



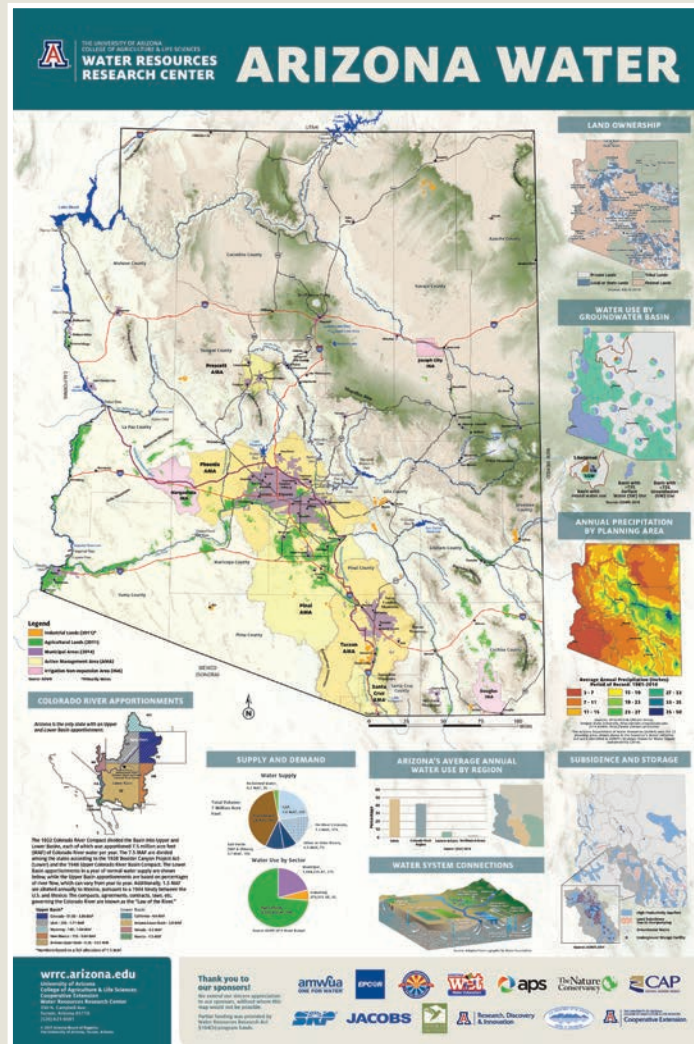
COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION

WATER RESOURCES RESEARCH CENTER

ANNUAL
REPORT **2016**

wrrc.arizona.edu

Arizona Water Map Poster



The Water Resources Research Center is pleased to announce the release of the new Arizona Water Map Poster, the latest in our series of reliable and concise visual representations of Arizona's water resources. This, the fourth edition of the map is the product of a design and review process that engaged stakeholders from across regions and sectors. The new map reflects the current state of water resources in Arizona, as well as a culture of management and planning unique to the state.

Order a Map Today!

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WATER RESOURCES RESEARCH CENTER

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A LEADER IN COLLABORATION AND DECISION-RELEVANT ANALYSIS FOR WATER RESOURCES SOLUTIONS

The University of Arizona Water Resources Research Center (WRRRC) has a 50-plus-year history of service as a center for research on vital water resource issues and a source for independent and objective water resource information. The WRRRC is a research and extension unit of the College of Agriculture and Life Sciences (CALs) and Arizona Cooperative Extension, and as such functions in partnership with CALs departments and Arizona Cooperative Extension personnel. The WRRRC is driven to fulfill its mission of engagement, education, and applied research to empower informed decision-making and enrich understanding of water policy and management. Our tag line: *Greater Depth, Broader Perspective for a Clear Water Future*, which was inaugurated in 2016 along with our updated website, conveys our aspirations and achievements.

This report is organized around the four overarching goals described in our Strategic Plan, which looks out to 2021. It describes our vision for the future in the statement “By 2021, our expanded applied research programs, increased engagement at the local, state, and broader levels, including international, and continued excellence of educational and outreach programs will cement our position as the leader in Arizona in applied water management and policy analysis.” The overarching goals are

- **Research:** To increase WRRRC capacity to engage in water policy and management research that is highly relevant to the real world;
- **Mentorship:** To increase recognition, both within and beyond the University, of the WRRRC as an excellent provider of skills and knowledge for future generations of water professionals;
- **Education:** Through the activities of Arizona Project WET, support teacher professional development, offer real-world learning experiences for K-12 students, and train community and business members to facilitate student learning; and
- **Partnerships:** To enhance WRRRC leadership in the dissemination of sound and independent water management and policy information and research results by increasing communication with a broad network of professional contacts around the State and beyond.

Everyone at the WRRRC works toward these goals through the programs and projects described in this report.

WRRC DIRECTOR

WRRC Director Sharon B. Megdal, Ph.D., continued to fulfill her multiple responsibilities at the University of Arizona (UA), where she is the C.W. and Modene Neely Endowed Professor for Excellence in Agriculture and Life Sciences, Distinguished Outreach Professor, and Professor in the UA Department of Soil, Water and Environmental Science. At the UA, she holds courtesy appointments in seven departments or schools, which include the School of Government and Public Policy, the School of Geography and Development, the College of Architecture, Planning and Landscape Architecture, the Mel and Enid Zuckerman College of Public Health, the James E. Rogers College of Law, and the Arizona Center for Judaic Studies. In addition, she directs Water, Environmental, and Energy Solutions (WEES) initiative, funded by the Technology Research and Initiative Fund (TRIF). She also serves on several committees and advisory boards, including for the Kyl Center for Water Policy, the new UA WEST Center, and the Center for Middle Eastern Studies.



Beyond participating, often as lead principal investigator, in several of the projects this report describes, she was active in numerous additional efforts. Her work focuses on water policy and management, on which she writes and speaks frequently. During 2016, she made over 35 presentations and responded to multiple requests from the public and media. Her numerous publications included three articles for the Special Issue of the journal *Water*, “Water Governance, Stakeholder Engagement, and Sustainable Water Resources Management,” for which she was lead co-editor. She writes a popular and well-respected Public Policy Review column for the Arizona Water Resource newsletter each quarter. Interviews appear in two films released in 2016: “Beyond the Mirage: The future of water in the West” and “Our Desert Farms”, a short film by Anna Augustowska. On the international front, she helped organize a visit to Israel and Jordan by the Commissioners of the International Boundary and Water Commission as part of her efforts to connect our region’s water management successes to other parts of the world.

WRRC Director Megdal advises graduate students from multiple graduate programs. She teaches a class entitled Arizona Water Policy in the Spring semester, which is cross-listed in multiple departments and attracts students from a broad range of fields. She also leads a seminar for students in the Water, Society, and Policy M.S. program. Her commitment to the program remains strong and many of her advisees are students in that program.

On September 30, her one-year term as Immediate Past-President of the National Institutes for Water Resources (NIWR) and membership on the NIWR Board ended. She remains active in NIWR, which is the organization of 54 water institutes funded through the Water Resources Research Act. She continues to serve on the board of the Universities Council on Water Resources, is President-Elect of that organization and chair of the June 13-15, 2017 Annual Conference. She was elected to the board of the American Water Resources Association and continues as a member of the Board of the International Arid Lands Consortium. A publically elected member of the Central Arizona Project (CAP) Board, she was elected by fellow CAP board members to serve as Board Secretary and Chair of the Central Arizona Groundwater Replenishment District and Underground Storage Committee.

In March of 2016, WRRC Director Megdal received a Lifetime Achievement Award at the 13th Annual Women of Influence event, presented by Inside Tucson Business and Tucson Local Media for her outstanding achievements in water policy and water resources management.

WRRC EXTERNAL ADVISORY COMMITTEE

The WRRC's External Advisory Committee (EAC) is a group of leaders from the Arizona water community who provide valuable advice on WRRC programs and plans. The EAC meets at least once annually, and in 2016 they met on December 19th at the Salt River Project Offices, Tempe, Arizona. The members of the EAC as of December 2016 are listed below with their affiliations as of that month.

