



COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION

**WATER RESOURCES
RESEARCH CENTER**

ANNUAL REPORT 2018



COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION

WATER RESOURCES RESEARCH CENTER

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APPENDIX A: 2018 METRICS REPORT AND PARTNERSHIP MATRIX

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Both appendices are located at <https://wrrc.arizona.edu/about#annual-reports>

Cover Photo: Talia Chorover - Reflection in Standing Water Adjacent to Sabino Creek



OUR MISSION

PROMOTING WISE WATER RESOURCE DECISION MAKING THROUGH RESEARCH, EDUCATION, OUTREACH & ENGAGEMENT

Greater Depth, Broader Perspective for a Clear Water Future

The WRRC mission is to tackle key policy and management issues, empower informed decisionmaking, and enrich understanding through engagement, education, and applied research. We work with a variety of stakeholders, including decisionmakers, professionals, students, and the public; conduct “real-world” research; and produce and disseminate independent and reliable water information. Founded at the University of Arizona (UA) 1957 as the Institute of Water Utilization, the WRRC was renamed the Water Resources Research Center in 1964 when it was designated Arizona’s federally authorized water resources research institute. Part of the UA Division of Agriculture, Life & Veterinary Sciences & Cooperative Extension, the WRRC is a research unit of the [College of Agriculture and Life Sciences \(CALS\)](#) and an Extension unit within [Arizona Cooperative Extension](#). The WRRC’s Director reports to the Associate Dean for CALS Economic Development, and Director, UA Cooperative Extension.

As an Extension center, the WRRC is part of a statewide network of knowledgeable faculty and staff, which itself is part of a nationwide educational network of scientists and educators who help people solve problems and put knowledge to use. Cooperative Extension agents and specialists were involved with WRRC projects in Cochise, Gila, Graham, and Greenlee counties. In addition, Arizona Project WET (APW) coordinates directly with County Extension Office Directors in Pinal and Maricopa counties and partners in other counties with Extension Agents who assist with the Arizona Water Festivals. In 2018, the WRRC strengthened relationships within Cooperative Extension through a survey of county needs that polled the interest of County Extension Directors and Cooperative Extension Tribal Offices joint activities and identified opportunities for collaboration.

In its more than 60 years, the WRRC has established a reputation for conducting research applied to real-world water issues, being a trustworthy partner and neutral facilitator, and expanding community knowledge about water resources. We are grateful for the support of our partners and look forward to many more years in the service of responsible water policy and management.



DIRECTOR'S MESSAGE

I am pleased to present you with this overview of Water Resources Research Center activities for 2018. The WRRC remains focused on programs and projects that align with our mission to engage the spectrum of water stakeholders, educate students of all ages, and conduct user-driven applied research on water challenges and solutions. I am especially proud of the many partnerships we have built, including with our External Advisory Committee, which provides us with valuable input. As you will see in the following pages, our accomplishments reflect our collaborative approach.

My own activities in 2018 reflect my commitment to addressing water issues that are important to the people of Arizona and beyond. Many of my programmatic activities relate to Arizona's leadership in groundwater and Colorado River management and our geographic location within the Colorado River Basin and at the U.S.-Mexico border. I continue to work on groundwater governance and management, transboundary aquifer assessment, use of recharge to meet water management objectives, and comparative policy analysis. Through teaching the course "Water Policy in Arizona and Semi-arid Regions" and advising students, I connect University of Arizona graduate students to the most recent water management developments, problems, and potential solutions. I continue to make presentations to audiences of varied backgrounds, and I endeavor to share information through journal articles, columns, and other written materials. In addition, I share information about our Extension and research programs and practices through national and international organizations, including the National Institutes for Water Resources, the Universities Council on Water Resources, the American Water Resources Association, and the International Arid Lands Consortium. I chronicle these and other professional activities, which keep me very busy, on my detailed Curriculum Vitae, which we post at wrrc.arizona.edu/director.

