Poster Abstracts

Optimization Techniques in the Membrane-Based Desalination Technologies

Leili Abkar, New Mexico State University
WERC/IEE, PO Box 30001, MSC WERC, Las Cruces, NM 88003-8001
abkar@nmsu.edu, 575-640-5236

Abbas Ghassemi, New Mexico State University
WERC/IEE, PO Box 30001, MSC WERC, Las Cruces, NM 88003-8001
aghasem@nmsu.edu, 575-646-2357

James Loya, Program Manager at WERC/IEE
WERC/IEE, PO Box 30001, MSC WERC, Las Cruces, NM 88003-8001
jloya@nmsu.edu, 575-646-6305

Poster Abstract 1

Optimization is the matter of investigation on other options or methods regarding the system expenditure or utmost performance based on the specific circumstances. This objective can be achieved by maximizing desired elements and minimizing undesired ones. To optimize the membrane-based desalination technologies such as reverse osmosis and electro dialysis reversal the desired factors and undesired ones should be determined. The desired factors that should be maximized are permeate flow rate and water recovery. Concentrate flow rate, energy consumption, operating pressure, final cost of water production are taken into consideration as a undesired factors, which should be minimize in order to optimize desalination system. In this paper, factors that contribute to the optimization is investigated and the techniques which have been applied are summarized.

Contact: Leili Abkar, New Mexico State University, WERC/IEE, PO Box 30001, MSC WERC, Las Cruces, NM 88003-8001, abkar@nmsu.edu, 575-640-5236

WITHDRAWN

Assessing Change and Resilience in a Northern New Mexico Acequia Irrigation Community

Amy Miller
University of New Mexico, 3337 Betts Drive NE, Albuquerque, NM 87111
amyrmiller11@gmail.com, 510-299-0689

Poster Abstract 2

Acequias in New Mexico are the oldest water management institutions of European origin in the United States. Remarkably, the acequias studied in this project have been continuously maintained for over 200 years. These communal water management systems have survived through major droughts and persisted through time, but are now vulnerable to new disturbances that threaten their livelihood. Research on these disturbances helps us protect acequias, not only for their inherent cultural and historic values, but also for the example they provide as an effective way to manage water in times of scarcity. This should be particularly important in an era and region of current and projected water shortages. Three major disturbances affecting the Rio Hondo acequias were studied in this project: land use change, climate change, and demographic change. Land use change was quantified over time by examining historic and contemporary aerial photos of the region in a Geographic Information Systems program and by utilizing a historic crop report. Climate data were collected from a number of sources and evaluated using a statistical trend test. Demographic data were collected mainly from the U.S. Census and the American Community Survey and analyzed through time. The findings suggest a loss of 25 percent of the agricultural lands in the Rio Hondo between 1969 and 2010, a shift towards less crop diversification, and displacement of agricultural land by development. The climate change research findings indicate that the region has experienced increased temperatures and drier conditions over time. Substantial shifts in demographics took place, including a decline in Hispanics and increase in Anglos, an aging of the population, and large overall population growth rates. Even with these major changes, the acequias in the Rio Hondo are found to be resilient, although there is some evidence of weakening of the acequia institution. Recommendations for future resilience are provided based on the report findings.

Contact: Amy Miller, University of New Mexico, 3337 Betts Drive NE, Albuquerque, NM 87111
amyrmiller11@gmail.com, 510-299-0689

Potential Climate Change Impacts on the San Juan - Chama Project

Jesse Roach
Sandia National Laboratories, P.O. Box 5800 MS 1137, Albuquerque, NM 87185-1137
jdroach@sandia.gov, 505-284-9367

Dagmar Llewellyn
U.S. Bureau of Reclamation, 555 Broadway Avenue NE, Albuquerque, NM 87102
dllewellyn@usbr.gov, 505-462-3594

Poster Abstract 3

The San Juan - Chama (SJC) inter-basin diversion moves water from the Colorado River basin into the Rio Grande basin. The SJC project, since it began operations in 1971, has never experienced a shortage, and as recently as 1999 was estimated to have a firm yield of 96,200 acre-feet per year (AF/yr). In the past 10 years, cities in the Rio Grande Valley have begun to augment local supplies with direct diversion of SJC water, making the reliability of those supplies ever more important. This poster presents results from the Upper Rio Grande Impact Assessment (URGIA) on the reliability of the SJC project under a changing climate. URGIA is an activity within the United States Bureau of Reclamation's West Wide Climate Risk Assessment. URGIA analysis suggests that a 96,200 AF/yr yield will not be firm if the future is at all similar to that characterized by the suite of general circulation models (GCM) simulations utilized in Phase 3 of the Coupled Model Intercomparison Project (CMIP3). According to URGIA simulations, the SJC project will experience supply shortages in more than 10% of simulation years in the 2020s, more than 25% of simulation years in the 2050s, and more than 35% of simulation years by the 2090s.

Contact: Jesse Roach, Sandia National Laboratories, P.O. Box 5800 MS 1137, Albuquerque, NM 87185-1137, jdroach@sandia.gov, 505-284-9367

Riparian Habitat Restoration of the Lower Rio Grande

Elizabeth Verdecchia
International Boundary and Water Commission, U.S. Section, 4171 N Mesa C100, El Paso, TX 79902
elizabeth.verdecchia@ibwc.gov, 915-832-4701

Poster Abstract 4

In 2009, the International Boundary and Water Commission, U.S. Section (IBWC) signed the Record of Decision (ROD) for long-term river management of the Rio Grande Canalization Project in New Mexico and Texas. The ROD incorporated 10 years of stakeholder discussions of river management alternatives and committed the IBWC to implement 30 habitat restoration sites and new management practices within the river channel and floodplain, such as phasing out grazing leases, evaluating channel maintenance activities, ceasing mowing in certain areas to develop managed grasslands, and invasive saltcedar control.

The U.S. Fish and Wildlife Department, through an interagency agreement, is assisting the IBWC to implement restoration sites. Since 2011, the two agencies have planted over 3,000 native willow and cottonwood trees and treated 300 acres of saltcedar on the first 5 pilot sites, with 4 new sites in the works. The restoration sites have a range of habitat types, including riparian woodland and dense willow habitat for the federally endangered Southwestern Willow Flycatcher.

The riparian vegetation will increase evapotranspiration, potentially using allocated water; therefore, the IBWC has initiated a public-partnership to develop an Environmental Water Transaction Program. IBWC will purchase over 450 acres of water rights for the restoration sites, both to offset water depletions and to ensure habitat persistence during drought years.

These partnerships are essential for the successful implementation of habitat of the Rio Grande. By the year 2019, the IBWC plans on restoring over 550 acres of native riparian habitat and 2,000 acres of managed grasslands.

Contact: Elizabeth Verdecchia, International Boundary and Water Commission, U.S. Section
4171 N Mesa C100, El Paso TX 79902, elizabeth.verdecchia@ibwc.gov, 915-832-4701

Using Remote Sensing and Ground Measurement to Assess Agricultural Water Use in Middle Rio Grande

Zohrab Samani, Salim Bawazir, R. Skaggs
New Mexico State University, Civil Engineering Dept., 3CE NMSU, Las Cruces, NM 88003
zsamani@nmsu.edu, 575-646-2904

John Longworth
NM OSE

Poster Abstract 5

Agriculture uses more than 90 percent of the water in New Mexico. Middle Rio Grande is a major component of the agriculture in Rio Grande Basin. Remote sensing technology was used combined with ground level measurements to determine spatial and temporal variability of agricultural water use in the area. The results showed that agricultural water use can be estimated through remote sensing with high accuracy. Various alfalfa fields were identified and annual and monthly ET for the individual fields were calculated. The results showed that while the theoretical water use for alfalfa is about 1200 mm, the actual water use varies from 650 mm to 1300 mm with an average of 1050 mm. The results of the remote sensing were compared with local ET flux measurements and ET estimate from crop production function.

Contact: Zohrab Samani, New Mexico State University, Civil Engineering Dept., 3CE NMSU, Las Cruces, NM 88003, zsamani@nmsu.edu, 575-646-2904

Bringing Back the Mosaic in the Middle Rio Grande Bosque

Jennifer F. Schuetz
Bosque Ecosystem Monitoring Program, Department of Biology, MSC 03 2020,
1 University of New Mexico, Albuquerque, NM 87131
schuetz@unm.edu, 505-277-0758

Kim D. Eichhorst
Bosque Ecosystem Monitoring Program, Department of Biology, MSC 03 2020,
1 University of New Mexico, Albuquerque, NM 87131
kimde@unm.edu, 505-277-0758

Poster Abstract 6

The Rio Grande has been changed from a shallow, wide, meandering river that frequently flooded the adjacent bosque (riparian forest), to an incised, straight channel as a result of flood control measures. Lack of flooding has led to a lack of habitat for cottonwood establishment, resulting in aging cottonwood stands with shade-tolerant exotic understory vegetation. This, combined with the predicted changes in precipitation, temperature and river flow, suggests a future with far fewer cottonwoods in the Rio Grande bosque. Creating a mosaic of habitats would allow the bosque ecosystem a greater range of response and higher tolerance to changes in weather patterns due to climate change. Instead of the current cottonwood gallery forest, there should be a patchwork of different-aged cottonwood stands, saltgrass meadows, areas of bare soil, wetlands, shrub thickets, and savanna-type landscapes. The increased resilience and health provided by a mosaic of habitats would increase ecosystem function and allow for less land management.