Tom Buschatzke, *Arizona Department of Water Resources*

Misael Cabrera, *Arizona Department of Environmental Quality*

Guy Carpenter, *aqua TECTURE*

Ted Cooke, *Central Arizona Project*

Mark Cross, *Montgomery & Associates*

Maria Dadgar, *Inter Tribal Council of Arizona*

Tom Davis, *Yuma County Water Users' Association*

Kathleen (Kathy) Ferris, *Attorney, Arizona Municipal Water Users Association*

Alan Forrest, *CH2M*

William Garfield, *Arizona Water Company*

Patrick Graham, *The Nature Conservancy*

Andy Groseta, *Groseta Ranches*

Joe Gysel, *EPCOR, Water USA, Inc.*

Jason Hauter, *Akin Gump Strauss Hauter & Feld LLP and Attorney for the Gila River Indian Community*

Bradley (Brad) Hill, *City of Flagstaff*

Bob Johnson, *Retired, National Water Resources Association*

James (Jim) Leenhouts, *U.S. Geological Survey, Arizona Water Science Center*

Bob Lotts, *Arizona Public Service*

Francis McAllister, *Freeport-McMoRan Copper and Gold*

John McKinney, *Farmers Investment Co. (FICO)*

Leslie Meyers, *U.S. Bureau of Reclamation*

Richard Morrison, *Morrison Institute for Public Policy, Arizona State University*

Joe Olsen, *Metro Water*

Sarah Porter, *Kyl Center for Water Policy, Morrison Institute for Public Policy, Arizona State University*

Dave Roberts, *Salt River Project*

John Shepard, *Sonoran Institute*

Joe Sigg, *Arizona Farm Bureau Federation*

David Snider, *Retired (Pinal County Board of Supervisors)*

Kathryn Sorensen, *City of Phoenix*

Graham Symmonds, *FATHOM, Global Water*

Warren Tenney, *Arizona Municipal Water Users Association*

Timothy (Tim) Thomure, *Tucson Water*

Chris Udall, *Agribusiness & Water Council of Arizona*

Sid Wilson, *Retired (Central Arizona Project)*

Brian Wong, *BKW Farms*

REAL-WORLD RESEARCH

The WRRC Carries out Real-world water policy and management research focusing on water-stressed regions with growing populations and economies.

Water Quality Research

wrrc.arizona.edu/jean-mclain

Work in the water quality laboratory run by Dr. Jean McLain takes place at the interface of water microbiology, soil science, and ecosystem ecology. McLain and her students study the processes controlling the response of soil and water bacteria to anthropogenic and natural stressors. A major theme of current research is the study of anthropogenic effects on the development of bacterial antibiotic resistance in soil and water.



**Water Quality
Research Lab**

Following their use for control of human disease and/or animal husbandry, it is estimated that up to 75% of antibiotics are excreted in urine and feces unaltered or as potentially bioactive metabolites. Many wastewater treatment plants are not designed for the removal of organic pollutants and as a result, residual antibiotics are released into the environment with treated wastewater, leading to concerns regarding their contribution to resistance in soil and water microorganisms. Another research focus is the unique biological and chemical qualities of recycled municipal wastewater. McLain and her students are using molecular and cultural methods to study a range of bacterial groups in recycled water and irrigated soils. This work has identified points within water distribution systems where degradation in microbiological water quality occurs, providing utility operators with



Jean McLain, WRRC Associate Director and Associate Research Scientist in the Department of Soil, Water and Environmental Science (SWES), continued to lead a productive research program examining the microbiology of water and irrigated soils. Dr. McLain's work is funded by grants from the Arizona Department of Agriculture, the National Science Foundation (NSF), the U.S. Agency for International Development (USAID), and the Water Environment Research Foundation. In September 2016 she was part of a research team notified of an NSF award of \$2.2 million to train Arizona underserved homeowners in rainwater harvesting. Dr. McLain continues to actively seek additional funding, participating in grant proposals totaling over \$7 million in 2016.

Dr. McLain continued to represent the WRRC at local and national meetings. In June 2016, she traveled to Washington, DC to present Antibiotic Resistance in Surface Water and Groundwater to the Presidential Advisory Council on Combating Antibiotic Resistant Bacteria. Information on Dr. McLain's work in antibiotic resistance has been in high demand and in 2016 she presented informational talks at national meetings, state agencies, consulting firms, and university groups.

information to be used in efficient placement of in-line chlorine boosters. Internationally, McLain continued work on a USAID project, *Developing a Sustainable Seafood Safety Infrastructure in Myanmar*, traveling to Yangon, Myanmar in August. In sum, this highly applied research is designed to tackle the challenges of soil and water sustainability in a world experiencing population growth and global climate change.

Research on Water Resource Planning for Arizona's Rural Communities

wrrc.arizona.edu/waterrapids

Applied research is more effective when it involves the people who will use it. Because of the importance of stakeholder engagement, many of our research projects involve communication and interactions with stakeholders. The work we are doing for rural communities and small towns in Arizona is no exception. The following three research projects are components of the Water RAPIDS (Research and Planning Innovations for Dryland Systems) program. They engaged deeply with a range of interested parties to foster new approaches to water resource management with the goal of integrating planning for natural resources with land use planning.





Ashley Hullinger is a Research Analyst for the Water RAPIDS (Water Research and Planning Innovations for Dryland Systems) program. Much of her work revolves around developing effective stakeholder engagement for sustainable water management throughout Arizona. She has worked directly with rural communities to consider the people and history that have contributed to current water resource conditions. Hullinger's work in 2016 included progress toward the completion of a multi-year watershed planning effort to develop a Decision Support System (DSS) for the rural Upper Gila Watershed in eastern Arizona with support from the U.S. Bureau of Reclamation. A major focus in 2016 was to incorporate agricultural voices in planning efforts. In a related project, she conducted four case studies throughout the Lower Colorado River Basin as part of research exploring how watershed partnerships reach their stated goals; findings will be drafted in an article to be published in a scholarly journal in 2017. She coordinated and led other projects, including the development of a water budget for the Upper Santa Cruz River and a multi-staged evaluation of the water conservation program Conserve2Enhance™ (C2E). Hullinger's article focusing on the innovations of the program C2E was accepted for publication by Solutions Journal in 2016.

Watershed Planning in the Upper Gila Watershed

The Water RAPIDS team has been working in the Upper Gila Watershed since 2012. A new project was funded through a cooperative agreement with the U.S. Bureau of Reclamation. A collaborative effort involving the WRRC, Arizona Cooperative Extension, and the Gila Watershed Partnership, the project has involved work with watershed communities on developing an understanding of water supply and demand in order to use this knowledge to develop alternatives that foster a resilient community. The project team also has been exploring effective mechanisms of stakeholder engagement for water resource management in rural Arizona and throughout the Colorado River Basin.

In the past year, the team developed a conceptual water budget for the watershed to highlight potential gaps in supply and demand through 2050. The project team convened and facilitated a large workshop to present the conceptual water budget and discuss possible water supply and demand alternatives. The team also documented the water budget and the policies that govern water supply availability in the region in an Arizona Cooperative Extension Bulletin published in July 2016.

Understanding Environmental Flow Needs in Water Scarce Regions

In 2016, the WRRC, in partnership with Northern Arizona University (NAU), published the "Desert Flows Assessment: Environmental Water Needs of Riparian and Aquatic Species in the Desert Watersheds of the U.S. and Mexico", which provides a summary of findings from the Desert Flows Database created in 2015. The report represents the end of the First Phase of the Desert Landscape Conservation Cooperative (LCC) Environmental Flows Database project and is available at: wrrc.arizona.edu/sites/wrrc.arizona.edu/files/RAPIDS/PDF/DesertRivers_Gap_Analysis_March2016.pdf

Starting in March 2016, the Second Phase of the project has included the creation of a Guidebook for Environmental Flow Needs Assessment under a Changing Climate, designed as a manual that can be used by land and water managers in their attempts to determine, safeguard, and predict environmental flows throughout the region. Additionally, the article "Environmental Flows in the Desert Rivers of the United States and Mexico: Synthesis of Available Data and Gap Analysis" was submitted to the *Journal of Arid Environments* in August 2016.

Recommendations for Water Resources Management in Cobre Valley

In 2016, together with Gila County Cooperative Extension, the Water RAPIDS program completed the project "Raising Water Awareness in Globe-Miami." The project was funded by the Freeport McMoRan Foundation. A series of three fall community conversations in 2015, entitled "Good to the Last Drop? Water in the Cobre Valley", led to a notable showing of community support for a Shared History Timeline. In Spring 2016, more than 50 community members gathered at the Bullion Plaza Museum and Cultural Center in Miami to share their memories, as well as the stories of generations past. Water RAPIDS staff recorded the stories on a physical timeline on paper and in video for an interactive online timeline and a poster for the Museum. The online timeline can be accessed at wrrc.arizona.edu/Globe-Miami.