About the Director

WRRC Director **Sharon B. Megdal** is the C.W. & Modene Neely Endowed Professor for Excellence in Agriculture and Life Science and University Distinguished Outreach Professor. She also serves as Director of the University of Arizona's Water, Environmental, and Energy Solutions (WEES), which is funded by the Technology and Research Initiative Fund. A member of the faculty in the Department of Soil, Water and Environmental Science, she holds numerous courtesy appointments in departments and colleges across campus.

In addition to her service to many academic and professional associations, in 2018 she served her 10th year as an elected member of the Board of the Central Arizona Water Conservation District, for which she is Secretary and serves as Chair of the Central Arizona Groundwater Replenishment District and Underground Storage Committee.

PARTNERSHIPS

Partnerships are fundamental to the WRRC's activities. Advice on major initiatives and programs is provided by an External Advisory Committee of water community leaders. These individuals and the organizations they represent commit time and resources to reflect on the WRRC's service to Arizona and beyond and to promote the accomplishment of the Center's goals. In addition, they join other partners in contributing to specific programs and projects, as shown in Appendix A to this report – the Partnerships Metrics table. Affiliated programs extend the WRRC's reputation and impact within the university, the state, and the nation. Primary affiliations include UA-TRIF Water, Environmental and Energy Solutions, Arizona Cooperative Extension, and the National Institutes for Water Resources (NIWR).

External Advisory Committee

The WRRC's External Advisory Committee meets at least once annually. In 2018, they met on December 17 at the Salt River Project's PERA Club in Tempe, Arizona. The members of the EAC as of December 2018 are listed below with their affiliations as of that month.

Tom Buschatzke, Arizona Department of Water Resources

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

Scott Deeny, The Nature Conservancy

Alan Forrest, HDR Engineering Inc.

William Garfield, Arizona Water Company

Andy Groseta, Groseta Ranches

Joe Gysel, EPCOR, Water USA, Inc.

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

Bradley (Brad) Hill, City of Flagstaff

John Kmiec, Marana Water

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

Randy Matas, Arizona Department of Environmental Quality

Francis McAllister, Freeport-McMoRan Copper and Gold

John McKinney, Farmers Investment Co. (FICO)

Juliet McKenna, Montgomery & Associates

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

Philip Richards, Arizona Public Service

Dave Roberts, Salt River Project

John Shepard, Sonoran Institute

David Snider, Retired (Pinal County Board of Supervisors)

Kathryn Sorensen, Phoenix Water Services

Warren Tenney, Arizona Municipal Water Users Association

Timothy (Tim) Thomure, Tucson Water

Chris Udall, Agribusiness & Water Council of Arizona

Christopher (Kip) Volpe, The Estes Company

Sid Wilson, Retired (Central Arizona Project)

Brian Wong, BKW Farms

Primary Affiliations

Water, Environmental, and Energy Solutions



THE UNIVERSITY OF ARIZONA
RESEARCH, DISCOVERY & INNOVATION

Water, Environmental & Energy Solutions

The WRRC has an integral role within the TRIF-funded Water, Environmental, and Energy Solutions, which supports research on innovative and practical solutions to Arizona's pressing water, environmental, and energy challenges. Directed by the Arizona Board of Regents, TRIF is a university-administered fund generated through a voter-approved sales tax. TRIF has the goal of strengthening research, industry engagement, workforce development, and interdisciplinary collaborations at UA. Director Megdal serves as WEES Director and the initiative has a very active five-member WEES Executive Committee.

In 2018, WEES invested approximately \$1.8M in water-related grants and hiring. WEES-supported hires work on a wide array of research topics, including environmental governance and water security, membrane technology, and the dynamic behavior of managed hydrologic systems. The \$500K invested in water-related equipment will improve chemical characterization of aqueous samples, expand water quality analysis, and advance research on precision agriculture. In addition, WEES funds supported UA institutes and centers, including the WRRC. WEES continued to reach out through the Water Network Listserv and, in fall 2018, launched an updated UA Water Network web portal at water.Arizona.edu.



Claire Zucker is the WRRC Associate Director and WEES Program Director. In addition to managing WEES, she is responsible for managing and coordinating a range of new and ongoing activities at the WRRC, including the annual conference, and serves as a community and university resource on watershed and environmental planning topics.