Contact: Jennifer F. Schuetz, Bosque Ecosystem Monitoring Program, Department of Biology, MSC 03 2020, 1 University of New Mexico, Albuquerque, NM 87131, schuetz@unm.edu, (505) 277-0758

Can Partial Root Zone Drying Conserve Water While Sustaining Chile Yield?

Harmandeep Sharma
New Mexico State University, Las Cruces, 2420 S. Espina St. Apt. 25, Las Cruces, NM 88001
sharmah@nmsu.edu, 575-652-0146

Manoj K. Shukla
Environmental Soil Physics, New Mexico State University, Las Cruces, NM, 945 College Ave,
Skeen Hall, P.O. Box 30003, Las Cruces, NM 88003
shuklamk@nms.edu, 575-646-2324

Poster Abstract 7

Water supplies are limited in arid climate and water- saving irrigation methods should be practiced. Three irrigation treatments were assessed for water uptake pattern and yield of chile (NuMex Joe Parker; *Capsicum annuum*) in greenhouse conditions. Drip irrigation treatments applied were (i) water applied at surface standard operating procedure or control (ii) water applied at 100% of control at 20 cm. depth, and (iii) water applied at 70% of control on alternate root compartments at fortnight interval. Continuous measurements of soil water content and soil temperature were carried out using TDR sensors and TMC6-HD sensors respectively. LI-6400XT used for plant physiological measurements. Other plant measurements including stem water potential, plant height, and root length density were also done. To calculate evaporative demands inside greenhouse, meteorological data including net radiation, air temperature, wind speed, and relative humidity was recorded. In both irrigation treatments higher root length seemed to compensate water stress by taking up more water from the water available zone of the root-soil system as was evident from the similar transpiration or photosynthetic rates among treatments. Both irrigation techniques could be adopted as water conservation method in arid environments.

Contact: Harmandeep Sharma, New Mexico State University, 2420 S. Espina St. Apt. 25, Las Cruces, NM 88001, sharmah@nmsu.edu, 575-652-0146

Vegetation Mortality in the Southwest: Testing the effects of heat and drought on plant mortality and survival

Sanna Sevanto
Los Alamos National Laboratory, Bikini Atoll Rd MS J495, Los Alamos, NM 87545
sanna@lanl.gov, 505-664-0232

Nate McDowell
Los Alamos National Laboratory
mcdowell@lanl.gov

Henry Adams
Los Alamos National Laboratory
adamshd@lanl.gov

Adam Collins
Los Alamos National Laboratory
acollins@lanl.gov

L. Turin Dickman
Los Alamos National Laboratory
lee@lanl.gov

Chonggang Xu
Los Alamos National Laboratory
cxu@lanl.gov

Poster Abstract 8

Vegetation is one of the key components of a healthy, sustainable water cycle. Vegetation stabilizes the water cycle by retaining moisture in the soil and by reducing run-off and erosion. It also provides a pathway for returning about half of annual land precipitation back to the atmosphere, helping to control land surface temperature, shorten heat waves and increase precipitation. During the past 20 years, drought-related, regional-scale forest mortality has affected many areas in the Southwest. Current climate scenarios predict even more frequent and severe droughts in this region in the future. Understanding what will happen to our forests under such conditions, and how forest disturbance could be prevented, is therefore essential for maintaining a habitable climate with stable water sources. To understand how drought and heat affect tree physiology and survival, we built an ecosystem scale manipulation experiment in Los Alamos, NM to simulate possible climate change effects in piñon-juniper woodland. Piñon pine and one-seed juniper use different strategies to control water use and photosynthesis during drought. According to current leading hypotheses of plant mortality mechanisms, these alternative strategies differentially affect survival time during droughts of contrasting duration and severity. We use the results from this experiment, to built tree mortality models for an Earth system model to better predict the extent of global tree mortality and its impact to our regional and global climate systems. Here, we present results from the first two years of this experiment and their expected impact on forest transpiration.

Contact: Sanna Sevanto, Los Alamos National Laboratory, Bikini Atoll Rd MS J495, Los Alamos, NM 87545 sanna@lanl.gov, 505-664-0232

Modular Pumped Hydro Energy Storage

Mark L. Bibeault
Los Alamos National Laboratory, Applied Engineering Division,
PO Box 1663, MS J576, Los Alamos, NM 87545
bibeault@lanl.gov, 505-665-1204

Poster Abstract 9

Building and operating “smart-sited”, scalable, closed-loop pumped hydro facilities near existing renewable generation sources and transmission lines, yet away from endangered species and environmentally sensitive areas, is a practical approach towards meeting future energy storage needs. Referred to as Modular Pumped Hydro (MPH), the technology is a paradigm shift away from conventional pumped hydro applications which are limited by geography and hydrologic resources, take up to 10 years to permit, build, commission, with initial capital costs exceeding 3 $/W. MPH offers opportunities to reduce permit, build, commission activities through smart siting and properly scaled design to 4 years total, utilizes a very mature, efficient (80% full cycle), reliable, low maintenance, and 4 decade design life technology, with capital costs approaching 2 $/W. MPH has operational characteristics that make the technology very desirable to use, such as the ability to start without grid voltage (i.e. black start), ability to reach full power in approximately a minute from a complete idle condition under emergency conditions, ability to swing from full power production to full energy storage, or vise versa, in less than 15 minutes and operate anywhere in-between at partial load conditions, and ability to both produce and store energy at the same time. MPH produces no emissions or solid waste, utilizes scalable man-made reservoirs with ring berms that are covered and lined resulting in zero net water consumption, and can utilize a variety of brackish or fresh water quality conditions. MPH ultimately provides system flexibility to constantly changing market conditions.

Contact: Mark L. Bibeault, Los Alamos National Laboratory, Applied Engineering Division, PO Box 1663, MS J576, Los Alamos, NM 87545, bibeault@lanl.gov, 505-665-1204

Using System Dynamics Modeling to Evaluate Environmental Flows in the Rio Chama, NM

Ryan Morrison
University of New Mexico, 1920 Vassar Dr. NE Apt 21, Albuquerque, NM 87106
rmorriso@unm.edu, 971-212-5876

Mark Stone
University of New Mexico, Department of Civil Engineering, University of New Mexico
210 University Blvd NE, Albuquerque, NM 87106
stone@unm.edu

Poster Abstract 10

Managing our water resources requires balancing of the economic, environmental, and social needs of the basin. It is difficult capture the impact of environmental flow alternatives on each of these components using traditional deterministic modeling approaches. System dynamics modeling offers a method of assessing the connections between economic, environmental, and social components of a basin and the impacts of flow alternatives on these components. Given the benefits of using a system dynamics modeling approach, our objective was to develop and demonstrate a stochastic system dynamics modeling framework to evaluate environmental flow alternatives. Specifically, our research examined the influence of flow alternatives on cottonwood recruitment and reservoir storage within the Rio Chama basin, New Mexico, USA. We used the "recruitment box model" to evaluate the impact of three alternatives on cottonwood recruitment within the project reach. We also show that alternatives can be evaluated using comparative metrics, which allow managers to more easily employ an adaptive management strategy for incorporating environmental flows into existing operations.

Contact: Ryan Morrison, University of New Mexico, 1920 Vassar Dr. NE Apt 21, Albuquerque, NM 87106 rmorriso@unm.edu, 971-212-5876

Modeling Potential Impacts of Pumping a Non-Potable Water Supply for the Ochoa Potash Mine

Cheng Cheng
INTERA, Inc, 6000 Uptown Blvd, Suite 220, Albuquerque, NM 87110
ccheng@intera.com, 505-246-1600 x1245

Annelia Tinklenberg
INTERA, Inc, 6000 Uptown Blvd, Suite 220, Albuquerque, NM 87110
atinklenberg@intera.com, 505-246-1600 x1208

Bill Linderfelt
INTERA, Inc, 6000 Uptown Blvd, Suite 220, Albuquerque, NM 87110
blinderfelt@intera.com, 505-246-1600

Peter Castiglia
INTERA, Inc, 6000 Uptown Blvd, Suite 220, Albuquerque, NM 87110
pcastiglia@intera.com, 505-246-1600

Randy Foote
Intercontinental Potash Corp. (USA), 30 Johnson Road, Suite 300, Golden, CO 80401

Terre Lane
Intercontinental Potash Corp. (USA), 30 Johnson Road, Suite 300, Golden, CO 80401

Poster Abstract 11

Competing for limited water supplies in the arid Southwest is a challenge for new mines looking to gain public and regulatory support for proposed projects. Focusing on deep, non-potable groundwater sources for mining and industrial purposes can reduce the competition for limited fresh-water resources in the region. Intercontinental Potash Corp. USA (ICP) is proposing to construct and operate the Ochoa Mine Project (Project), located southeast of Carlsbad, New Mexico. The Project will mine polyhalite to produce sulphate of potash and is estimated to require up to 4,000 gallons per minute of water for processing ore and running the mine facilities. The Capitan aquifer, a non-potable groundwater resource, was selected as a viable option to meet the Project's water needs as well as minimize competition for the limited fresh water resources. ICP drilled and tested two exploratory groundwater wells penetrating the Capitan aquifer approximately 4,500 feet deep. To assess potential impacts on groundwater and surface water within and adjacent to the Capitan aquifer, conceptual and numerical groundwater flow models were developed. This poster will show how the exploratory drilling and modeling re-shaped our understanding of an important aquifer that extends across portions of southeastern New Mexico and western Texas. Our results demonstrate the proposed pumping impacts on nearby surface water and groundwater. As a result of this work, ICP has significantly reduced the risk associated with the water supply for the Project, using a source that will not compete for the limited fresh-water resources in the region.