Grant Weinkam, Ph.D. was hired in August 2016 as a full-time Research Analyst with the Water RAPIDS program. His work has involved completing previously funded projects associated with: agricultural and rancher engagement in the Upper Gila Watershed, water quality and quantity data synthesis and communication in mining communities of Globe/Miami, Arizona, and development of an “Environmental Flows Methodology Guidebook” for the Desert Landscape Conservation Cooperative. To conduct this work, information is continually collected through review and organization of historical resources, in-person and over-the-phone interviews with regional experts, and regular feedback and review from our cooperative extension and local agency partners. Ongoing, research results and output are transferred to members of the community and the broader scientific community through education, engagement, and publications targeted at ultimately improving the economy, ecology, and long-term water resource resiliency of the affiliated regions.

This work provided an introduction to water resources issues in the region, the foundation of further research during a 1.5-year long project funded by the U.S. Bureau of Reclamation and started in September of 2016.

Transboundary Aquifer Assessment Program (TAAP)

wrrc.arizona.edu/TAAP

The Transboundary Aquifer Assessment Program (TAAP) for the San Pedro and Santa Cruz binational aquifers (specified as priority aquifers in 2006 by Public Law 109-448) continued its efforts in September of this year with new funding. Activities focus on three tasks: assist TAAP partners in completing the Santa Cruz Aquifer Report; organize stakeholder workshops; and characterize the impacts of changing precipitation patterns in the Santa Cruz River Aquifer in Mexico. A summary for the Transboundary San Pedro Aquifer Report, along with the officially and binationally approved version of the Report, form the basis of stakeholder workshops. These workshops will be held in 2017. As of December 2016, planning for U.S. workshops was underway, while further discussions is needed before planning for workshops in Mexico can occur. Characterization of precipitation pattern impacts will result in: high-resolution regional climate projections; establishment of a study area for hydrology projections in the Santa Cruz River Aquifer in Mexico and a survey of existing hydrologic models for the area; and a report on



Jacob Petersen-Perlman joined the WRRC staff as a Research Analyst in September. Along with graduate student Elia Tapia, Jacob has been planning a stakeholder engagement forum for the TAAP program in Sierra Vista, AZ for the spring of 2017. Future workshops will be held later in the year. He drafted a summary for the Binational Study of the Transboundary San Pedro Report, as well as other preparatory documents for the workshop. Petersen-Perlman gave three public presentations: one for the WRRC Brown Bag series, an invited presentation at the University of Minnesota-Duluth, and a remote presentation for a graduate class at the University of Montana. Additionally, he contributed to an article published in 2017 *Environmental Management* on collaborative groundwater governance in the United States and a book chapter under review on transboundary groundwater governance and assessment.

climate change assessment methodology and results. The effort follows methodology used by the WRRC and its partners through a previous NOAA-funded project.

The International Boundary and Water Commission hosted a binational cooperation meeting in El Paso, TX in September to discuss current and future TAAP activities. Future activities include continued cooperation between the University of Arizona, USGS, the University of Sonora, and CONAGUA.

The *Binational Study of the Transboundary San Pedro Aquifer* was officially approved by the U.S. and Mexican sections of the International Boundary and Water Commission. This first-ever binational aquifer assessment report has undergone peer review and was prepared simultaneously in English and Spanish.

Online Groundwater Management Data Portal for the Santa Cruz AMA

<https://warcat.hrcwater.org/SCAMA>

The WRRC participated in a project, completed in 2016, called Water Resources and Climate Assessment Tool (WARCAT), which provided a one-stop portal presenting current hydrological and meteorological datasets relevant to water resources management and planning in the Santa Cruz Active Management Area. Area stakeholders' data needs were addressed through assembly and intuitive visualization of real-time datasets from multiple sources. The Hydrologic Research Center (HRC) created the website under a subcontract to the WRRC with funding from the Arizona Department of Water Resources. The WRRC and HRC hosted three workshops for stakeholders in conjunction with this project.

National Groundwater Governance Survey

Although groundwater is relied upon as a major source of water for communities, industries, and irrigators, governance of the resource has been historically neglected. In 2015, a team from the WRRC designed and launched a nationwide survey, focusing on groundwater quality, to develop a better understanding of groundwater governance in the United States. One state water professional was recruited in each state to participate in the survey. Throughout 2016, survey results were compiled, gaps filled with follow-up inquiries, and responses analyzed and synthesized for a report. Results confirmed that groundwater governance and management practices vary considerably across the United States. The state water professionals identified a wide variety of groundwater concerns, from water quality and quantity to staffing and budget issues, and most states have seen significant changes to groundwater quality policy in the last 10 years. Funding from the Ground Water Research and Education Foundation (GWREF) supported development of a report that is available on request.

MENTORING, TRAINING, AND INFORMING

The WRRC fosters the growth in water knowledge in students of all ages and is recognized for its success in training new cadres of water professionals.

Students

In addition to her Arizona Water Policy class and Water, Society, and Policy seminar, Sharon Megdal devotes time to advising and mentoring graduate students. She served as committee chair for 13 students in 2016, three Ph.D. students and 10 MS students. She served on the committee of two additional Ph.D. students and led the committee for an undergraduate honors student final project. She has placed students in the Water, Society, and Policy program with organizations and agencies where they work on real-world problems as they complete the program's requirement for a culminating project. One student worked with a U.S. Bureau of Reclamation Basin Study for the Tucson Basin, while another worked with the Arizona Department of Environmental Quality on a project planning and priority setting exercise for the Arizona-Sonora, Mexico border area. In 2016, one of her students won a research prize offered annually by the Central Arizona Project. Her commitment to the Water, Society, and Policy program, along with her membership on the Executive Committee for the UA interdisciplinary Ph.D. Program in Arid Lands Resource Sciences, makes her a unique resource for students interested in water resources.

Through her work, Dr. McLain actively mentors several undergraduate and graduate students in laboratory and field microbiological sciences. Two new graduate students started research projects in 2016 that focused on improving the microbiological safety of tools used to harvest leafy greens and identifying factors that enhance toxin production by blue-green algae, respectively. Also in 2016, the McLain lab hosted students from SWES, the College of Science, and the Honors College, all of whom were conducting research related to irrigation with recycled water, food safety, and environmental impacts of emerging contaminants. While in Myanmar, she trained more than 80 instructors from 40 universities in Myanmar in laboratory methods used to assess seafood safety.

In 2016, the WRRC tried something new by focusing its 104b grants program on student research projects. Because program goals emphasize the entry of new research scientists, engineers, and technicians in the water resources field along with education of students through significant involvement in water research, the WRRC requested that graduate students and their faculty sponsors submit proposals that feature student research. The program's

Technical Review Committee met on December 2 to evaluate the seven proposals received. The Committee ranked proposals and the two top ranked proposals were selected for funding, subject to the availability of the full \$92,335. The two selected projects are (1) Impact of Projected Climate-change on Mountain-block Recharge Processes, Principal Investigator: Tom Meixner, Student Co-Principal Investigator: Ravindra Dwivedi, University of Arizona and (2) Might Recycled Wastewater Solve the Rising Problem of Toxin-producing Algae? Principal Investigator: Kevin Fitzsimmons, Student Co-Principal Investigator: Robert Lynch, University of Arizona

Students are an important part of our workforce, and we provide them with meaningful learning opportunities through our many projects. The WRRRC employed 31 students in 2016. A list of our students can be found in Appendix B of this report.

Brown Bags

wrrc.arizona.edu/events/brownbag

The WRRRC's Brown Bag seminar series continues to attract diverse audiences to hear about a range of water topics. In 2016, the WRRRC has held 22 Brown Bag seminars. Speakers included state, national, and international experts. Average attendance was 22 people (in person), approximately half from UA and the other half from the broader community. Charles Bayless, retired Tucson Electric Power Chairman and CEO, former President and Provost of the West Virginia University Institute of Technology, and member of The Board of Directors at Recycled Energy Development, drew the largest audience with a talk on "Perspectives of an Electric Utility Executive on the Water-Energy-Climate Nexus." Other well-attended seminars included a presentation by Eve Halper, Natural Resources Specialist, Bureau of Reclamation, and Kathy Chavez, Water Policy Manager, Pima County, on "Water Supply/Demand Imbalance in the Face of Climate Change – How will we prepare?" and one by Shane Snyder, Professor Chemical and Environmental Engineering, and Co-Director, Water & Energy Sustainable Technology (WEST) Center, University of Arizona, on "Ensuring the Safety of Recycled Water". Access to the WRRRC's Brown Bag series now routinely includes offsite listeners through live webcasts via Go-to-Webinar. Offsite attendance continued to grow and in 2016, 191 participants attended Brown Bag seminars electronically. The website hosts the recorded Go-To-Webinar seminars as well as the slide presentations of most seminars.



