – 11:00
Guest Speaker: *Water Resources & Technology: Municipal Perspective*	John M. Stomp III, P.E., City of Albuquerque	11:00 – 11:40
Discussion		11:40 – 12:00
LUNCH	GARDEN ROOM	12:00 – 1:00
SESSION 2: TECHNOLOGIES RELATED TO WATER CONSERVATION & IRRIGATION EFFICIENCY (Moderator: Howard D. Passell, SNL)		
Status of Evaporation Suppression Research & Potential Applications for Water Management in NM	Mike Hightower, SNL	1:00 – 1:20
Hydroponic Forage for Water Conservation in Mexico	Hector M. Leon Gallegos, Consultant, SNL	1:20 – 1:40
Systems Assessment of Water Savings Impact of Controlled Environment Agriculture Forage Production	Darryl D. Drayer, SNL	1:40 – 2:00
Water Conservation Techniques in Irrigation: Trends & Technology	Phillip Pohl, SNL	2:00 – 2:20
Water Depletions from Soil Evaporation	John C. Stormont, UNM	2:20 – 2:40
Current State of the System: Water Management & the ET Toolbox	Steven Bowser, US Bureau of Reclamation	2:40 – 3:00
PM BREAK	COLORADO ROOM	3:00 – 3:15
SESSION 3: TECHNOLOGIES FOR EVALUATING SOURCES, TRANSPORT, & HYDROGEOLOGIC ARCHITECTURE (Moderator: Peter B. Davies, SNL)		
Linked Surface Water & Groundwater Model for San Acacia Reach as a Tool to Support Decision Making Analysis	Nabil Shafike, NM Interstate Stream Commission	3:15 – 3:35
Numerical Models and Water Resources	George Zyvoloski, LANL	3:35 – 3:55
Characterization of Groundwater Using Nonreacting & Reacting Tracers	Paul W. Reimus, LANL	3:55 – 4:15
Activities of the Jemez y Sangre New & Expanded Water Technologies Committee	Sigmund Silber, Jemez y Sangre Water Planning Council	4:15 – 4:35
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Water Warning: It's Not Just the Drought	Baird Swanson, NM Environment Dept.	4:35 – 4:55
Development of the River Interaction & Observation (RIO) Field Laboratory Consortium	Bruce M. Thomson, UNM	4:55 – 5:15

RECEPTION (Garden Room) – Cash bar. Everyone is welcome. 5:30 - 6:15 PM

BANQUET (Southwest Ballroom) – Reservation & ticket required (see Registration form) **6:15 – 8:30 PM**

The Role of Technology in Active Water Resources Management Guest Speaker: John R. D'Antonio, Jr., State Engineer

The Office of the State Engineer (OSE) and the Interstate Stream Commission (ISC) are separate but companion agencies charged with administering the state's water resources. The agencies have power over the supervision, measurement, appropriation, and distribution of almost all surface and groundwater in New Mexico, including streams and rivers that cross state boundaries. The State Engineer is also secretary to the ISC and oversees the staff of both agencies. He is the primary advisor to State government on water management.

22 April, Thursday: Continental Breakfast/Check-in (Colorado Room) **7:30 – 8:30 AM**

SESSION 4: TECHNOLOGIES RELATED TO WATER QUALITY: MEASUREMENT, TREATMENT, & REMEDIATION (Moderator: Michael E. Campana, UNM)

Aqueous Geochemistry of Uranium & Arsenic: Los Alamos & Surrounding Areas, NM	Patrick Longmire, LANL	8:00 – 8:20
Arsenic in the Groundwaters of NM: Challenges & Potential Solutions	Malcolm Siegel, SNL	8:20 – 8:40
New & Emerging Groundwater Remediation Technologies	H. Eric Nuttall, UNM	8:40 – 9:00
Vadose-Zone Contaminant Transport Modeling: Quantifying Uncertainty for Risk Assessment	Kay Birdsell, LANL	9:00 – 9:20
Water Treatment Technology for the Oil & Gas Produced Water	E. Jeri Sulllivan, LANL	9:20 – 9:40
Status of Desalination Technology Development & Potential Applications in NM	Mike Hightower, SNL	9:40 – 10:00
AM BREAK COLORADO ROOM		10:00 – 10:15
Technical Challenges to Concentrate Disposal from Inland Desalination	Kerry J. Howe, UNM	10:15 – 10:35