Contact: Annelia Tinklenberg, INTERA, Inc., 6000 Uptown Blvd, Suite 220, Albuquerque, NM 87110 atinklenberg@intera.com, (505) 246-1600 x12086

Evaluating the Potential for Establishment of Two Aquatic Invasive Plants in New Mexico

Constance Jones
Water Resources Program, University of New Mexico and New Mexico Department of Agriculture, Water Resources Program, MSC05 3110, UNM
cjones@nmda.nmsu.edu, 505-263-0607

Rebecca Bixby
Water Resources Program, UNM and Department of Biology, UNM, Department of Biology, MSC03 2020, 1 University of New Mexico, Albuquerque, NM 87131-0001
bbixby@unm.edu, 505-277-3411

Brad Lewis
New Mexico Department of Agriculture and New Mexico State University, New Mexico Department of Agriculture, Entomology and Nursery Industries, PO Box 30005 MSC 3BA, Las Cruces, NM 88003-8005
blewis@nmda.nmsu.edu, 702-293-8843, 702-293-8843

Bruce Thomson
Water Resources Program, UNM and Department of Civil Engineering, UNM, Department of Civil Engineering, MSC01 1070 1 University of New Mexico, Albuquerque, NM 87131-0001
bthomson@unm.edu, 505-277-4729

Poster Abstract 12

The spread of invasive aquatic plants is an issue of growing concern due to their ability to cause significant negative impacts to the water resources and aquatic environments where they proliferate. Adverse effects on the delivery and supply of water can result from invasion by aquatic plants, as well as ecological, economic, and even health-related impacts. The New Mexico Aquatic Invasive Species Management Plan has identified *Hydrilla verticillata* (L.f.) Royle (hydrilla), and *Eichornia crassipes* (Mart.) Solms. (water hyacinth) as potential invasive weeds in the state and called for identification of the water bodies at risk of invasion in New Mexico. The suitable habitats of hydrilla and water hyacinth in the state were predicted using an ecological niche model, the Genetic Algorithm for Rule-set Prediction (GARP). This model uses the known occurrence points of a given species, and the environmental data, such as temperature and precipitation, that affect its distribution, to predict suitable habitat for that species in a new area. Potential habitat for hydrilla was identified in a large portion of the eastern side of New Mexico, as well as regions in the southwestern and northwestern corners. The prediction of suitable habitat for water hyacinth, based on GARP, encompassed almost the entire state. Use of the GARP model will aid in the prevention of the establishment of aquatic invasive plants in New Mexico by identifying potential suitable habitat, allowing water resource managers, regulators and policy makers to better allocate resources to monitor and protect susceptible aquatic environments.

Contact: Constance Jones, Water Resources Program, University of New Mexico and New Mexico Department of Agriculture, NMDA ENI P.O. Box 30005, MSC 3BA, Las Cruces, NM 87131-0001, cjones@nmda.nmsu.edu, 505-263-0607

WITHDRAWN

Aquifer Based Hydroelectic Pumped Storage

William Riley
Aquifer Based Hydroelectric Systems LLC, 400 Prospect St, New Haven, CT 06511
billrileyhere@earthlink.net, 908-229-5300

Poster Abstract 13

Aquifer-based pumped storage is a system in which an aquifer serves as the lower reservoir in a pumped storage system, with ground-level water storage as the upper one. Not all aquifers are sufficiently permeable to be appropriate for this system, but many are. A significant advantage of this approach is that it eliminates the capital cost of the lower reservoir and avoids the topographic limitations of surface-based systems. Ground-level storage can take the form of a purpose-built pond or reservoir (lined and covered as necessary to protect aquifer water quality). Economic and performance modeling indicate that this approach is feasible.

In one approach the upper reservoir can be already built and in place, thus further reducing cost. A typical installation would involve a large pipe with pump-turbine located at ground level below the reservoir, connecting through a manifold to numerous smaller pipe/well bores into the aquifer, each containing a smaller pump-turbine. This combination allows the use of both the head from the reservoir and the additional head from ground level to aquifer level. Suitable treatment is required to insure that aquifer quality is not compromised.

Still another approach would use existing facilities, such as public water supply systems, taking advantage of the system's pumps and storage for electrical storage purpose when they are not needed for their primary mission. In most cases the pumps already in use could be modified to serve as pump-turbines at nominal expense, thus providing extraordinarily low capital cost for a complete system.

Contact: William Riley, Aquifer Based Hydroelectric Systems LLC, 400 Prospect St, New Haven, CT 06511 billrileyhere@earthlink.net, 908-229-5300

Remote-Sensing-Based Evaluation of Relative Water Consumption Between Flood- and Drip-Irrigated Fields in Deming, New Mexico

Amber Whittaker
INTERA, Inc., 6000 Uptown Blvd Ste 220, Albuquerque, NM 87110
awhittaker@intera.com, 505-246-1600

Guillermo Martinez
INTERA, Inc., 1812 Centre Creek Dr., Ste 300, Austin, TX 78754-5153
gmartinez@intera.com, 512-425-2000

David Jordan
INTERA, Inc., 6000 Uptown Blvd, Ste 220, Albuquerque, NM 87110
djordan@intera.com, 505-246-16000

Richard Allen
University of Idaho, 3496 N. 2500 E., Twin Falls, ID 83301
office@allen-engineering.com, 208-423-6601

Poster Abstract 14

A strategy frequently employed to mitigate water supply shortages in agricultural regions is the conversion from traditional irrigation methods to more direct water delivery practices. This study, part of a larger effort by the New Mexico Interstate Stream Commission to understand the environmental and economic impact of irrigation conversion, evaluates relative water consumption of drip irrigation in Deming, New Mexico, using remote-sensing-based techniques combined with ground data collection. Relative temperature differences calculated from satellite data were used as a proxy for water use to show relative differences in crop consumptive use between flood- and drip-irrigated fields. On average, drip-irrigated fields were cooler than flood-irrigated fields, indicating higher water use. More water consumption generally results in more robust crops, and this was confirmed by a higher relative Normalized Difference Vegetation Index (NDVI) for drip-irrigated fields. METRIC surface energy balance modeling yielded higher instantaneous evapotranspiration (ET) for drip-irrigated fields when compared to flood-irrigated of the same crop and corroborated the temperature and NDVI results. Higher water consumption is postulated to occur with drip because water is delivered more efficiently to plant roots, enabling producers to realize greater crop mass with resultant increases in ET rather than losing a percentage as return flow to the aquifer. These results demonstrate a method of evaluating spatial patterns of ET from different irrigation methods using remote sensing techniques and represent a preliminary assessment that can be used by water resources managers to guide policy change to maintain a sustainable water supply.

Contact: Amber Whittaker, INTERA, Inc, 6000 Uptown Blvd Ste 220, Albuquerque, NM 87110, awhittaker@intera.com, 505-246-1600

Evaluation of Geomorphic Mine Reclamation Performance and Models in the Southwestern United States

Colin Byrne
University of New Mexico, 1500 Central Ave SW #123, Albuquerque, NM 87104
cfbyrne@unm.edu, 414-426-3366

Mark Stone
John Stormont
Edward Epp

Poster Abstract 15

The objectives of this study were to assess the performance of geomorphic reclamation in the semi-arid, southwestern United States and analyze the effectiveness of the Water Erosion Prediction Project (WEPP) and Soil, Erosion, Discharge by Computer Aided Design (SEDCAD) models in describing watershed processes on geomorphic reclamation lands. The implementation of geomorphic reclamation is based on the idea that natural landscapes most often evolve over long periods of time under localized conditions. This creates a natural system that minimizes the impact of storm events. In its design, geomorphic reclamation formations are intended to mimic the surrounding natural hydrologic systems and provide stability to a reclaimed landscape that traditional reclamation does not. This two-year study is being conducted at La Plata Mine in northwestern New Mexico with funding from the Office of Surface Mining. The study provides a unique opportunity for researchers from the University of New Mexico to work in partnership with industry personnel from BHP-Billiton - San Juan Coal Company. Researchers are studying three catchments: two reclaimed watersheds and one natural watershed adjacent to the reclamation area. Soil and land cover characteristics were measured using both field experiments and laboratory analysis of site-specific sampling. Monitoring and modeling of the sites began in 2012 and the performances of the La Plata Mine reclamation as well as the two models are being assessed through comparisons of measured runoff volumes, measured eroded sediment, and model predictions.