Other Public Events

The WRRRC has sponsored, co-sponsored, and hosted a number of events for a broad range of interests. Our annual February Chocolate Fest provided an opportunity for our friends in the water community to meet informally. Co-sponsored speakers included Patrick O'Toole, President of the Family Farm Alliance, who spoke on "Spreading the Water: Connecting Agriculture and Conservation in the Western U.S.". During the UA's annual book festival, the WRRRC hosted an informal breakfast with Seth Siegel, the author of *Let There Be Water: Israel's Solution for a Water-Starved World*. On October 14, "Water Management in Mexico: Status and Challenge", a lecture by Dr. Fernando González Villarreal, and "Principles in Sustainable Groundwater Management Policy" by Adriana Palma Nava, both with the Institute of Engineering, Universidad Nacional Autónoma de México (UNAM), were presented by the WRRRC, joined by a number of co-sponsors. Then on November 15, the WRRRC partnered with the UA James E. Rogers College of Law to present Dr. Michael E. Webber, who spoke on his book, *Thirst for Power: Energy, Water and Human Survival*.

Other Outreach Activities

Water RAPIDS staff contributed to the 16-week Master Watershed Stewardship class that began in January 2016 through Gila County Community College and had 22 registered students, the largest registration in the past five years.

Osher Lifelong Learning Institute classes on various aspects of water resources were offered in the spring of 2016 by WRRC personnel. This was the second year of presenting these classes and a new set of classes were offered in the spring of 2017.

The WRRC is called upon frequently to inform audiences about Arizona water and our water management practices and policies. Throughout the year, WRRC faculty, staff, and students make many presentations, both oral and poster format, locally, nationally, and internationally. Director Megdal presented many of these, including the Annual Meeting of the National Institutes for Water Resources (NIWR), Washington, DC; Groundwater Protection Council Annual Forum, Orlando, FL; and International Symposium on Managed Aquifer Recharge (ISMAR9), Mexico City, MX. Other WRRC personnel presented at the AZ Water Annual Research Workshop, Tempe, AZ; Farm, Home, and Ranch Day with Arizona Cooperative Extension - EAC campus, Thatcher, AZ; a national webinar for the Water Reuse Community of Practice, Arcadis, Inc.; and the Desert Landscape Conservation Cooperative CMQ Annual Workshop, Alpine, TX., among many others. See Appendix B for a complete list of presentations.

Fostering Future Water Professionals

The Summer Writing Internship at the WRRC was initiated in 2009 with funding from Montgomery & Associates, an Arizona-based consulting firm specializing in hydrology and water resource issues. For the internship, students work alongside WRRC professionals doing research and writing for the *Arroyo* publication that is published the following spring. The internship fosters the important skill of communicating highly technical and complex information to a general readership. Noah Silber-Coats, a Ph.D. student in Geography, was selected from a highly talented applicant pool as the Montgomery & Associates Summer Intern to work on the 2017 *Arroyo*. He produced a first draft over the summer, which was reviewed and revised in 2017.

From graduate student to analyst and beyond, the WRRC has nurtured talent as evidenced by departures and additions to staff. Senior Research Analyst Kelly Mott Lacroix left in August 2016 to take a position as a Presidential Management Fellow with the U.S. Forest Service, but she continues to provide expertise for different aspects of Water RAPIDS projects as an official WRRC volunteer. Also a Presidential Management Fellow, Research Analyst Nate Delano left in June to take a position with the U.S. Environmental Protection Agency in New York City. In September we hired two Research Analysts, Grant Weinkam, who joins Research Analyst Ashley Hullinger (a former graduate student) on the Water RAPIDS Program, and Jacob Petersen-Perlman, who focuses on the Transboundary Aquifer Assessment Program and other projects. Dr. Weinkam has over 10 years of experience applying physical, chemical, ecological, and socio-economic principles to solve water resources challenges, including four years as a research scientist at the U.S. EPA. Dr. Petersen-Perlman served as a post-doctoral scholar through the Ken Alberman Fellowship in Water, Society, and Geopolitics at Hebrew University of Jerusalem, Israel. His research areas of interest include transboundary water conflict and cooperation, water security, and water governance.

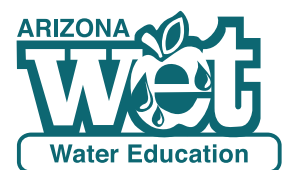
ARIZONA PROJECT WET

The WRRC supports the goals of Arizona Project WET to educate teachers, students, and community members to build understanding and the capacity for informed problem solving.

Arizona Project WET Water Education Program

arizonawet.arizona.edu

The focal point of Arizona Project WET (APW) in 2016 was providing instruction that develops and utilizes a language and structure for thinking. The APW team has taken year-long curriculum content and created individual STEM units for easier use by teachers. We call it the Aqua STEM Program. Each unit focuses on making distinctions, identifying the parts of the system and what the system is a part of, exploring relationships between two ideas, and studying the same topic via different lenses or perspectives. Unit topics include: Rainwater Harvesting, School Water Audits, and Riparian Area Investigations. Engineering practices were also highlighted in these STEM units. Curriculum units are available online and teacher professional development on the units is offered throughout the year.





Kerry Schwartz is Director of the APW water education program and Associate Specialist with Arizona Cooperative Extension at UA with an academic home in the Soil Water and Environmental Science Department. She is responsible for programs that teach science, STEM literacy and systems thinking skills to educators, K-12 students, and community members. She works statewide, supervising 10 personnel located in three extension offices. She and the APW team work to develop and evaluate STEM-focused education programs and teacher professional development that incorporate real world science and engineering practices and foster thinking and problem solving. This year, she worked closely with a cognitive scientist and evaluator out of Cornell University to integrate and assess systems thinking in APW Programs. She partnered with Watershed Management Group to win a four-year NOAA grant focused on resiliency to extreme weather events in the Southwest. Kerry works collaboratively with the APW team to achieve the reported impacts.



Betsy Wilkening is the Education Coordinator for the Tucson Program. In 2016 she worked with a local non-profit, Watershed Management Group, on an Environmental Literacy Grant proposal to build community resilience. APW and Watershed Management Group were awarded the multi-year grant, Recharge the Rain: Community Resilience Through STEM Education and work began on it in January 2017. A new professional development opportunity for 4-12th grade teachers, The Living River Academy, was provided in the spring and fall of 2016. APW partnered with Pima County Natural Resources Parks & Recreation to engage teachers in environmental monitoring of the Santa Cruz River and systems thinking about rivers in Pima County. Teachers compared their sampling data to the long-term science data published by the Sonoran Institute and Pima County in the 3-year monitoring of the lower river.



Holly Thomas-Hilburn is an Education Coordinator for Arizona Project WET. She holds a Master's degree in Teaching and Teacher Education with an emphasis in environmental learning. Utilizing her education and evaluation background, she supports evaluation and assessment efforts throughout the program. She has led the effort to develop the Aqua STEM program, a series of project-based STEM units that integrate Systems Thinking skills, giving students a language and structure for thinking. Employing new methods, meta-mapping, and models that make thinking tangible, APW is seeing significant results in students ability to think more creatively and critically.

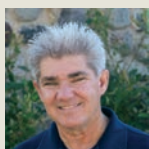


Dee Fife, Senior Instructional Specialist for the Tucson Education Program, manages 12 UA student Water Educators and coordinates direct student outreach programs in Tucson area classrooms. The Water Educators are trained to facilitate Groundwater lessons to 3rd, 4th and 6th graders as well as lessons for 3rd and 4th graders at Sweetwater Wetlands on Technology/Water Conservation, Watershed Management, the Water Cycle and a Wetlands Tour. They also deliver program components including: Water Efficiency Technology Presentations, indoor water audits, outdoor water audits, home water audits, and community STEM/Science Night events. These programs reached 10,052 students through direct instruction, 13,107 students through teachers participating in Academies, 2,890 Adults and 5,772 students through public outreach events, and 429 students performed water audits with projected savings of 432,521 gal/yr.

As a partner in the systems thinking research of the Cabrera's Research Lab at Cornell University, APW was asked to provide a plenary speaker at the *Applying Systems Thinking to Complex Water and Policy Problems Symposium* in December 2016 (www.cornellsysthink.com). The APW story; taking the online systems thinking 101 course; consulting over a year with the Cabreris; mapping, activating, and checking curriculum units; and building systems thinking into professional development and direct student outreach will be highlighted for educators across the country and the world.

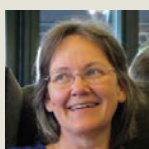
Arizona Water Festivals instill a deeper understanding of water in the earth system and Arizona's water resources through a community water festival event, teacher professional development workshop, and extensive volunteer and community involvement. This year, the total number of 4th grade students reached by this program since 2000 exceeded 100,000! The Pinal County water education program, in partnership with the Abbott Fund, will reach another milestone; exceeding 10 million gallons of water savings since 2009 through student-driven water efficient technology installation.