National Institutes for Water Resources



The National Institutes for Water Resources is a national organization of water research centers authorized in 1964. The WRRC is the water resources research institute for Arizona, federally authorized under the Water Resources Research Act.

Institutes receive base funding, which in Arizona is used to support a small competitive research grants program that is open to investigators from Arizona's three public universities and information transfer projects.

In September 2017, the WRRC solicited research grant proposals from student researchers and their faculty advisors. Of the nine student research proposals submitted, two projects were funded for the 2018-2019 grant year: "Microplastic Contamination in the Lower Santa Cruz River" and "Using Freshwater Algae to Remove Lead from Water." In fall 2018, 11 student-faculty research teams responded to the Center's call for proposals and three were recommended for funding.

RESEARCH & ENGAGEMENT

Groundwater Governance and Management

The Groundwater Governance and Management Program, produced four publications during the year. With several other university and private sector authors, the program team published "Critical Issues Affecting Groundwater Quality Governance in the United States," in the journal *Water* and a chapter, "Groundwater Governance and Assessment in a Transboundary Setting," in the book *Lake Governance*. An article will be published in the journal *Jurimetrics* and an invited perspective piece appeared in the new journal *npj Clean Water*. In addition, team members gave 10 presentations to disseminate research on the program. The Ground Water Research and Education Fund Board is considering whether to fund additional research.

Comparative Water Management for Arid Regions

Research and engagement with international experts, professionals, and public officials informs efforts to facilitate communication and develop partnerships related to water management and policy. A program led by Director Megdal

contributed to mutual understanding of challenges and solutions of water scarce regions, especially with respect to transboundary waters. In 2018, she participated in the Jewish National Fund Conference, speaking on Israel Water Challenges and Opportunities. For the U.S. Department of State International Visitor Leadership Program, she discussed water issues common to the Semi-arid Southwest and Jordan. Megdal presented a talk on desalination in Israel to the Multi-State Salinity Coalition 2018 Annual Salinity Summit and organized an afternoon colloquium on water technology, featuring Israeli and Colorado River Basin experts, for the Colorado River Water Users Association meeting in Las Vegas. An article, "Evaluating Gravity-Flow Irrigation with Lessons from Yuma, Arizona," was published in the journal *Sustainability*.

Collaborative Solutions in Rural Watersheds

Since 2017, the WRRC, in partnership with the U.S. Bureau of Reclamation and Gila County Cooperative Extension, has been working in the Globe-Miami area in Arizona to identify water needs and foster locally appropriate management solutions. A component project of the Water Research and Planning Innovations for Dryland Systems (Water RAPIDS) Program, the Globe-Miami work was extended in 2018 with the launch of the "Cobre Valley Water Research Initiative," a project to evaluate water supply and demand in the region. The WRRC is gathering information to develop a conceptual water budget and, together with stakeholders, prioritize actions based on the identified needs. On September 6, the WRRC, with the assistance of a local steering committee, organized the Cobre Valley Small Town Forum on Water. More than 50 community members and regional partners participated in proposing and prioritizing actions to address water-related challenges.

In another rural watershed, Water RAPIDS and Stillwater Sciences, Inc. undertook a data synthesis project in Graham and Greenlee counties with the Gila Watershed Partnership. Together the collaborators created the Upper Gila River Watershed Assessment to guide regional restoration and collaborative efforts in the short and long term.

Water for Natural Areas

Water RAPIDS partnered with the Tucson non-profit Sky Island Alliance on a three-year initiative funded by the Nina Mason Pulliam Charitable Trust to develop regional dialogues and local on-the-ground actions aimed at protecting and enhancing water resources in southeastern Arizona. To highlight the flow protection and restoration work of partners, in 2018 the project launched the Water Roots speaker series, which drew nearly 300 people. The project also made progress on a toolbox that will enable prioritization of areas for restoration and protection based on available data about flows and ecosystem function at springs in the Sky Island region.