Contact: Colin Byrne, University of New Mexico, 1500 Central Ave SW #123, Albuquerque, NM 87104 cfbyrne@unm.edu, 414-426-3366

WITHDRAWN

Santa Fe, New Mexico, Water Distribution System—Vulnerability to Climate Change

Donatella Pasqualini
Los Alamos National Laboratory, PO BOX 1663 MS C933, Los Alamos, NM, 87545
dmp@lanl.gov, 505-667-0701

David R. Judi
Los Alamos National Laboratory, PO BOX 1663 MS C933, Los Alamos, NM, 87545
aghassem@nmsu.edu , 575-646-2357

Christina M. Brelsford
Arizona State University

Timothy N. McPherson
Los Alamos National Laboratory

Steve P. Linger
Los Alamos National Laboratory

Hwee Hwang
University of Arizona

Poster Abstract 16

Water supply and distribution systems are critical to sustaining life and economic activity. Water systems consist of both natural and manmade assets, such as rivers, diversions, dams, reservoirs, pumps, and pipes. Disturbing any water system asset may result in system-wide disruptions that have cascading impacts on public health, the economy, and other infrastructures. Threats from climate change have the potential to negatively impact water systems. Examples of these threats include changes in the magnitude and frequency of droughts, potable water availability, water demand, and infrastructure failure. Policy makers are charged with developing strategies to manage, plan, and protect these systems, while maintaining natural resources. Most of the models used to quantify these impacts (e.g., EPAnet) require a considerable amount of data; however, these data are often owned by the utilities and are proprietary in nature. We developed a system-level water system model that describes an urban water system and assesses system vulnerability using only the information usually reported in a city water distribution master plan and based on a limited amount of data. For this poster, we used our model to quantify the implications of a variety of climate scenarios on the water supply of Santa Fe, New Mexico and assessed system vulnerability. These analysis results can support policy makers and stakeholders as they adapt urban water systems in response to climate change.

Contact: Donatella Pasqualini, Los Alamos National Laboratory, PO Box 1663 MS C933, Los Alamos, NM, 87545, dmp@lanl.gov, 505-667-0701

Examining Mesilla Basin Aquifer Pollution Sensitivity Using the DRASTIC Model

Steve Walker
New Mexico Water Resources Research Institute, 1305 Kearny Place, Las Cruces, NM 88007
salto@nmsu.edu, 505-250-9883

Poster Abstract 17

In the Paso del Norte watershed, groundwater is the sole source of fresh drinking water and a majority of the irrigation water. With many lives connected to this natural resource, the need to protect it from pollutants and contamination is extremely important. When visually inspecting the ground, a land owner, planner, manager, or administrator may not know how easily the aquifer under their feet can be polluted, or how easily their activities can affect neighbors around them. The DRASTIC model can be used as a preliminary test to help evaluate areas that may be vulnerable to ground water contamination from sources of pollution. DRASTIC is an acronym for the components of a standardized, risk assessment model used to determine the sensitivity of an aquifer to pollution from a surface contaminant. This DRASTIC model uses ArcGIS to compile data gathered from public sources into ranked layers for seven components. The component layers are hydrogeological factors that affect the capacity of pollutants to reach an aquifer from the ground surface. These factors are: (D)epth to water table, net (R)echarge to the aquifer, (A)quifer media, (S) oil media, (T)opography, (I)mpact of the vadose zone, and hydraulic (C)onductivity of the aquifer. When these weighted and ranked layers are overlaid and added together, a pollution risk surface is mapped over the study area. The final results of this DRASTIC model are used for examining the risk that septic systems in central Paso del Norte pose to the Mesilla Basin aquifer.

Contact: Steve Walker, New Mexico Water Resources Research Institute, 1305 Kearny Place, Las Cruces, NM 88007, salto@nmsu.edu, 505-250-9883

Estimation of Uncertainty in Streamflow Response Based on Hydro-Cluster

Lijuan Jia
University of New Mexico, 417 Harvard DR SE APT.3, Albuquerque, NM, 87106
lijuan@unm.edu, 775-815-2542

Mark Stone
University of New Mexico, MSC01 1070 Civil Engineering Department
University of New Mexico, Albuquerque, NM, 87131
stone@unm.edu, 505-277-0115

Poster Abstract 18

The objective of this research is to investigate parameter sensitivity for discharge responses in the Southwest U.S. on the Gila River Basin within a hydrologic model. Because model parameters can vary both spatially and temporally, an innovative approach was used to simulate parameter uncertainty based on geographic proximity in order to develop regionally-local parameter sets. The Variable Infiltration Capacity (VIC) was used in this study. The results reveal a series of distributed parameter sets based on characteristics that were found to be similar across watersheds (particularly the dryness ratio (evapotranspiration / precipitation)). These similar watersheds were grouped into what we refer to as hydro-clusters. The following questions were then addressed: 1) what are the effects of hydro-cluster (characterized as humid, semi-humid, and dry) to calibrated parameters? and 2) what are the contributions of water balance components to streamflow responses across hydro-clusters? Compared to the traditional method which is calibrated a unique global optimum parameter set for the entire watershed, the improved approach as hydro-cluster evaluations shown improved performance. The implementation also allows for a more accurate approach to considering topographic heterogeneity and the sensitivity of parameters to specific hydrograph periods.

Contact: Lijuan Jia, University of New Mexico, 417 Harvard Dr. SE Apt.3, Albuquerque, NM, 87106
lijuan@unm.edu, 775-815-2542

Engaging Communities of Faith in Watershed Issues

Bob Wesseley
MRG Water Assembly
Wessely@sciso.com

Nancy Carrillo
NM Interfaith Power and Light
nancyeval@gmail.com, 505-934-0680

Elaine Hebard
MRG Water Assembly
ehebard@yahoo.com

John Brown
MRG Water Assembly
john.r.brown2@gmail.com

Poster Abstract 19

In the years following the 2004 Middle Rio Grande Regional Water Plan, advocates have been working to improve the representation of a wide range of values in the water debate given that economic interests alone cannot create sustainable solutions. In the fall of 2013, members of the Middle Rio Grande Water Assembly and Interfaith Power and Light partnered to present one-hour presentations to communities of faith in the Albuquerque Area. We began the 'Water as a Sacred Trust' presentation with detailed scientific information regarding the Region's water budget, historical trends of wet and dry periods, and expected population growth and warming trends. We also described basic features of water law and described the roles of various water decision makers and regulatory players. We introduced audiences to some spiritual values that could provide guidance both in terms of what actions might be taken to improve water sustainability as well as how to implement those actions. Audiences then discussed the values important to them and the actions that best seemed to match them.

At this conference presentation, we will describe the results from the first two presentations to communities of faith; whether they see themselves as having a unique voice in the water debate; and the implications for engaging communities of faith in water advocacy efforts.

Contact: Nancy Carrillo, NM Interfaith Power and Light, 8616 Liberty Dr. NE, Albuquerque, NM 87109 nancyeval@gmail.com, 505-934-0680

Ecophysiological Requirements for Southwestern Vegetation, Gila River, New Mexico

Savannah Martinez
Civil Engineering, University of New Mexico, 6101 Little Joe place NW, Albuquerque, NM 87120
savannahmtz@gmail.com, 505-280-3751

Mark Stone
University of New Mexico
stone@unm.edu

Poster Abstract 20

Riparian zones in the Southwest United States are vulnerable to hydrologic changes resulting from modified watershed conditions and land use. For example, wildfires can have a profound impact on watershed condition and result in drastic changes in the magnitudes of flood flows. Land use changes, such as agricultural and urban development, can impact water quality and increase demand for water extractions. These changes can stress natural ecosystems and result in potentially undesirable shifts in riparian vegetation communities and the species that depend upon them. Thus, increased knowledge of riparian processes and improved predictive models are needed in order to predict and help avoid undesirable changes in riparian conditions. As a first step, this research aims to describe ecophysiological requirements of common southwestern U.S. riparian species. The underlying processes that drive riparian recruitment are a particular focus of this work. This has been accomplished through a thorough literature review and by gathering expert opinions on common riparian species. The results are being incorporated into a Bayesian Believe Network (BBN) in order to predict potential changes in vegetation communities as a result of wildfires, climate change, and potential flow diversions with an emphasis on the Cliff-Gila valley in southwest New Mexico.