The Tucson APW program continues to impact the community at all levels, engaging about 10,000 students each year directly and another 7,000 at community events. As the City of Tucson studies rerouting reclaimed water to the Santa Cruz River through downtown, APW is already engaging area teachers in studying the interconnected natural and human water distribution systems through the Living River Teacher Academy. According to pre- and post- self-rating of knowledge, teachers engaged in this 2-day academy demonstrated a 162 percent gain in knowledge about the current state of the Santa Cruz River (using Pima County's and Sonoran Institute's three Living River Reports). At a 3-day energy water nexus academy in the county, 100 percent of teachers agreed or strongly agreed with the statements. *This workshop was excellent—one of the best I have ever attended.*



Chuck Dugan, Is approaching three years as the Pinal County Water Program Coordinator. With his leadership the Pinal County Water Festivals have seen a nearly 10% increase in student and teacher participation. His work with Pinal County partners and sponsors has led to continued funding from the Arizona Department of Corrections (\$10,000) and Nissan (\$7,000), while new opportunities are being explored by re-establishing relationships with some of our past partners, such as Global Water. His work with Abbott Nutrition, the program’s founding sponsor, continues to promote a community water conservation ethic through a multi-pronged approach to reach people of all ages while generating measureable

water savings across the community. The Spray Head Replacement Program continues to provide water savings in restaurants across Pinal County, while new initiatives including a fourth grade “Toilet Tank Bank” and a 5th grade aerator replacement program (SWAP) are projected to save nearly 300,000 gallons of water through the next year.

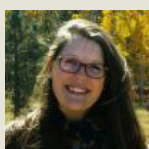


Mary Ann Stoll is an Education and Technology Coordinator with Arizona Cooperative Extension at the UA, celebrating ten years of working with the APW water education program. She holds a Master’s degree in Educational Technology and is an avid systems thinker. Stoll develops and delivers curriculum for APW’s new Aqua STEM Program and facilitates professional development in STEM literacy. She is a team leader in the integration of best instructional practices for teachers and educators. She also designs, develops, and maintains APW’s website, which provides an online connection to the community and ready resources for participants in APW programs.



Pam Justice, Senior Education Coordinator, has represented Arizona Project WET at the Maricopa County Cooperative Extension office since 2003. She coordinates educational and outreach programs that improve the understanding of both youth and adults regarding water issues. She also develops and delivers curriculum and professional development in STEM literacy. She led four water festivals in 2016, delivering professional development workshops for teachers; coordinating logistics and evaluation with teachers; recruiting and training volunteers; organizing festivals for up to 1,350 students at a time; and developing partnerships for program sustainability. In 2016, Justice engaged 1,535 sixth grade students in 57

classes in the Water Scene Investigations (<https://arizonawet.arizona.edu/programs/wsi>) home water audit within the Gilbert, Higley, and Chandler School districts. A total of 536 aerators were changed, producing a total projected annual water savings of 2,650,176 gallons.



Sara Krzmarich is an Instructional Specialist working with the Arizona Water Festival and Aqua STEM programs. She has been with both programs since September 2015 and has a Bachelor of Science degree in Environmental Science. Since September, she has organized and assisted with 8 water festivals, totaling approximately 5,060 students, 189 teachers, and 300 volunteers. She has conducted teacher workshops and volunteer training to prepare teachers and volunteers for the festivals. She has also supported 7 Aqua STEM teachers within 6 of the participating schools in the 2016-2017 school year, with approximately 620 students. She delivered groundwater, rainwater harvesting, water in the environment, and water conservation presentations within classrooms and conducted water audits with schools to install high-efficiency faucet aerators.



Julie Hasty is a half-time Community Coordinator who works with the Aqua STEM and Arizona Water Festival programs. As a Community Coordinator for Arizona Project WET, she supports participating teachers by facilitating classroom activities for the Aqua STEM program on groundwater, water conservation, school water audits, rainwater harvesting, water in the environment, and riparian area science, directly reaching more than 480 students. She assisted in design and development of Aqua STEM lessons. Her work with Arizona Water Festivals includes coordinating Phoenix area east valley festivals by delivering teacher professional development workshops, volunteer recruiting and training, organizing festival logistics for up to 1800 4th graders, and developing community partnerships to support the program. The east valley water festivals reached over 2,650 students and 100 teachers in the 2016-2017 school year.



Barbara Owens joined the Arizona Project WET team in November of 2016 as a full-time Instructional Specialist, Sr. She works with the Aqua STEM and Arizona Water Festival programs. For the Aqua STEM program, she facilitates field and classroom activities on groundwater, water conservation, school water audits to install high-efficiency aerators, rainwater harvesting engineering challenge, water in the environment presentations and riparian area science investigations. Her work with the Arizona Water Festival program includes coordinating water festivals around the state by delivering teacher professional development workshops, volunteer recruitment, and training, organizing festival logistics for up to 900 4th

grade students during a festival, and developing community partnerships to support the program.

Diverse STEM Academies this past summer engaged teachers in learning many ways to integrate subject instruction around real-world and relevant content. At the 5-day SRP Academy, teachers’ self-ratings showed a 96 percent gain in *understanding how Phoenicians in the past engineered solutions for their water needs* and an 111 percent increase in *relating Phoenicians’ past water objectives and challenges to modern objectives and challenges*.

Larger sponsorships with Tucson Water, Salt River Project, Arizona Department of Water Resources and the Abbott Foundation were sustained at approximately \$410,000 per year. Smaller contributions from over 35 other sponsors combined (approximately \$130,000) fund 22 water festivals and associated professional development around the state.

PARTNERSHIPS FOR KNOWLEDGE CREATION

The WRRC engages with partners, stakeholders, and the community to create the knowledge foundation for water policy and management decision making.*

*For a summary of WRRC partnerships see the Partnership Matrix in Appendix A to this report

Annual Conference

wrrc.arizona.edu/conference

The 2016 Annual Conference, #AZwaterfuture: Tech, Talk, and Tradeoffs was held on March 21 at the UA Student Memorial Union in Tucson. The conference focused on innovative ideas and approaches in technology, communication, and policy. Anne Castle, former Assistant Secretary for Water and Science, gave the opening keynote address, while Hunter Moore and Lisa Beutler spoke at the luncheon and the opening of the afternoon sessions, respectively. Approximately 275 people attended from 23 communities throughout Arizona and six Southwestern states. A full roster of experts and innovators from water technology, communication, education, policy, and management fields provided talks and panel discussions. In a poster session after lunch ongoing research and programs were on display. Student posters were judged during the day and the winners were awarded cash prizes provided by Netafim, one of the 16 conference sponsors. The winning student posters were University of Arizona students: first, Aloah Pope, second, Tirthankar Roy, and third, Benjamin Richmond and Saige Williams. During the post-conference reception, conference goers interacted with electronic resources at stations that monitored the conference's Twitter conversations, introduced the new UA Water Network, and engaged participants to explore the "Beyond the Mirage" web experience and build their own documentaries.



Conference planning began in 2016 for our 2017 Annual Conference, "Irrigated Agriculture in Arizona: A Fresh Perspective". A committee of knowledgeable advisors proposed an agenda rich in its depth and variety of perspectives on this important and timely topic. As a special feature, a showing of the film "Groundwater: To enact a law for the common good" was programmed and Kathleen Ferris, who developed the film with Michael Schiffer, was scheduled to lead a panel in a discussion of water leadership.

Arizona Water Resource

wrrc.arizona.edu/publications/awr



In addition to its regular news content, *Arizona Water Resource* (AWR), the WRRC's quarterly newsletter, provides opportunities for partners to publish their research and perspectives in an outlet respected as a source of objective water resources information. The AWR appeared in January, April, July, and October 2016. Print copies were mailed to approximately 1,800 subscribers, in addition to electronic distribution. The AWR moves to an all-digital format beginning with the Winter 2017 issue. We anticipate that the change will provide more flexibility and reduce waste, in addition to saving personnel time and printing and distribution costs.