Recycled Water Quality & Antibiotic Resistance

In 2018, the Water Quality Research Program focused on assessing the sustainability of using recycled water to augment Arizona's water supplies. A project funded by the Arizona Department of Agriculture is examining how the unique chemistry of recycled water can skew the results of tests for pathogens. A second project, initially funded by the WRRA 104b program, showed significantly less toxin production in recycled water ponds when compared with ponds filled with groundwater. In April, the program's leader, Jean McLain, was invited to join a team of international researchers, convened by the Centers for Disease Control and Prevention, to draft a series of white papers focusing on the worldwide problem of antibiotic resistance.

Water & Land Use in the Colorado River Basin

In 2018, the WRRC formed a partnership with the recently established Babbitt Center for Land and Water Policy at the Lincoln Institute of Land Policy to undertake a year-long exploratory research project examining decision-making processes around land use and water management in Arizona and Colorado. This project has used multiple methods of case study analysis, such as geospatial techniques and expert interviews, to reveal insights into policies that facilitate growth, water planning, and land-use changes over time, as well as significant challenges faced by water managers.



Victoria Obergh manages the daily operations of the McLain laboratory.

WRRC Research Scientist **Jean McLain** also holds the position of CALS Assistant Dean for Faculty Advancement and is a Research Scientist in the Department of Soil, Water and Environmental Science. Her research program focuses on water quality and she teaches a technical writing course to undergraduate and graduate students in CALS.

Locally Relevant Water Information

Know About Your Water – Green Valley/ Sahuarita is a project funded through the Freeport McMoRan Foundation to develop a presentation and related materials about the local water issues that matter most to people in the Green Valley-Sahuarita area. Work began in August 2018 with preparation of stakeholder communications and a survey that was distributed through local networks in October. Analysis of the more than 250 survey responses will guide research and frame project outputs. Local partners are facilitating introductions to key stakeholders, identification of presentation venues, and access to unpublished information.



Transboundary Aquifer Assessment

For the Transboundary Aquifer Assessment Program (TAAP), authorized in 2006 by Public Law 109-448, the WRRC worked with TAAP partners to compile a draft of the *Binational Study of the Transboundary Santa Cruz Aquifer*, which is undergoing binational peer review. Partners include the U.S. Geological Survey and International Boundary and Water Commission (IBWC), the University of Sonora, CONAGUA, New Mexico State University, and Texas A&M University. The WRRC team also assessed physical effects of climate variability, drought, and effluent discharges on groundwater recharge and storage in the transboundary Santa Cruz Aquifer. With the IBWC, the WRRC helped plan a binational summit on transboundary groundwater for April 2019. The team published two articles and gave 15 presentations at regional, national, and international meetings and conferences, including the U.S.-Mexico Border Water Summit in El Paso, Texas. Articles appeared in *Water Resources IMPACT* and a special issue of the *Journal of Hydrology: Regional Studies*.

Ashley Hullinger is a Research Analyst, whose primary role is managing the Water RAPIDS Program. Her work revolves around research and stakeholder engagement to promote sustainable water management in rural watersheds.

Jacob Petersen-Perlman is a Research Analyst, focusing on groundwater governance and the Transboundary Aquifer Assessment Program.

Elia M. Tapia is a Senior Research Specialist, contributing to Transboundary Aquifer Assessment Program research and stakeholder engagement efforts.

OUTREACH & EDUCATION

WRRC faculty, staff, and students make many oral and poster presentations to academic, professional, civic, and community groups, locally, nationally, and internationally throughout the year. They author academic papers, Extension publications, and public information pieces and are often quoted in the media as experts on water-related topics. In 2018, projects and personnel were featured more than 20 times across a variety of news and media outlets. WRRC personnel collaborated with local, state, regional, and federal agencies and organizations, as resources for water resource related information and as partners on specific projects. They participated on community and regional boards and commissions and served on state and local task forces and study committees. They also responded to student requests for interviews for classroom projects and to inquiries from the public on issues of concern.

WRRC faculty teach and advise university students and all WRRC staff mentor student workers and provide information for student papers and class projects. The Arizona Project WET program offers UA students classroom experience teaching water science to K-12 students. APW's water education programs improve the instructional skills of teachers and critical thinking skills in students of all ages.