SESSION 5: WATER ALLOCATION & USE, ECOMOMIC ISSUES, EVAPOTRANSPIRATION, & ECOSYSTEM MONITORING (Moderator: James N. Bradbury , UNM)

Including Tradeoffs in Stakeholder Water Allocation Decisions: An Experimental Approach	Kate Krause, UNM	10:35 – 10:55
Information Technology—Improving Water Productivity: Case Study for San Luis Valley, CO	Mary Ewers, UNM	10:55 – 11:15
ZeroNet Water for Energy: Managing Water for Power Production	Cathy Wilson, LANL	11:15 – 11:35
Tools to Understand the Impact of Drought on Plant & Ecosystem Carbon & Water Balance	Nate G. McDowell, LANL	11:35 – 11:55
LUNCH GARDEN ROOM		12:00 – 1:00
State-of-the-art Technologies for Evaluating Water Use by Riparian Vegetation: UNM Hydrogeoecology & the Middle Rio Grande	James R. Cleverly, UNM	1:00 – 1:20
Adaptive Remote Sensing Software Tools for Improving Regional Water Stewardship	Steven P. Brumby, LANL	1:20 – 1:40
Modeling Habitat Availability as a Function of Flow Rate for the Pecos River, Part I: Depth & Velocity Availability	Jesse D. Roberts, SNL	1:40 – 2:00

SESSION 6: TOOLS & TECHNOLOGIES FOR MULTIDISCIPLINARY DATA INTEGRATION, MODELING, & SYSTEM STUDIES (Moderator: Cathy Wilson, LANL)

Development of a Technological Approach for Getting Satellite Information & Derived Products to End Users in Real Time	Louis A. Scuderi, UNM	2:00 – 2:20
NM RGIS: A Web Application for Discovering, Visualizing, & Acquiring Geospatial Data in Support of Water Stewardship Decision-Making	Karl Benedict, UNM	2:20 – 2:40
Implementation of Water Resource Management Technologies: Examples from the Rio Grande	Gail Stockton, US Army Corps of Engineers & Tim Ward, UNM	2:40 – 3:00
PM BREAK COLORADO ROOM		3:00 – 3:15
Water Stewardship in the Rio Grande Corridor: The Value of an Ecohydrological Perspective	Brent D. Newman, LANL	3:15 – 3:35
Water Research & Technical Assistance in the Espanola Basin, NM	Charlie L. Nylander, LANL	3:35 – 3:55
Cooperative Water Resources Modeling in the Middle Rio Grande Basin	Howard D. Passell, SNL	3:55 – 4:15
Whole-Basin, Multi-System Modeling on the Rio Grande	Vincent C. Tidwell, SNL	4:15 – 4:35
PANEL: Key Technologies for Improving Water Management: Pathways & Priorities (Moderators: R. L. Hagengruber & J. Bradbury) Panelists: Wilson (LANL), Passell (SNL), Schmidt-Petersen (ISC), Campana (UNM), Yates (UNM), Davies (SNL)		4:35 – 5:35
Closing & Adjournment	Roger L. Hagengruber, UNM/OPST	5:35 PM

This new conference series will bring together experts from universities, national laboratories, government, and the private sector to explore the roles of existing and emerging technologies in improving the water environment of the Rio Grande Corridor. A major goal is identification of those technologies that could have the highest impact in understanding, managing, and ameliorating water issues, e.g., those associated with availability, quality, and allocation to various categories of use. Particular emphasis will be placed on technical areas and opportunities that draw from or contribute to the technology base of the universities, national laboratories, and industries located within the Rio Grande watershed. It is expected that a result of the series will be a framework that associates technologies with their potential usefulness, relative cost, technical risk, and current state of maturity. Such a framework would facilitate collaboration among regional institutions, aid regional and/or state strategic planning, and guide technology investment; it would also provide a valuable technical context for those involved in policy and planning. **Registration:** The conference is hosted by UNM/OPST at no cost to the attendees; however, everyone is required to preregister by completing and submitting the registration form on the website. Direct registration questions to the Registrar (dcole@unm.edu). Conference check-in will be conducted onsite. **Banquet:** If you wish to attend the Banquet (21 April), complete the payment portion of the registration form and remit payment. Banquet reservations must be received by 14 April and are <u>not</u> final until payment has been received. Tickets indicating the meal selection are required.

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