The Summer 2016 issue contained a 4-page summary of WRRC accomplishments in 2015 "At-a-glance", which provided key metrics from the WRRC's 2015 Annual Report. In 2016,

Guest Views were provided by Abe Springer, School of Earth Sciences and Environmental Sustainability, Northern Arizona University, Mike Crimmins, Department of Soil, Water and Environmental Science, University of Arizona, and Chuck Graf, Arizona Department of Environmental Quality. Following the 2016 Annual Conference, the AWR featured articles by conference speakers including Hunter Moore, Resources Policy Advisor to Arizona Governor Doug Ducey, and Lisa Beutler, Public Affairs Specialist with MWH Global, who wrote on “wicked water problems”, APW Director Kerry Schwartz on education innovations, and Amy L McCoy, AMP Insights LLC, together with WRRRC Research Analyst Kelly Mott Lacroix on the concept of tradeoffs in water resources planning. These articles and a Special Feature by Associate Director Jean McLain were the fruits of a new focus on contributed articles. In addition, the AWR provided an opportunity to shine a spotlight on some of the WRRRC’s exceptional students.

Arroyo

wrrc.arizona.edu/publications/arroyo



The 2016 *Arroyo* WRRRC’s annual newsletter on a single topic of timely interest to Arizona, had 1,852 email subscribers and 1,796 print subscribers, including libraries, schools, firms, and nonprofits, as well as individuals representing a very wide range of organizations. Past *Arroyos* have been used for reference by the Blue Ribbon Panel on Water Sustainability, agency personnel, reporters in various media, university and K-12 teachers, the scientific research community, and many others.

The topics for the *Arroyo*, are selected each year with EAC guidance. The topic for 2016, selected in early 2015, was “Potable Reuse of Water”. The 2016 *Arroyo* was published in May after review by Guy Carpenter, then with Carollo Engineers; Karen Dotson, BKW Farms; Chuck Graf, Arizona Department of Environmental Quality; Brad Hill, City of Flagstaff; Jean

McLain, University of Arizona; Arthur Nuñez, City of Scottsdale; Channah Rock, University of Arizona; Timothy Thomure, City of Tucson; and Wally Wilson, City of Tucson. Carollo Engineers provided funding for printing and mailing of the 2016 *Arroyo*. A synopsis of this popular *Arroyo* appeared as an article in the July 2016 issue of *IMPACT*, a journal of the American Water Resources Association.

The 2017 *Arroyo* topic is water banking, recharge, and recovery. A draft was completed in the summer of 2016 and was subsequently revised for review. Printing and mailing of the 2017 *Arroyo* are funded by the Central Arizona Project.

Conserve2Enhance (C2E)

conserve2enhance.org

Since 2010, Conserve2Enhance (C2E), a trademarked program of the WRRRC, has connected voluntary water conservation to environmental enhancement by using participant donations based on their water savings to fund local projects. Participating residential and business water customers can create accounts on the C2E Water Use Dashboard (www.conserve2enhance.org) to track their water use, learn conservation tips, and donate to a local C2E program. The much-anticipated launch of the Flagstaff C2E Program in Summer 2016 marked the participation of the second water utility in C2E, alongside Tucson Water. Utility involvement in a C2E program has been found to be a major driving force for success.

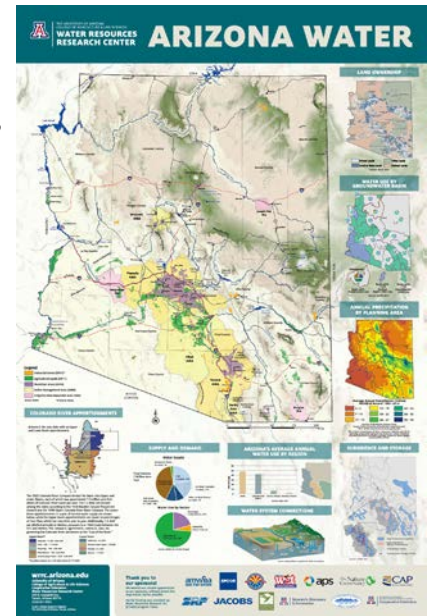


In total, C2E participants have conserved over 9.3 million gallons of water and invested over \$98,000 in community-identified project sites that enhance local washes, reduce flooding, and increase wildlife habitat. Most of this investment has been in neighborhood-scale projects in Tucson, involving hundreds of volunteers. Results include improvements to community waterways and increased water awareness across diverse groups. Community-wide water conservation will get a boost from increasing use of the C2E Water Use Dashboard. Developed by the WRRRC, this tool is available at no cost to participants and interested communities. As of November 2016, there are more than 250 participants, with the majority in Tucson and a growing number in Flagstaff.

Arizona Water Map Poster Update

A stakeholder-driven process informed the development of the new Arizona Water Map from brainstorming to final reviews, ensuring that this fourth version of the Water Map accurately reflects the current state of water resources

in Arizona. An Arizona Water Map Technical Advisory Committee (TAC) was convened on the basis of GIS expertise, experience with Arizona water resources data, and involvement in previous Arizona Water Map development. The TAC included representatives from the Arizona Department of Environmental Quality, Arizona Department of Water Resources (ADWR), Central Arizona Project (CAP), Salt River Project (SRP), U.S. Bureau of Reclamation (Reclamation), University of Arizona (UA), and Water Infrastructure Finance Authority of Arizona. The TAC provided vital guidance and expertise, which was taken by WRRC staff to create the map poster. The WRRC personnel who worked through the various stages of map development relied on the volunteer hours of dozens of supporters. In addition to data updates, notable changes included a stronger emphasis on water supply and demand among different water using sectors and regions and on groundwater usage. The map also highlights population density and shows sites of recharge and subsidence. The new natural terrain background uses Esri's multi-directional hillshade, which computes hillshade from six different directions (as opposed to one direction in a default hillshade). The logos of sponsors and partners who contributed to map development are displayed at the bottom of the map and include ADWR, Arizona Municipal Water Users Association, Arizona Public Service, Arizona Project WET, Arizona Cooperative Extension, CAP, EPCOR Water, Jacobs Engineering, SRP, Sonoran Institute, The Nature Conservancy, Reclamation, UA Research, Discovery & Innovation, and Water Resources Research Act §104(b) program.



Beyond the Mirage

beyondthemirage.org

Two years ago, we began work on a multi-faceted project to raise awareness and knowledge about water issues in Arizona and the Southwest. The project's core is an interactive, guided but self-directed learning experience drawing on hundreds of video clips. Clips are presented in a smart web environment, and users can choose among them according to their interests. Users are then able to create their own documentaries, which can easily be shared on social media. The WRRC, working with Cody Sheehy and a team from CALS, successfully completed the "Beyond the Mirage" web experience and launched it at events in Phoenix and Tucson, including the WRRC 2016 Annual Conference in March.



The "Beyond the Mirage" documentary was completed in March and two free "sold out" documentary screenings were held prior to its premiere broadcast on AZPM PBS 6, Friday, April 15 at 9:00 pm. Each screening was followed by a panel discussion moderated by AZPM's



Susanna Eden, WRRC Assistant Director, completed work on two major projects in 2016. The Beyond the Mirage web experience was launched in March and the documentary was screened and broadcast on public television stations in the following months. Stakeholder engagement workshops launched a data portal designed to support optimal water management in the Santa Cruz Active Management Area. She continued her management of the federal Water Resources Research Act 104 program and oversaw a change in the 104b proposal process to focus on graduate student research. In 2016, she managed the review and publication of the 2016 Arroyo on potable reuse of water and the research and development of the 2017 Arroyo on water banking, recharge, and recovery. She assembled the WRRC's 2015 Annual Report and continued to write for and edit the quarterly newsletter. In addition, she co-edited a special issue of the journal *Water* for which she was also lead author on a paper on stakeholder engagement. She presented two webinars for the Desert Landscape Conservation Cooperative webinar series and talked on direct potable reuse at the Arizona Hydrological Society Symposium.

Loraine Rivera. Following the AZPM broadcast, an expert panel was recorded for premiere airing, consisting of UA Professors Robert Glennon and Sharon B. Megdal, along with Sheehy and moderator Loraine Rivera. KAET (PBS) in Phoenix aired the documentary on its main station 8.1 HD on May 16th at 9 PM. AZPM secured national distribution through American Public Television and in mid-October, “Beyond the Mirage: The Future of Water in the West” was shown in 33 states or approximately 80 stations nationwide. Live streaming of the documentary, which had to wait until after nationwide airing through the national PBS network, is available as of April 2017. DVDs are available for purchase from beyondthemirage.org.

Multiple screenings for specific audiences have taken place since it was first shown and requests for screenings and presentations continue to come in. For example, the documentary was screened at Marana’s Big Green Event on November 5, 2016, and “Beyond the Mirage” was invited to participate in Kartchner Caverns State Park Cave Fest in January 2017. Kerry Schwartz presented the web experience to Leadership West in a two-hour session that engaged West Valley decision-makers. The documentary is being shown at the American Water Resources Association International Speciality Conference in Israel on September 10-11, 2017.

