Water Resources Research Institute

New Mexico State University

Annual Technical Report
2018

General Information

Products

Allan, M.J. 2018. Understanding Soil Spatial and Temporal Variability for Forage Corn Production and Hydrological Modeling within New Mexico. Masters Thesis.

Brungard, C.W., and Allan, M.J. 2019*. Predictive Soil Mapping to Improve the Physical Basis of Distributed Ecohydrological Models in Arid Environments. WRRI Technical Completion Report 128377.
* This report has been edited/revised to address reviewers' comments and returned for second review following the initial peer-review.

Cerrato, J. and Rahman, A. 2018. Effect of Wildfire Ash on Water Quality. New Mexico Water Resources Research Institute Technical Completion Report No. 379. 45 pp.

Chaudhary, Binod, Robert Sabie, Mark Engle, Pei Xu, Spencer Willman, Kenneth Carroll. 2019. Produced Water Quality Spatial Variability and Alternative-Source Water Analysis Applied to the Permian Basin, USA. Hydrogeology Journal (accepted – in editorial review)

Gomez-Velez, J. and Wang, C. 2019. New Mexico's Mountain Sources of Water: A Mechanistic Approach to Understand Mountain Recharge and its Implications for Local and Statewide Water. New Mexico Water Resources Research Institute Technical Completion Report No. 381. 55 pp.

Kubicki, C. 2019. An Integrated Geophysical and Geochemical Approach for Defining Sources of Groundwater Salinity in the Rio Grande Valley of the Mesilla Basin, New Mexico and West Mexico and West Texas, USA. Master Thesis

Rahman, A., El Hayek, E., Blake, J.M., Bixby, R., Ali, A., Spilde, M., Otieno, A.A., Miltenberger, K., Ridgeway, C., Artyushkova, K., Atudorei, V., and Cerrato, J.M. 2018. Metal Reactivity in Laboratory Burned Wood from a Watershed Affected by Wildfires. Environmental Science and Technology, 52, 8115-8123 (https://doi.org/10.1021/acs.est.8b00530)

Rahman, A. 2018. Metal Reactivity in Laboratory Burned Wood from a Watershed Affected by Wildfires. Masters Thesis.

Tellez, A., Boykin, K., and Fernald, A. 2018. Effects of Changing Available Water Regimes on Riparian Vegetation in the Mesilla Basin Aquifer, New Mexico, USA. Masters Thesis.

Wang, C., Gomez-Velez, J., and Wilson, J. 2018. The Importance of Capturing Topographic Features for Modeling Groundwater Flow and Transport in Mountainous Watersheds. Water Resources Research, 54.12, 10, 313-10, 338 (https://doi.org/10.1029/2018WR023863)

Information Transfer Program

The primary methods for information transfer are the institute's website, conferences, publications, and audio/visual presentations. The 63rd Annual New Mexico Water Conference, At the Tipping Point: Water Scarcity, Science and Policy, took place in Las Cruces, NM on October 17-18, 2018. Over 270 participants were in attendance, a record number of posters, 63, were displayed of which 52 were presented by students. During the reporting period the institute coordinated over five workshops and/or conferences bringing together water resources practitioners working for state, federal, or local agencies, although some members of the general public and academia also attend.

Publications include technical completion reports resulting from NM WRRI-sponsored projects, special in-house publications, and conference proceedings. The institute has published more than 400 technical and miscellaneous reports. The peer reviewed technical completion reports are directed toward water professionals working in disciplines related to the research projects.

The institute produces a monthly newsletter, “New Mexico Water eNews.” which reaches about 1,852 recipients and keeps its recipients informed of institute activities, upcoming meetings, publications, and research projects.

The institute’s online library catalog provides, 9,013 books and references, which can be searched through the NM WRRI website, reference room link at https://nmwrri.nmsu.edu/reference-room/, accessible by faculty, students, and the general public.

Student Support

The annual base (104b) grant supported 14 undergraduates and 2 master's graduate students.
Coordination Grant awards supported 4 master's graduate students and 1 doctoral graduate student. The total number of students supported by the USGS annual base (104b) grant and required matching funds and other Coordination Grant awards was 21 (14 undergraduates and 7 graduate students).