Signature Events & Products

The WRRC is known for its signature events and products, which include a periodically revised Arizona Water Map poster, along with the following activities and resources.

Annual Conference (<https://wrrc.arizona.edu/conferences/2018>)

Organization of the WRRC 2018 Annual Conference, “The Business of Water” benefitted from the input of a committee of experts, who proposed an agenda rich in its depth and variety of perspectives. Sessions included discussion of transactions, public-private partnerships, business and the environment, and water’s role in economic development. A poster session with 21 posters showcased current water-related research. More than 330 people attended the daylong conference. An article on the conference was published in the July 2018 issue of *The Water Report*, a monthly journal on water in the West.



Planning for the February 1, 2019 Annual Conference, "Arizona Runs on Water – Scarcity, Challenges, and Community-based Solutions," took place during the second half of 2018. Once again, a committee of knowledgeable individuals guided development of the program.

Brown Bag Seminars and Special Events (<https://wrrc.arizona.edu/brown-bag-seminars>)

The WRRC's 2018 Brown Bag seminar series continued to attract diverse audiences to presentations on a range of water topics. Speakers for the 20 Brown Bag seminars held in 2018 included state, national, and international experts. Average attendance was 50 people, including off-site participants through Go-To-Webinar. The in-person audience is approximately equally divided between UA personnel and members of the wider community. The WRRC website hosts Go-To-Webinar recordings and copies of the slide presentations for most Brown Bag seminars. Several of the Brown Bag seminars were cosponsored by partners at UA and events were cosponsored by off-campus partners as well.

The annual WRRC Photo Contest allows the WRRC to add to the gallery of original photographs of water in Arizona. Photographs are used in multiple ways, including publications, posters, and promotion. The annual February Chocolate Fest provided an opportunity for showcasing the 2018 Photos Contest winners and for friends in the water community to meet informally.

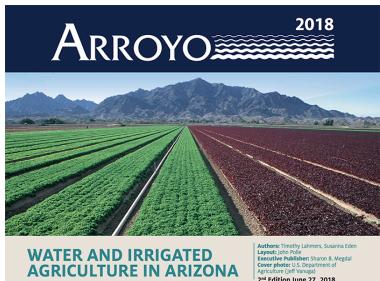
Weekly Wave (<https://wrrc.arizona.edu/weekly-wave>)

During 2018, the WRRC published 34 editions of the *Weekly Wave* e-news digest and seven editions of the bi-monthly *Summer Wave*. Each edition included updated WRRC and water community news, events, publications, and announcements. During the year, the *Weekly Wave* distribution list increased from 2,257 to 2,620. Its reach is enhanced through posting on the WRRC website and further distribution by some recipients. Subscribe at wrrc.arizona.edu/subscribe.

Arizona Water Resource (<https://wrrc.arizona.edu/publications/awr>)

Four issues of the WRRC's quarterly newsletter, *Arizona Water Resource* (AWR), were published electronically in 2018, its final year of publication. Changing communication strategies and the need to reallocate limited resources dictated that the WRRC cease production of this 26-year-old newsletter. This past year the AWR included reporting on the 2018 Annual Conference. A feature article summarized the conference, the Public Policy Review column presented take-away messages, and a Guest View by Richard Morrison reprised the remarks he prepared for the conference on the ethics of water transactions. In addition, the Winter issue published the WRRC Photo Contest winners, the Summer issue included a feature on the early history of AWR, and the final Fall issue provided a list of e-resources for water news. The Fall issue also announced the posting of a compendium of 75 Public Policy Review columns by Director Megdal. All past issues of AWR can be accessed through the WRRC website.