Contact: Savannah Martinez, Civil Engineering at the University of New Mexico, 6101 Little Joe Place NW, Albuquerque, NM 87120, savannahmtz@gmail.com, 505-280-3751

Environment- and Landscape-Specific Water Quality Standards (LA-UR-13-27099)

Armand Groffman
Los Alamos National Laboratory Surface Water Program, TA-00, Building 1237, Room 207A, Drop Point 00123707U, P.O. Box 1663, Los Alamos, NM 87545
groffman@lanl.gov, 505-667-2682

Amanda White
abwhite@lanl.gov, 505-665-6190

Daria Cuthbertson
dariac@lanl.gov, 505-795-8011

Anita Lavadie
alavadie@lanl.gov

Steve Veenis
veenis@lanl.gov, 505-667-0013

Poster Abstract 21

Water quality standards in the United States were initially developed for humid environments with perennial streams and lakes such as the Midwest and East Coast. In the semi-arid to arid west, ephemeral streams dominate the landscape with the exception of drainages emanating from upland features. Ephemeral streams generally do not support aquatic life, but in many cases are assigned water quality standards which were developed for perennial streams that do support aquatic life. The surface water program at Los Alamos National Laboratory is proposing to define environment and landscape -specific local background values for metals and organic compounds in lieu of federal or state standards. This approach is more representative and applies to the environment directly impacting the quality of surface water. Natural background values have been developed for a suite of metals including aluminum, copper, and zinc, and select radioactivity including gross alpha and radium-226 and -228. Although New Mexico Water Quality Standards recognize and accept natural background, anthropogenic background has not been accepted to date although it is globally ubiquitous in the environment. Persistent organic compounds (POCs), including polychlorinated biphenyls (PCBs), accumulate as a result of atmospheric deposition and are not only found in industrial settings, but are observed in ecosystems throughout the Earth. Metals, radioactivity, and POCs contribute to pollutant loading in surface water, are a component of the background environment, and landscape, thus should act as benchmarks on a local scale. This would represent a positive transition to managing surface water quality in the future.

Contact: Armand Groffman, LANL Surface Water Program, TA-00, Building 1237, Room 207A, Drop Point 00123707U, P.O. Box 1663, Los Alamos, NM 87545,
groffman@lanl.gov, 505-667-2682

A Hydrologic Investigation into the Potential Impacts on Riparian Wetlands of the Gila River from the Arizona Water Settlement Act

Jeffrey Samson
University of New Mexico, 210 University Blvd. NE, Centennial 3020, Albuquerque, NM 87106
jsamson@unm.edu, 505-277-2843

Mark Stone
University of New Mexico, 210 University Blvd. NE, Centennial 3020, Albuquerque, NM 87106
stone@unm.edu

Poster Abstract 22

The dynamism of the Gila River, in southwestern New Mexico, USA, has resulted in the creation of a topographically diverse floodplain that supports an array of riparian wetlands. The purpose of this paired wetland study is to investigate the hydrologic processes of two wetlands, to predict their potential responses due to stream alterations as a result of diversions related to the Arizona Water Settlement Act. One site represents a natural wetland and the other a wetland that exists only as a result of an anthropogenic modification to the river valley system. A network of 28 wells and 2 weather stations were installed in early 2013 to provide a high resolution of data on surface water and ground water hydrologic conditions. Phreatic surface contour maps were produced to aid in the visualization of sub-surface gradients. Based on these results, an electrical resistivity investigation is planned to be conducted to help further identify paleoflow channels as well as depth to bedrock and other potential areas of interest. These data will form the development of three dimensional MODFLOW models that will be used to investigate potential future stream flow scenarios on wetland hydrology. The model outputs will be used in tandem with the results of quarterly ecological surveys on vegetation, algae, benthic, and bird communities, to help make predictions of potential hydrologic changes, as well as changes to biotic community structure and function.

Contact: Jeffrey Samson, University of New Mexico, 210 University Blvd. NE, Centennial 3020 Albuquerque, NM 87106, jsamson@unm.edu, 505-277-2843

Effects of Precipitation Manipulation on Carbohydrate Dynamics and Mortality in a Piñon-Juniper Woodland

L. Turin Dickman
UNM, LANL, 1706 Medio, Santa Fe, NM 87501
lee@lanl.gov, 505-660-8450

Nate G. McDowell
LANL

Sanna Sevanto
LANL

Robert E. Pangle
UNM

William T. Pockman
UNM

Poster Abstract 23

Drought induced forest mortality is an accelerating global problem with far-reaching consequences, yet mortality mechanisms remain poorly understood. Depletion of non-structural carbohydrate (NSC) stores has been implicated as a major factor in drought-induced mortality, but experimental field tests are rare. We conducted an ecosystem-scale precipitation manipulation experiment and evaluated foliar and twig NSC dynamics of two co-occurring conifers with different water regulation strategies; the drought-avoiding piñon pine (*Pinus edulis*) and drought-tolerant one-seed juniper (*Juniperus monosperma*). Experimental drought decreased foliar starch in dying trees of both species and increased allocation to glucose and fructose in juniper, consistent with osmoregulation requirements. For both species, average foliar starch concentration between drought treatment onset and date of recorded mortality was a good predictor (R2 = 0.77) of the duration of drought-survival. These results along with observations of limitations to photosynthesis and growth implicate carbon starvation as an important process during mortality of these two conifer species.

Contact: L. Turin Dickman, UNM, LANL, 1706 Medio, Santa Fe, NM 87501,
lee@lanl.gov, 505-660-8450

Farm Water Budgets for Semiarid Irrigated Floodplains of Northern New Mexico: Characterizing the Surface Water-Groundwater Interactions

Karina Gutierrez
NMSU, 2610 Fairway Dr. Unit C, Las Cruces, NM 88011
kgutier@nmsu.edu, 575-650-1640

Alexander G. Fernald
New Mexico State University

Carlos G. Ochoa
Oregon State University

Steven J. Guldan
New Mexico State University

Poster Abstract 24

With the recent projections for water scarcity, water balances have become an indispensable water management tool. In irrigated floodplains, deep percolation from irrigation can represent one of the main aquifer recharge sources. A better understanding of surface water and groundwater interactions in irrigated valleys is needed for properly assessing the water balances in these systems and estimating potential aquifer recharge. We conducted a study to quantify the parameters and calculate the water budgets in three flood irrigated hay fields with relatively low, intermediate and, high water availability in northern New Mexico. We monitored different hydrologic parameters including total amount of water applied, change in soil moisture, drainage below the effective root zone, and shallow water level fluctuations in response to irrigation. Evapotranspiration was calculated from weather station data collected in-situ using the Hargreaves-Samani equation. Previous studies in the region have estimated deep percolation as a residual parameter of the water balance equation. In this study, we used both, the water balance method and actual measurements of deep percolation using passive lysimeters. Preliminary analyses for the three fields show a relatively rapid movement of water through the upper 50 cm of the vadose zone and a quick response of the shallow aquifer under flood irrigation. In addition, results for deep percolation disagree between the estimated approach using the water balance equation and the measured method from the passive lysimeter. Further results from this study will provide a better understanding of surface water-groundwater interactions in flood irrigated valleys in northern New Mexico.

Contact: Karina Gutierrez, NMSU, 2610 Fairway Dr. Unit C, Las Cruces, NM 88011, kgutier@nmsu.edu, 575-650-1640

Estimating Available Saline Water Resources in Aquifers of New Mexico Using GIS

Racheal Jones
New Mexico State University, 2610 Fairway Dr., Unit C, Las Cruces, NM, 88011
jonesra@nmsu.edu, 360-223-0335

Kenneth C. Carroll
NMSU

Michelle Chapman
NMSU

Mick O'Neill
NMSU

Alexander G. Fernald
NMSU

Poster Abstract 25

It is currently believed that there are roughly 15-billion acre-feet of saline groundwater available in New Mexico aquifers, an estimate first published in 1962 by the New Mexico Office of the State Engineer. This estimate is based on 50-year old, reconnaissance-level investigations even though it is still a widely-published statistic. This research seeks to answer the question of whether or not 15-billion acre-feet of available saline water resources is a reasonable estimate for New Mexico. This research will collect, synthesize, and analyze existing well data housed by municipal, state, and federal agencies. Well data will also be collected from non-governmental agencies, regional and site specific reports. Methods used to answer the "15-billion acre-feet" question will include mapping and analyzing synthesized well data in ArcGIS 10.2. Geology data will be used in conjunction with well data to determine where saline groundwater exists and to estimate the availability of saline groundwater. The goal of this research is to provide updated information regarding the total quantity of saline groundwater available in New Mexico and to provide a starting point for water managers at all levels to assess the viability of their saline groundwater supplies.

Contact: Racheal Jones, New Mexico State University, 2610 Fairway Dr., Unit C, Las Cruces, NM, 88011 jonesra@nmsu.edu, 360-223-0335

Bayesian Network as a Decision Support System for Multi-Objective Flood Management

Hamed Zamanisabzi
NMSU, 416 McArthur Dr., Las Cruces, NM, 88001
hzamani@nmsu.edu, 915-207-0241

James Phillip King
NMSU
jpking@nmsu.edu

Delbert Humberson
NMSU
dghumber@nmsu.edu

Poster Abstract 26

In this study, a Bayesian Network is used as a decision support system for multi-objective management of stochastic floods in the Sunland Park area (Diez Lagos) of southwest New Mexico. Bayes Theorem assists decision making by providing a rigorous framework for describing how beliefs should be altered in light of given evidence and uncertainty. This research utilizes the Bayesian interpretation of probabilistic consequences of stochastic floods, and focuses on the dynamic Bayesian Network's ability to obtain correct results for various flooding conditions under all related uncertainties to optimize the utility of the physical system's performance. Using a Bayesian Network as a decision support tool allows for effective multi-objective management. The objectives of the Diez Lagos facility are protecting property from flood damage, increasing usable water supply from the Rio Grande, mitigating E. coli contamination associated with storm water and maintaining riparian habitat in the study area. The most important advantage of applying a Bayesian Network to flood management is the prediction of realistic outcomes for floods with different return periods, which makes it a powerful decision support system.