Arizona Project WET engaged teachers and schools in the Phoenix area using the “Beyond the Mirage” video content and website as a teaching tool during a special event on Earth Day, April 22. The Stack Sharing Festival resulted in 273 stacks created by the middle school students. In early May, these stacks were judged and voted on by users of the “Beyond the Mirage” site, parents, teachers and students. “Oscar” awards were presented to the three winners at the Water Investigations STEM Symposia in mid-May. Schwartz worked with Lili DeBlieux, Superintendent of Pendergast School District, on setting up a Water Academy that incorporates video stacking with Beyond the Mirage, using Arizona Project WET (APW) instructional practices and resources in the 2016-17 school year.

The Beyond the Mirage project won the top Environmental Education/Communication Award at the Arizona Forward Annual Environmental Excellence Awards on September 10, 2016.

Water Resources Research Act Programs

wrrc.arizona.edu/wrra-104-grants

The WRRC is the water resources research institute for Arizona, federally authorized under the Water Resources Research Act (WRRRA). WRRRA base (104b) funding supports a portion of our information transfer activities and a small competitive grants program, which is open to investigators at all three state universities. WRRRA funding flows through the USGS budget. In normal years, the WRRC anticipates receiving \$92,335 annually. For the 2016-17 grant cycle, the WRRC selected two research projects for funding from the five proposals received:

- Sunlight-driven Reactive Oxygen Species Production for Natural Attenuation of Wastewater Trace Organic Compounds, Principal Investigator: Robert Arnold, University of Arizona
- Recycled Water for Agriculture: On-farm Demonstration and Evaluation, Principal Investigator: Channah Rock, University of Arizona

Activities relating to the 2017-18 grant cycle, with its shift in focus toward student projects, were described above.

As of September 30, 2016, Director Megdal ended her term as immediate Past President of the National Institutes of Water Resources (NIWR), the organization of 54 water institutes funded through the Water Resources Research Act. In this role, she was responsible for the development of NIWR’s Executive Summary of activities for the past year, a document that is used to demonstrate to Congress and others the accomplishments of member institutes. With the assistance of John Polle, our web manager and graphic designer, and working with the NIWR Executive Committee, she initiated a new, visually impactful format for the document. She was also responsible for working





Claire Zucker is the Program Director for the Water, Environmental, and Energy Solutions (WEES) Initiative at the University of Arizona. WEES is funded through the Technology and Research Initiative Fund (TRIF), with the goal of strengthening research, industry engagement, workforce development, and interdisciplinary collaborations at UA. As Program Director, Ms. Zucker ensures that proposed WEES investments are vetted through a transparent cross-disciplinary proposal review process, are aligned with WEES priorities, and that return on investment is tracked and reported. She coordinates the WEES Executive Committee and External Advisory Committee, builds understanding about WEES objectives and accomplishments through presentations and materials, and works within the UA Water Resources Research Center on a variety of WEES-linked projects. She also oversees the Water Network web portal, which connects the more than 28- faculty and researchers in 48 UA departments and programs that specialize in topics related to water, www.water.arizona.edu. As part of this effort, she provides faculty and researchers with key information about research, grant, and student opportunities through the Water Network Faculty Listserv.

with the team developing NIWR's new public web presence (www.NIWR.info), which improved the look, content, and usability of NIWR's online public face.

Water, Environment, and Energy Solutions Initiative

<http://www.wees.arizona.edu/>

The WRRC has an integral role in carrying out the Water, Environment, and Energy Solutions (WEES) initiative at the University of Arizona (UA). WEES supports research that brings innovative and practical solutions to pressing environmental, energy, and water challenges. WEES funding is provided by the Technology and Research Initiative Fund (TRIF); a university-directed educational fund generated via the 0.6% sales tax authorized by Proposition 301, which passed in year 2000. In July 2016, the water-related portion of WEES, previously known as the Water Sustainability Program, was administratively integrated with the energy and environmental aspects of the initiative. Dr. Megdal now serves as the WEES Director and works with a newly established four-member WEES Executive Committee, which consists of representatives from four Colleges: Science; Engineering; Agriculture and Life Sciences; and Social and Behavioral Sciences. Claire Zucker serves as program director for WEES, which also employs a graduate assistant. The three-person WEES External Advisory Board includes Joe Gysel, President, EPCOR Water USA; Lisa Harris, President, Harris Environmental Group, Inc.; and Richard Silverman, retired General Mgr., Salt River Project.



THE UNIVERSITY OF ARIZONA
RESEARCH, DISCOVERY & INNOVATION

**Water, Environmental
& Energy Solutions**

In FY 2016, TRIF-WEES invested in equipment for UA water-related research, with application to topics such as quantifying pathogens in water samples, measuring evapotranspiration in Arizona pistachio orchards, and vertical farming water use. TRIF-WEES funding fosters private-public partnerships and provides a means for UA scientific knowledge and technology to interface with industrial partners and the public. Investments are provided to several transdisciplinary research initiatives including the WRRC, the Water and Energy Sustainable Technology (WEST) Center, the Center for Environmentally Sustainable Mining, the Center for Climate Adaptation Science and Solutions, and the recently formed UA Institute for Energy Solutions. Each of these centers address critical issues and connection to Arizona stakeholders. WEES also continues to support K-12 water education through Arizona Project WET activities in Maricopa County. In order to highlight TRIF-WEES investments in cutting-edge research that connect to Arizonans, WEES published an impacts brochure, *Funding for Innovation: Stories of Success*, which is available in hard copy in addition to being accessible on the WEES website.

WEES hosted two distinguished speakers on water topics during 2016. Patrick O'Toole, President of the Farm Family Alliance, spoke about the connections between ranching and the need for conservation in Wyoming and the West. Anne Castle, former Assistant Secretary for Water and Science at the Department of the Interior, offered keynote remarks entitled "Our Worn-Out Water Security Blankets" at the 2016 WRRC Annual Conference.

Connecting UA researchers, students, and Arizona stakeholders is a primary goal for the WEES initiative. The new UA Water Network web portal, water.arizona.edu, highlights the many ways UA tackles complex water issues, features a campus-wide events calendar, and hosts a Jobs and Opportunities page. The Water Network listserv regularly informs over 375 faculty and researchers about important grant, conference, and opportunity deadlines.



LaVonne Walton, Business Manager, is Fiscal Officer for the WRRRC and Arizona Project WET. As such, she controls the successful operation of the Center’s business, financial and human resource functions. In addition, she is the go-to person for information and guidance on all matters relating to these responsibilities, providing a high level of service to all members of the WRRRC community.



Bernadette Capossela, the WRRRC’s Administrative Associate, replaced Georgine Speranzo in May 2016. She assumed administrative duties and operational functions, including maintaining the Director’s calendar and providing her administrative support. In addition, Capossela is an active member of the communications committee, coordinating the Brown Bag activities and assembling the Weekly Wave. She is also responsible for conference logistics.



Lynette Featherston, Office Assistant, is the face of the WRRRC to the public, fielding inquiries, and greeting visitors. A valuable team member, she assists the Administrative Associate and Business Manager and handles exceptional tasks as they arise. She also maintains the WRRRC contacts databases, oversees the preparation of WRRRC facilities for events, and maintains the lobby displays.

Last summer, WEES furthered water conservation efforts by launching a Desert Landscaping website; a powerful tool to encourage desert-friendly landscaping and reduce outdoor water consumption. This website converted and updated low-water use landscaping information, which was first presented 20 years ago as a very popular CD-ROM.

CORE FUNCTIONS

Achieving our mission depends on the effectiveness of our core functions of administration and communication. A small, dedicated staff excels at seeing that faculty, professionals, and students can focus on mission-oriented projects.

Weekly Wave e-news digest

wrrc.arizona.edu/weekly-wave

Getting the word out about WRRRC news and events is essential to our effectiveness. The Weekly Wave serves this important function, as well as providing the community with an outlet for water-related announcements. In 2016, 30 editions of the Weekly Wave and seven editions of the bi-monthly Summer Wave were sent through November 2016. Each edition included updated WRRRC and water community news, events, publications, announcements, and social media interaction opportunities. In 2016, 304 new names were added to the Weekly Wave distribution list, which as of December 12 included 2,023 names. Weekly Wave distribution boosts website traffic, event attendance, and dissemination of WRRRC news through external outlets. In 2016 the Weekly Wave was redesigned for better mobile compatibility and ease of use.