Notable Achievements and Awards

Asifur Rahman, master’s degree student at University of New Mexico, supported by annual base 104b grant, graduated and is now a Ph.D. student at Virginia Tech.

Aracely Tellez, master’s degree student at New Mexico State University, supported by the TAAP coordination grant, graduated and is employed by the New Mexico Office of the State Engineer.

Ashley Page, master’s degree student at New Mexico State University, supported by the TAAP coordination grant, graduated. She was awarded a Fulbright Fellowship and will be studying water science and transboundary water policy in Bulgaria and Greece.

Dr. Frank Huang, Professor of Civil and Environmental Engineering at New Mexico Institute of Mining and Technology, supported by annual base 104b grant funding in 2006, was awarded funding ($399,488) in 2018 from the USBR for a Phase II pilot-scaled project entitled, Geothermal Membrane Distillation for Large-Scale Use. In 2019 Dr. Huang was awarded funding ($400,000) by the USBR for a second Phase II, pilot-scaled projected entitled, Thermally Regenerable Pressure Forward Osmosis (T-PFO) for Concentrating High-Salinity Produced Water. The 104b grant helped pave the way for Dr. Huang to continue his research and provided the groundwork for his membrane experiments to flourish.

Supported by the TAAP coordination grant Chris Kubicki successfully defended his MS thesis and graduated. Kubicki is preparing an article, “An Integrated Geophysical and Geochemical Approach for Defining Sources of Groundwater Salinity in the Rio Grande Valley of the Mesilla Basin, New Mexico, and West Texas, USA,” to be submitted to a scientific, peer-reviewed journal for publication.

Projects

Digital Soil Mapping for Improving Hydrological Modeling of NM Water Resources

Project Type: Annual Base Grant **Project ID:** 2017NM187B

Project Impact: Spatial patterns in soil properties significantly affect hydrological and ecological processes. Finely spatially resolved information about the spatial distribution of soil properties may improve ecohydrological modeling. This research used geostatistical methods to interpolate soil depth as well as sand and clay concentrations at four harmonized depth increments (0-5, 5-15, 15-30, & 30-60 cm) within a single alluvial landform in southern New Mexico. Soil depth and sand and clay concentration observations were analyzed for anisotropy and statistically significant relationships with nine terrain variables. Spherical, circular, and exponential variogram models were fit to all sand and clay concentrations and soil depth and compared using root-mean-square-error (RMSE) derived from leave-one-out cross validation. RMSE ranged between 4.8 & 5.9% for sand and between 1.3 & 1.9% for clay. RMSE for soil depth was 37.7 cm. In general sand had a shorter range of spatial autocorrelation and a smaller nugget than did clay at all depths. The range of spatial autocorrelation for sand was between 150 and 225 m, while clay had a range of values between 90 and 3206 m. Nugget values were relatively low because of the sampling design which had a minimum distance of 3 m which captured most of the small scale variability. Spatial prediction was done using Kriging with External Drift. Uncertainty in sand and clay concentration predictions were low while the uncertainty of soil depth predictions was greater. Interpolated variables and the associated prediction uncertainty will be used to improve the parameterization of future ecohydrological modeling applications.

Effect of Wildfire Ash on Water Quality

Project Type: Annual Base Grant **Project ID:** 2017NM188B

Project Impact: The results from this study enable the identification of negative effects of wildfires, which are essential to improve post-fire recovery strategies, and to ensure the resilience of our forests and water sources. The work reported in this study has been published in the prestigious journal Environmental Science & Technology.

Geographic Information Systems for Water Resources

Project Type: Annual Base Grant **Project ID:** 2018NM192B

Project Impact: The New Mexico Water Resources Research Institute (NMWRRI) has become the focal point for geographic information system (GIS) data and information concerning water resources in New Mexico. It combines database management with digital mapping into spatial-tabular data models. During the reporting period, the GIS laboratory provided spatial analysis and mapping for five graduate students theses. The NM WRRI GIS laboratory used remote sensing capabilities to seek new research funding opportunities which address the diverse needs of stakeholders throughout New Mexico.