Contact: Hamed Zamanisabzi, NMSU, 416 McArthur Dr., Las Cruces, NM, 88001, hzamani@nmsu.edu, 915-207-0241

Response of Piñon and Juniper Respiration to Drought and Warming

Adam Collins
Los Alamos National Laboratory, University of New Mexico, MS J495, Los Alamos, NM 87545
acollins@lanl.gov, 505-665-1597

Nate G. McDowell
Los Alamos National Laboratory, MS J495, Los Alamos, NM 87545
mcdowell@lanl.gov, 505-665-2909

Michael G. Ryan
Colorado State University, Natural Resource Ecology Laboratory
Colorado State University, Fort Collins, CO 80523-1499
Mike.Ryan@colostate.edu, 970-217-5798

William Pockman
University of New Mexico, MSC03 2020, Biology,
1 University of New Mexico, Albuquerque, NM 87131-0001
pockman@unm.edu, 505-277-2724

Poster Abstract 27

Drought and temperature-induced tree mortality is believed to be occurring globally, though the physiological mechanisms underlying documented mortality events are not well understood. Mortality event outcomes often include vegetation shifts which can alter land surface – atmosphere interactions and change the hydrologic cycle. Pinon pine (Pinus edulis) and oneseed juniper (Juniperus monosperma) are widespread species in New Mexico and known to be susceptible to mortality due to altered precipitation and temperature. Respiration is a key component of the tree carbon budget and its response to abiotic stress is thought to play a role in mortality or survival. The ability of these species to acclimate respiration to altered temperature and/or precipitation is a key model parameter, but is currently not known. A careful examination of the response of pinon and juniper respiration to increased temperature and drought conditions is thus a necessary step in predicting their future distribution in a changing environment.

We established a rainfall and temperature manipulation experiment in a pinon-juniper woodland near Los Alamos, NM. In-situ trees were exposed to one of five treatments: Heat (+5 deg C), Drought (-40% rainfall), Heat+Drought, Ambient Control, and Chamber Control. CO2 efflux measurements were conducted on the bole of each tree once per month between June 2012 and October 2013.

In pinon, the Heat and Drought+Heat treatments showed the highest efflux. In juniper, the highest rates were in the Drought treatment. Conversely, pinon Drought+Heat showed thermal acclimation while juniper exhibited acclimation in both the Heat and Drought+Heat treatments.

Contact: Adam Collins, Los Alamos National Laboratory, University of New Mexico, MS J495, Los Alamos, NM 87545, acollins@lanl.gov, 505-665-1597

Adaptive Terrain Systems for Drylands

James M. Brooks
Soilutions, Inc., P.O. Box 1479, Tijeras, NM 87059
jim@soilutions.net, 505-228-2881

Michael Young
Soilutions, Inc., P.O. Box 1479, Tijeras, NM 87059
michael.m.young@gmail.com, 505-228-2881

Brent Tanzy
US Bureau of Reclamation

Richard Luthy
Stanford University

J. Phillip King
New Mexico State University

Poster Abstract 28

Here is something meaningful, even transformative, that you can create, at any scale, with resources you now have at hand -- a common-sense method to control how desert land responds to extreme, often violent effects produced by the changing climate.

Using simple earthworks and methods, you'll create a system of networked surface flows. These systems survive catastrophic weather events and continue to function even when they are overwhelmed. And they are simple to maintain and repair.

These aren't tricks or isolated "BMPs;" they are easily-constructed terrain features interwoven to build on one another's assets and become more robust over time, as your site naturally matures.

The poster will illustrate the techniques in general with examples of completed work, work underway, and drawings.

Contact: Michael Young, Soilutions, Inc., P.O. Box 1479, Tijeras, NM 87059,
michael.m.young@gmail.com, 505-228-2881

Central Palomas Basin Aquifer Investigation

Erek H. Fuchs
NMSU, Water Science and Management, 4200 North Valley Drive, Las Cruces, NM 88007
ehfox584@gmail.com, 575-639-4464

James Witcher
Witcher and Associates, Las Cruces, NM
jwitcher@zianet.com

Poster Abstract 29

New Mexico experiences periodic and severe drought of decadal length. Farmers in the Hatch-Rincon Valley along the Rio Grande in southern New Mexico are especially impacted by the current severe and sustained drought because of the unique geology of the immediate area that does not allow significant augmentation of water for irrigation from pumping groundwater. Groundwater that is readily accessible is currently deteriorating in quality as salinity is increasing in the shallow Rio Grande alluvium aquifer. The economy in the Hatch-Rincon Valley is highly dependent on irrigated agriculture in the immediate area.

In response to this apparent crisis, interests in the Hatch-Rincon Valley have been investigating the potential of a groundwater drought reserve. Earlier studies suggested, but did not investigate in detail the possibility of a significant resource, the Central Palomas Basin Aquifer (CPBA).
A preliminary geologic cross-section model has been developed by Dr. John Hawley. Surface resistivity and EM geophysical surveys and water chemistry analysis are in progress by David Hyndman and James Witcher to define the CPBA, a buried and confined fluvial channel predating the Rio Grande. Investigation is designed to define and characterize this aquifer as an emergency supply during extreme drought by applying existing water rights of the water users in the Hatch-Rincon Valley. Much work is yet to be performed to fully quantify the aquifer but it may represent an important undeveloped shallow potable groundwater system in New Mexico.

Contact: Erek H. Fuchs, NMSU, Water Science and Management, 4200 North Valley Drive,
Las Cruces, NM 88007, ehfox584@gmail.com, 575-639-4464

Has State Water Policy Kept Pace with Water Realities?

Rebecca Wacker
University of New Mexico, 3 Lobelia Lane, Sandia Park, NM 87047
rebecca.wacker@gmail.com, 505-401-6172

Poster Abstract 30

New Mexico has a long history of recurring drought conditions due to continental positioning. Water shortage is an on-going issue for New Mexicans and has been for as long as people have lived in this region. In order to address water management practices, a number of groups have been tasked to provide recommendations toward sustainable growth and management of uncertain resources. In 2003, Governor Richardson's administration developed a list of target areas to address. They include 1) development of state wide, regional, and community water plans that are integrated, 2) address "indiscriminate permitting of domestic wells" 3) coordination of ongoing water issues with other states, Mexico, and Native Americans, 4) implement riparian clean-up, 5) creation of water banks for depositing unused water rights without losing such rights, 6) utilize technology and brainpower of national labs and state universities to explore conservation programs, desalinization, arsenic removal, water supply security, water quality monitoring systems, and advanced irrigation technology, and 7) upgrade the water rights file database to track 100 years of water rights ownership in the state (Lucero et al 2003). Additional groups such as Citizen Forums 2007 and 1000 Friends of New Mexico have also presented recommendations. Ten years after these targets were identified is enough time to provide good indication of progress made toward such goals. This research seeks to evaluate such progress and identify opportunity for additional implementation.

Contact: Rebecca Wacker, University of New Mexico, 3 Lobelia Lane, Sandia Park, NM 87047
rebecca.wacker@gmail.com, 505-401-6172

Sustainable Drinking Water Sources

Dennis McQuillan, dennis.mcquillan@state.nm.us, 505-827-2140
NMED Drinking Water Bureau, PO Box 5469, Santa Fe, NM 87502-5469

Matt Holmes, matt@nmrwa.org
New Mexico Rural Water Association, 8336 Washington Pl. NE, Albuquerque, NM 87113

Blanca Surgeon, BSurgeon@rcac.org
Rural Community Assistance Corporation, PO Box 2621, Las Vegas, NM 87701

Joy Esparsen, jesparsen@nmcounties.org
New Mexico Association of Counties, 444 Galisteo St., Santa Fe, NM 87501

Regina Romero, RRomero@nmml.org
New Mexico Municipal League, 1229 Paseo de Peralta, Santa Fe, NM 87501

John Longworth
New Mexico Office of the State Engineer, 407 Galisteo St., Santa Fe, NM 87504

Poster Abstract 31

Groundwater depletion, drought, wildfires, floods and other hazards pose increasing challenges to public water systems in New Mexico. To protect citizens and communities, the collaborators recommend the following:

- If possible, water systems should keep two or more sources of water supply in operable condition so that failure of one source will not create an outage.
- Static and pumping water levels, production rates, and specific conductance should be monitored for indications of groundwater depletion.
- Mandatory and voluntary water conservation programs, including metering and pricing water service according to cost and usage, should be discussed with the decision making body and community.
- Periodic water audits and leak detection should be performed.
- Emergency Response Plans should include emergency contacts, a list of potential alternative water sources, and instructions on how and where water tankers, approved by the NM Environment Department, can transfer potable water into the system. Water systems are encouraged to participate in the Water and Wastewater Agency Response Network (WARN) to facilitate communication and resource sharing in emergencies.
- Where appropriate, partnership of small rural systems into larger regional systems should be encouraged to increase operational and financial efficiency.