WRRRC Website and Communications

wrrc.arizona.edu

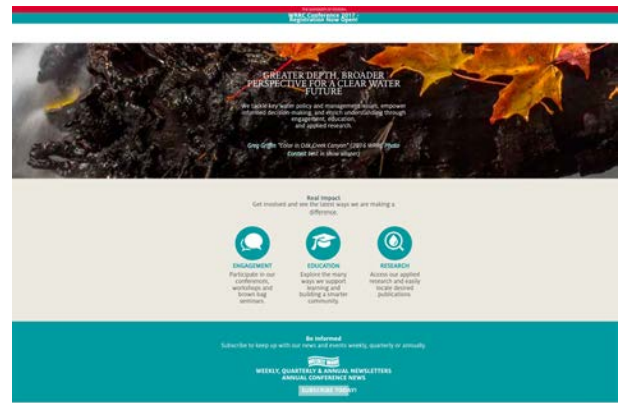
The new WRRRC website, developed in collaboration with the UA College of Agriculture and Life Sciences information technology team, was launched on November 15, 2016 with an entirely new look and improved functionality. Its structure allows program leaders to update information and provide news on their own programs, which will produce a more dynamic site. It continues to feature news, events, and programs, as well as publications and other resources. The site still provides access to a searchable video gallery (wrrc.arizona.edu/video-gallery) and Brown Bag webinar recordings. It also links with the University of Arizona Libraries’ Campus Repository, where 384 digitized archival copies of past WRRRC publications are available.



John Polle creates, develops, and manages content for the WRRC website and keeps up with the ongoing maintenance of the site. He designs printed and digital outreach materials for the WRRC and the various programs associated with the Center. He also manages and provides support for the audio and visual needs of the WRRC and when necessary, provides IT support. In 2016, he worked with the CALS Communication and Cyber Technologies team to redesign the WRRC website. Both the look and functionality of the site were overhauled. He created marketing pieces for WRRC programs and engagement activities, including the WRRC 2016 Conference, the annual report and associated infographic insert/brochure. He continued to work with the Conserve2Enhance program and UA Water network, maintaining and updating their websites.

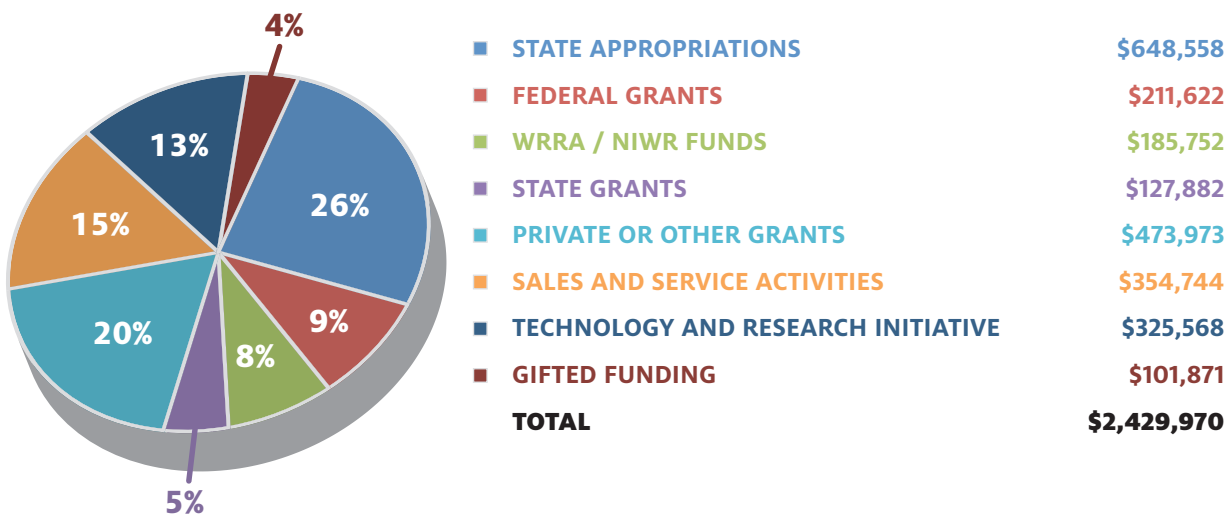
In 2016 we continued to focus on connecting our aims and achievements with our name within the family of UA units and programs in the minds of partners and constituents. Examples of WRRC branding efforts include the new WRRC rack card, the 2017 Conference bookmark, and the printed 4-page brochure, 2015 Highlights, used to publicize the impacts and accomplishments of our programs and activities.

Communications efforts at the WRRC continued to expand in 2016. Communications staff regularly submitted WRRC news, events, and accolades to University channels. Externally, a variety of news and media outlets featured WRRC personnel and programs 25 times. Efforts continued throughout the year to take advantage of social media outlets for communication using Facebook, Twitter, and YouTube. The results have been modest improvements, measured in increased shares, views, retweets, follows, and likes. The WRRC Facebook page surpassed 269 likes, adding 90 likes from last year, and Twitter followers now number 199.

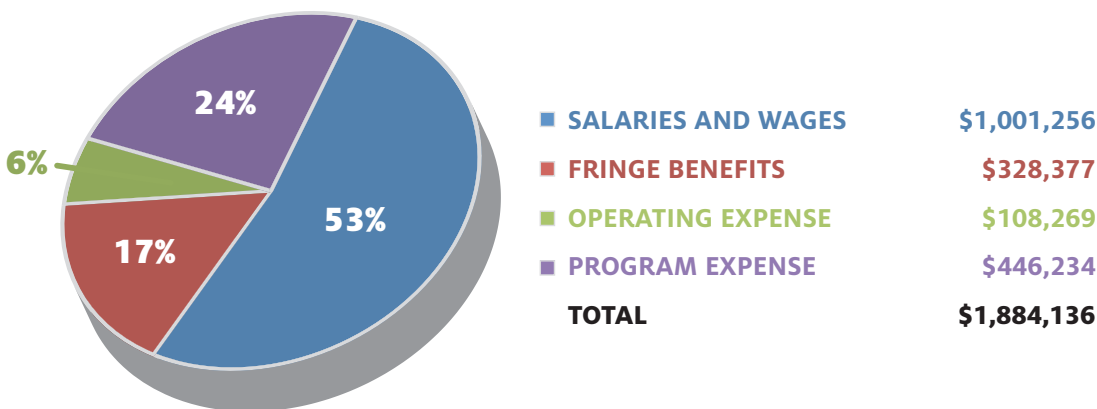


FINANCIAL REPORT CY 2016

OPERATING SUPPORT & REVENUE



OPERATING & PROGRAM EXPENSE



Notes:

Operating Support and Revenue

State Appropriations: State General Fund and tuition collections appropriated to the College of Agriculture and Life Sciences by the State of Arizona.

Federal Grants: Monies received for awarded competitive national federal grants and federally-funded cooperative agreements awarded to the WRRC.

WRRRA / NIWR Funds: U.S. Geological Survey 104(b) 5-year Cooperative Agreement funded annually in March. The WRRC receives this federal funding as Arizona's State Water Resources Research Institute.

State Grants: Revenue provided by the State of Arizona through competitive grants awarded to the WRRC by departments of the State of Arizona.

Private or Other Grants: Revenues received by the WRRC through the University and the UA Foundation from local governmental agencies and non-governmental organizations.

Sales and Service Activities: Revenue from one-time transactions accrued over time by the WRRC from publication sales, annual conferences, and miscellaneous services.

Technology and Research Initiative Fund (TRIF): Revenue from TRIF, a state sales tax-derived fund supporting a range of educational programs. TRIF funding is allocated to UA Water, Environmental and Energy Solutions (WEES), which provides direct support to the WRRC.

Gifted Funding: One-time gifts from individuals and companies and revenue generated by endowment interest bearing accounts.

Operating and Program Expense

Salaries and Wages: Includes salaries, wages and supplemental compensation paid to WRRC faculty, appointed personnel, classified staff, graduate assistants, and student hourly employees.

Fringe Benefits: Includes costs of employee fringe benefits (ERE) for insurance, medical and retirement benefits.

Operating Expense: Includes UA revenue and expense service fees; Facilities & Administration (Indirect Costs); UITS Network Funding Fees (Access to University communication systems for staff); Background checks; Membership dues; Subscriptions; Building & equipment maintenance and upgrades; Employee training; Brown Bag Seminar Series; ARROYO Annual publication; Conference.

Program Expense: Includes University and Lecturer's fees, Participant support and Temporary labor; Sub-contractual research agreements for 104(b) grants at Northern Arizona University (NAU); Printing and publications; Communications; Office, Research, Educational, and General supply; Employee travel; Conference registration fees; Facility and vehicle rental; Meetings and Workshops.



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