Increase Soil Water for Desirable Plants through Invasive Plant Management

Project Type: Annual Base Grant **Project ID:** 2018NM193B

Project Impact: Research is ongoing and primary findings will address the following research questions: 1) Does shredding of encroaching juniper conserve soil moisture, increase soil organic carbon, and reduce soil erosion and sedimentation? 2) What are the effects on desired future vegetation of converting living junipers into layers and piles of shredded juniper wood? 3) What impact will dormant and growing season prescribed fire have on subsequent vegetation, soil condition, and fire behavior?

Information Transfer

Project Type: Annual Base Grant **Project ID:** 2018NM191B

Project Impact: The New Mexico Water Resources Research Institute's (NM WRRI) Information Transfer Program is designed to bring the results of its research projects to the public, and to educate New Mexicans on the critical water issues of the state, region, and nation. Different sectors of the public are targeted for each of its activities. The program's goal to provide people with water information appropriate to their level of training and interest is ongoing. The NM WRRI will continue to provide avenues for information transfer such as conferences, symposia, workshops, technical publications, newsletters, audio/visual presentations, and the institute's website.

Program Administration/Management

Project Type: Annual Base Grant **Project ID:** 2018NM-ADMIN

Project Impact: The primary objective of the New Mexico Water Resources Research Institute is to maintain a balanced program of research that addresses water issues and problems critical to New Mexico, the region, and the nation. In administering this program, the institute relies on financial support from state appropriations, federal and state agencies, and the USGS Water Resources Research Institute Annual Base Program (USGS 104B). To make the best use of limited resources, the institute has targeted four areas as high priority for funding: water conservation, planning and management; atmospheric, surface and groundwater relationships; water quality; and utilization of saline and other impaired waters. During the reporting period, six projects received funding from the 2018 Annual Base Program. Four of these projects fit into the water conservation, planning and management category: 1) WRRI Information Transfer Program; 2) Geographic Information System for Water Resources Planning; 3) Transboundary Aquifer Assessment Program (coordination grant); and 4) Increase Soil Water for Desirable Plants through Invasive Plant Management. Two water quality projects were supported: 1) Digital Soil Mapping for Improving Hydrological Modeling of New Mexico Water Resources; and 2) Effects of Wildfire Ash on Water Quality. During the reporting period, June 18, 2018 through June 17, 2019, the NM WRRI administered a total 48 projects dealing primarily with water planning and management issues as well as water quality. The total value of these projects was $5,406,186. Dollar amounts per project award ranged from watershed projects of $1,527 to over $1.8 million, of which $930,077 was awarded to New Mexico State University faculty and students through a competitive request for proposals. These awards were funded through a cooperative agreement between New Mexico State University/NM WRRI and Bureau of Reclamation to increase scientific knowledge and research expertise in the area of characterization, treatment, and use of alternative waters for water supply sustainability in New Mexico and the Western U.S.

Transboundary Aquifer Assessment Program (TAAP): NM WRRI Effort

Project Type: Coordination Grant **Project ID:** G17AC00441

Project Impact: To better understand the Mesilla Basin priority transboundary aquifer, NM WRRI has addressed four major research efforts: 1) Geochemical and isotopic determination of deep groundwater as a source of discharge and salinity to the shallow groundwater and surface-water systems, Mesilla Basin, New Mexico, Texas, and Mexico. This research has advanced our understanding of deep groundwater in the Mesilla Basin aquifer to improve groundwater models and water management. 2) Remote sensing to develop evapotranspiration (ET) fluxes for the Mesilla Valley Aquifer. The project achieved the goal of improving the ET model for enhanced water budget and aquifer assessment. Other efforts include collecting additional data, synchronizing satellite images, and obtaining ground measurements to accomplish remote sensing objectives and compare the modified models with measured data. 3) Estimation of Regional Groundwater Recharge from Non-Irrigated Land in the Mesilla Basin, New Mexico. The project achieved these goals, no significant impacts affected this objective, and additional efforts are in progress. 4) Estimating recharge of alfalfa fields by measuring ET and soil moisture in the semi-arid Mesilla Valley Aquifer. Drainage estimates for year 2017 were achieved. Drainage was determined using the water budget method. The drainage amounts from Willie Koenig's field and Horse farm ranged from 530 mm (21 inches) to 580 mm (23 inches) for 2017 season. Drainage at the Leyendecker alfalfa site was very low for 2017. This is due to low irrigation and high amounts of clay in the soil. Drainage calculations for 2018 and 2019 are in progress.