In addition, the partner agencies can provide technical and managerial assistance with Source Water Protection actions to mitigate these risks. Funding opportunities are available for many of these recommended actions. A Source Water Protection Atlas http://gis.nmenv.state.nm.us/SWPA/ , and a Bibliography of N.M. Geology http://geoinfo.nmt.edu/libraries/gic/bibliography/home.cfm , can provide useful information for exploration of new water sources, and for assessing vulnerability to both natural and manmade contamination.

Contact: Dennis McQuillan, New Mexico Environment Department, NMED Drinking Water Bureau, PO Box 5469, Santa Fe, NM 87502-5469, dennis.mcquillan@state.nm.us, 505-827-2140

Benefit Sharing Opportunities in Transboundary Basins: Evidence from the Amu Darya

Shokhrukh-Mirzo Jalilov
New Mexico State University, Dept. of Agricultural Economics and Agricultural Business
PO Box 30003, MSC 3169, Las Cruces, NM 88003-8003
Ph: 575-646-4773, Fax: 575-646-3808
sjalilov@nmsu.edu, 575-405-6277

Saud A. Amer
US Geological Survey, 12201 Sunrise Valley Dr., Reston, VA 20192
samer@usgs.gov

Frank A. Ward
New Mexico State University, Department of Agricultural Economics and Agricultural Business
PO Box 30003, MSC 3169, Las Cruces, NM 88003-8003
fward@nmsu.edu

Poster Abstract 32

This article examines impacts of infrastructure, water allocation protocols, and climate variability on economic outcomes in the Amu Darya Basin for the countries of Afghanistan, Tajikistan, Turkmenistan, and Uzbekistan. Its aim is to identify policies that could lead to basin-wide opportunities for economic benefit sharing to occur, in which the economic welfare of all riparians is improved. We examine the development of storage infrastructure and the allocation of water within the Basin. An empirical optimization model is developed and applied to identify opportunities for improving the welfare of these four riparians that share the basin's waters. An analysis is presented that characterizes politically constrained and economically optimized water-use patterns without and with new reservoir storage capacity in place. The analysis describes a program that could improve economic welfare in all four nations. It takes into account potential impacts of water shortages from drought or climate variability. Results indicate that a combination of targeted water storage infrastructure and efficient water allocation can produce outcomes for which added economic benefits exceed incremental costs for each riparian. Results identify opportunities to foster cooperation among riparian nations through development of water storage infrastructure and associated efficient water allocation that improves the economic welfare for each riparian nation in a basin. Patient and deliberate negotiation will be required to transform potential into actual gains for all countries.

Contact: Shokhrukh-Mirzo Jalilov, New Mexico State University, Dept. of Agricultural Economics and Agricultural Business, PO Box 30003, MSC 3169, Las Cruces, NM 88003-8003, 575-646-4773, Fax: 575-646-3808, sjalilov@nmsu.edu, 575-405-6277

A Study of Selenium in Irrigation Networks in the Animas and San Juan River Watersheds

Andrew Martinez
Spatial Applications Research Center, NMSU, 1316 McArthur Dr, Las Cruces, NM 88003
anpama99@nmsu.edu, 575-640-0398

Mark Heil
Habitat Management, Inc.

Randy Carr
Spatial Applications Research Center, NMSU

Christopher Brown
Spatial Applications Research Center, NMSU

Poster Abstract 33

Selenium (Se) contamination in Northwest New Mexico is a concern among many stakeholders in the San Juan and Animas River Watersheds. As part of the outcome of a court settlement, New Mexico State University's Spatial Applications Research Center (SpARC) was contracted to conduct research into potential Selenium loading and transport in irrigation networks in the San Juan Watershed. Specifically, we explored the Hogback and Gadii'ahi irrigation districts that draw water from the San Juan River. To gather data on the Se contamination, we conducted fieldwork, collected samples from the main irrigation canal, and had these samples analyzed by a laboratory with much experience in Se studies. The first set of results came back as non-conclusive because levels of selenium in the samples were below the levels of detection. We also examined potential Se loading that may be due to the area's cretaceous soils. These soils are high in Se content and are being exposed due to geologic processes. This exposure has the potential to discharge Se into the irrigation fields via rain runoff from the hills through the drainage and irrigation ditches that the people have created. The project is set to continue through the end of 2014, and we will be back in the field in the 2014 irrigation season to conduct more soil and water samples and analysis. Data from these sampling runs will then be analyzed for the spatial extent of SE loading through use of geographic information systems tools.

Contact: Andrew Martinez, Spatial Applications Research Center, NMSU, 1316 McArthur Dr, Las Cruces, NM 88003, anpama99@nmsu.edu, 575-640-0398

Water Appropriation Systems for Adapting to Water Shortages in Iraq

Dina Salman
Water Science and Management Program, New Mexico State University, Dept. of Agricultural Economics and Agricultural Business, PO Box 30003, MSC 3169 Las Cruces, NM 88003-8003
dinasalm@nmsu.edu, 915-226-5028

Saud A. Amer
US Geological Survey, 12201 Sunrise Valley Dr., Reston, VA 20192
samer@usgs.gov

Frank A. Ward
New Mexico State University, Department of Agricultural Economics and Agricultural Business
PO Box 30003, MSC 3169, Las Cruces, NM 88003-8003
fward@nmsu.edu

Poster Abstract 34

Climate change and population growth have intensified the search internationally for measures to adapt to fluctuations in water supplies. An example can be found in the Lower Tigris-Euphrates Basin where recent water supply reductions have resulted in high economic costs suffered by irrigation farmers. Losses to irrigators in this basin have made a compelling case to identify flexible measures to adapt to water shortage. Few published studies have systematically examined ways to enhance the flexibility of water right systems to adapt to water shortages. This paper examines how profitability at both the farm and basin levels is affected by various water appropriation methods. Four water allocation methods are compared for impacts on farm income under three water supply scenarios. Results show that a (1) proportional sharing of water shortages among provinces and (2) unrestricted water trading perform as the top water appropriation methods. The shadow price of water for irrigation rises from zero at a full water supply level to $ US 91 per thousand cubic meters when supply falls to 20 percent of full levels. Results carry important implications for the design and efficient implementation of water appropriation systems in the world's irrigated regions.

Contact: Dina Salman, Water Science and Management Program/NMSU, 3650 Morning Star Dr. Apt# 703, Las Cruces, NM 88011, dinasalm@nmsu.edu, 915-226-5028

The Future of Energy and Water Nexus Under Climate Change in the Southwest

Donatella Pasqualini
Riccardo Boero
Nathan Urban
Los Alamos National Laboratory, DSA-4, MS C933, P.O. Box 1663, Los Alamos, NM 87545
dmp@lanl.gov, 505-667-0701

Poster Abstract 35

Climate change has been increasing current stresses on water supply making freshwater one of the most valuable resources particularly in areas vulnerable to drought such as the Southwest. Being electricity generation the biggest users of freshwater in the USA, water, energy and climate have become three critical intrinsically linked factors. Each year, the U.S. Energy Information Administration projects and analyzes the future of energy production in distinct regions of the United States under several economic scenarios. These scenarios support the evaluation of policy proposals in terms of energy security and emissions. Our research coupled these energy scenarios with predictions by global circulation models to analyze the water-energy nexus. Specifically, we quantified the stress imposed on fresh-water availability by energy production in the Southwest under different climate scenarios. Our analysis accounts for the uncertainties derived by climate models and technologies adopted in energy production. We analyzed the impact of different policies scenarios under the climate scenarios developed by Intergovernmental Panel on Climate Change in the Southwest area of the USA. Results are captured on a monthly basis and projected to 2040.

Contact: Donatella Pasqualini, Los Alamos National Laboratory, DSA-4, MS C933, P.O. Box 1663, Los Alamos, NM 87545, dmp@lanl.gov, 505-667-0701

How to Utilize Water Availability for Prosperity in the MRGV

Navida Johnson
University of New Mexico, School of Architecture & Planning, 931 Buena Vista Dr. SE #D-202
Albuquerque, NM 87106
ngrogan@unm.edu, 505-264-5901

Poster Abstract 36

Water is New Mexico's most precious natural resource. We must remain aware that New Mexico is a desert state and that our finite supply of water not only serves our communities but Southern Colorado near the New Mexico border as well as El Paso, Texas, and northeastern Mexico. In the future, it is very likely we will be faced with a reduction in surface water supply. More specifically, this will impact future economic, ecological and social relationships that encompass the Middle Rio Grande Valley, (MRGV). In order to make sure this region sees a prosperous future this project will deliver key facts, simulated results (from climatic, geographical, and land use scenarios), and tips that inform stakeholders and communities alike what challenges must be taken into consideration in order to accomplish the following goals:

- Meet compact obligations,
- Provide resources to communities,
- Value water utilization, production and quality,
- Decrease groundwater depletion, and
- Sustain the economy.

The 21st century has experienced several of the hottest and driest years on record. Many sources of climate projections suggest that these patterns of arid conditions will become the norm for the Southwest region throughout this century. This project will employ the Middle Rio Grande Cooperative Water Model. This software program is a resource management and educational tool that provides recommendations for balancing water use in the Middle Rio Grande region. With additional guidance implementing water model projections, improved planning methods could show us how to decrease groundwater depletion while sustaining and improving our state's economy.

Contact: Navida Johnson, University of New Mexico, School of Architecture & Planning,
931 Buena Vista Dr. SE #D-202 Albuquerque, NM 87106, ngrogan@unm.edu, 505-264-5901

Incipient Motion of Mixed Load Sediments on the Rio Chama

Angela Gregory
University of New Mexico, 320 Solano Dr. NE, Albuquerque, NM 87108
agregory@unm.edu, 575-644-5808

Poster Abstract 37

Discharge and sediment supply are the primary controls for river adjustment. Modifications to these controls are directly linked with changes in dynamic equilibrium conditions and can negatively impact the ecosystem. The result of control modifications typically involves changes in hydraulic geometry, decrease in heterogeneity, bed armoring, disconnection of floodplains, vegetative establishment and ecological impacts. Environmental flows provide water managers with a tool that can positively aid the physical and ecological needs of the river.

The Rio Chama, located in northern New Mexico, is controlled by three dams and reservoirs. Additionally, the San Juan-Chama Project delivers an estimated 96,500 acre-feet of water to the river. Due to the management of the river, the variability and peak flows of its hydrograph have been decreased and base flows have increased. Of particular importance to this project was the reach between El Vado dam and Abiquiu dam, where two sites (Archuleta and Cebolla) were studied.

The objective of this study was to determine the environmental flows required to mobilize the channel bed. This research suggested that there is a strong connection between channel geometry and the ability to transport sediments at a given flow. Furthermore, the results showed that the most effective use of environmental flows for sediment transport would resemble a natural flow regime in terms of variability. Variability of flood size would accomplish movement of a broad range of sediment size classes as spatial conditions changed with distance downstream of a dam.

Contact: Angela Gregory, University of New Mexico, 320 Solano Dr. NE, Albuquerque, NM 87108
agregory@unm.edu, 575-644-5808

Implementing "Public Welfare" by Valuing Unpriced Benefits and Costs in Water Governance

John R. Brown
New Mexico Water Dialogue, PO Box 1387, Corrales, NM 87048
john.r.brown2@gmail.com, 505-898-9551

Poster Abstract 38

Water may be viewed as a commodity or as a collective good. In the former, "the market" sets a price dependent on negotiations between potential buyers and sellers. In a "perfect" market, all participants are fully informed and have relatively equal power in reaching agreement. Potential sellers can walk away from a bad deal. In the real world of water transfers this isn't the case. Water markets are "thin"; transaction costs are high; sellers are under financial stress and relatively weak; and externalities are ignored. This almost always means that the causal arrow points in one direction: rural sellers and urban buyers. This is often described as moving water to its "highest and best" uses.

The frame changes when we treat water as a collective good. Its value is no longer simply a function of price. Water can be valued, not just for what it does, but for what it is. Through collective action – changing public policy on a broad range of issues like minimum stream flows, utility rates, and zoning – policy actors establish rules setting limits on market operations. The range of water-related values people hold may include a preference for non-monetized goods such as sustainable social-ecological systems. Democratic processes, including robust public participation in water planning, provide a corrective to the excesses of "free" markets. This presentation models how the balance between market and collective decisions may shift toward the latter under conditions of increasing scarcity.

Contact: John R. Brown, New Mexico Water Dialogue, PO Box 1387, Corrales, NM 87048, john.r.brown2@gmail.com, 505-898-9551

Water Supply Reliability for Energy Development Demands: Adaptation for Potential Climate Change

Richard Middleton
Dan Levitt
Cathy Wilson
Andrew Wolfsberg
Earth and Environmental Sciences, Los Alamos National Laboratory
awolf@lanl.gov, 505-667-3599 (w), 505-699-0995 (c)

Poster Abstract 39

Climate-Energy-Land-Water (CLEW) interactions present a complex set of competitive demands and impacts on water resources. Planning for water-intensive energy production—including electricity, biofuels, and unconventional fossil fuels—requires understanding critical basin-scale processes in order to provide quantitative predictions for integrated assessment in all sectors including energy, agriculture, municipal, and environmental demands. In this study, we examine Colorado River dynamics and storage capacity to provide water for new energy demands under current and future climate conditions.

We constructed an integrated framework to assess the impacts of climate change and variability on energy production and water demand in the Upper Colorado River Basin. The framework analyzes the interactions between climate, land, energy, and water (CLEW) processes. For example, projected climate change impacts annual snow pack development (extent, depth, time of melting), which affects vegetation through evapotranspiration, which influences regional hydrology, ultimately impacting water availability for energy development or other demands. The framework is used to model energy resiliency and response to climate change, including developing new storage capacity to manage reduced and irregular river flows. The framework also incorporates water rights in order to understand long-term management of the river while balancing impacts of climate change and water demands for energy, agriculture, environmental, and municipal use.

Contact: Andrew Wolfsberg, Deputy Division Leader, Earth and Environmental Sciences, Los Alamos National Laboratory, awolf@lanl.gov, 505-667-3599(w), 505-699-0995(c)

GPS Surveying Application in Water Conservation

Franck O. Kapoko Kamtchang
2460 Fairway drive Apt C, Las Cruces, NM 88011
kapoko@nmsu.edu, 575-621-1283

Poster Abstract 40

The use of GPS for positioning and mapping has been rapidly increasing since its introduction in the early 1980's. GPS surveys provide reliable sources for accurate 3D information, particularly for water-level monitoring applications. GPS surveys are conducted in either static or RTK modes. Data collected in the static mode, simultaneous between two stationary receivers, for at least 15 minutes, depending on baseline length, cancel most of the systematic errors at both stations through differential techniques. Using nearby control points, less than 30 km in length, with known coordinates can provide an accuracy of less than 5 cm.

This poster presents a ground survey carried out at 3 locations in northern New Mexico, Alcalde, El Rito and Rio Hondo. The task involved monitoring water level through a GPS survey. This was done by determining the elevation of wells, USGS gauges, and acequia, etc. To assess the GPS measurements, we used different GPS observation sessions for the same points. In addition, a level survey was conducted for several points to determine the differences in elevations between these points. A comparison was made between both the GPS and the level measurements and insignificant differences were found.

Contact: Franck O. Kapoko Kamtchang, 2460 Fairway drive Apt C, Las Cruces, NM, 88011, 575-621-1283, kapoko@nmsu.edu

Association Between Drinking Water and Urinary Arsenic Concentrations: A Meta-Analysis of Biomonitoring Results in New Mexico

Leilani Schwarcz
Miriam Wamsley
Barbara Toth
Heidi Krapfl
NM Department of Health, 1190 St. Francis Drive, Suite N1300| Santa Fe, NM 87505
https://nmtracking.org/water, SF: (505)827-2461, ABQ: (505)222-8667

Poster Abstract 41

In New Mexico, along the Rio Grande Rift Valley, arsenic concentrations in groundwater range from < 1 µg/L to 600 µg/L. Approximately 90% of New Mexico's drinking water supply is from groundwater. The presence of arsenic in drinking water is a potential public health concern in areas of New Mexico where concentrations in groundwater are above the EPA maximum contaminant level (MCL) of 10 µg/L. The objective of this meta-analysis was to evaluate the association between arsenic in drinking water concentrations and arsenic body burden as measured by urinary arsenic levels among participants of biomonitoring projects in New Mexico.

We utilized data from three New Mexico Department of Health biomonitoring projects conducted from 2004 through 2012, which included volunteer participants residing in 76 communities. For this meta-analysis, 1013 adults were identified as eligible participants. They provided samples of their drinking water, a spot urine sample and completed an exposure assessment survey. Drinking water and urine samples were analyzed for total arsenic. Sample collections and analytical methods applied were similar among the biomonitoring projects, therefore, the testing results were pooled for meta-analysis. A multiple regression model was developed to evaluate the effect of drinking water arsenic concentration on urinary arsenic concentration, with adjustment for potential variables such as age, sex, dietary supplement use, tobacco use, fish/seafood consumption, and daily water consumption.

The final regression model is presented, including adjustment for variables along with correlation coefficients, and assumptions. Exposure to arsenic through drinking water can be controlled and minimized by consumers' health behavior changes. Future groundwater arsenic mapping or predictive arsenic groundwater transport models are needed to identify potential excessive arsenic exposure from groundwater sources used for drinking water.

Contact: Miriam Wamsley, MWR | Private Well Epidemiologist, Environmental Health Epidemiology Bureau| NM Department of Health, 1190 St. Francis Drive, Suite N1300| Santa Fe, NM 87505 https://nmtracking.org/water, SF: (505)827-2461, ABQ: (505)222-8667