Arroyo (<http://wrrc.arizona.edu/publications/arroyo>)



Introduction

Why is so much of Arizona's water used to irrigate crops in the desert? A partial answer to this question is that Arizona has a dry climate, which requires irrigation for producing crops; ample sunshine, high-quality groundwater, and the Colorado River provide the water sufficient rainfall to grow most crops. Arizona's rivers and aquifers are limited by natural precipitation, and aquifers in Arizona's desert valleys hold just quantities of groundwater. Ongoing drought, coupled with the water needs of a growing population, are straining these rivers and aquifers. In this context, it is useful to understand how irrigation is used in Arizona, its water sources, users, and crops. Following sections offer background information on irrigation, groundwater use for irrigated agriculture in Arizona, groundwater and the Colorado River. A description of agricultural practices and challenges in Arizona is provided, along with new crops that may reduce water application follows. Irrigation efficiency, reuse of treated wastewater, and transfer to other uses is discussed. Collaboration opportunities between the WRRC and other agencies are outlined. The reader will come away with a deeper understanding of irrigation issues in Arizona, sustainable food and fiber production in a desert climate.

What is Irrigated Agriculture?

Irrigated agriculture involves the controlled application of water to crops in semi-arid environments, such as Arizona. Irrigation is essential because there

The Arroyo is the WRRC's annual newsletter on a single topic of timely interest to Arizona. The Center distributed it in June 2018 to both email and print subscribers, including libraries, schools, firms, and nonprofits. Summer internship funding for the 2018 Arroyo, "Water and Irrigated Agriculture in Arizona," was provided by sponsorships from the BKW Farms and the Agribusiness and Water Council of Arizona. The WRRC published the draft produced by the summer intern after revisions based on thorough reviews by external experts. The 2018 Arroyo drew on the WRRC's 2017 Annual Conference presentations, along with other publicly available information

resources. The Agribusiness and Water Council of Arizona and the Arizona Farm Bureau distributed copies to participants at their respective 2018 annual conferences.

In accordance with plans to link the Annual Conference and Arroyo topics, the topic of the 2019 Arroyo is "The Business of Water." The summer intern drafted the 2019 Arroyo and continued to refine the draft. The 2018 internship was sponsored in part by Water Asset Management through an Arroyo-linked sponsorship introduced for the 2018 conference. The Southern Arizona Water Users Association and the Walton Family Foundation are sponsoring the 2019 Arroyo intern through their conference sponsorship.

WRRC Website (<http://wrrc.arizona.edu>)

The WRRC's main website continued to feature news, events, and programs, as well as publications and other resources. The site also provides access to the WRRC YouTube channel and Brown Bag webinar recordings. Between December 2017 and December 2018, the WRRC website received 142,794 page views by 58,651 users. The Center added 13 videos to the WRRC YouTube channel, including videos from the 2018 WRRC Conference.

The WRRC maintains two additional sites: a site for water-related programs, activities, and expertise at UA (<https://water.arizona.edu>) and the Conserve2Enhance website for information on this WRRC trademarked water conservation and restoration program (<https://conserve2enhance.org>). In 2018, <https://water.arizona.edu> had 20,202 page views by 4,723 users and Conserve2Enhance had 12,941 page views by 6,551 users. The APW maintains its own website, which is linked to the WRRC site through the Programs tab.

Other E-communication

The WRRC uses Constant Contact to enhance direct communication with the Center's online subscribers. Constant Contact simplifies subscriber list maintenance, improves the look of the Center's messages, and allows staff to track communication effectiveness. For example, the Weekly Wave email list has an average open rate of 33 percent, which is a top tier score.

Throughout the year, efforts to employ social media, specifically Facebook, Twitter, and YouTube, have resulted in modest gains as measured by increased shares, views, retweets, follows, and likes. The WRRC Facebook page had 578 followers at the end of 2018, an increase of 131 from the previous year, and 732 Twitter followers, an increase of 194 followers.



John Polle manages the WRRC website and the Conserve2Enhance and UA Water Network sites, designs printed and digital materials for the WRRC and its programs, oversees the WRRC Photo Contest, and provides audio/visual support for WRRC events.

WRRC Assistant Director **Susanna Eden** has multiple responsibilities, including writing and editing Center publications, managing the WRRA 104 Program, leading and participating in applied research efforts, and contributing to special initiatives and on-going engagement projects.

Water Awareness (<http://beyondthemirage.org>)

A collaboration with CALS Communication and Technologies personnel increased awareness and knowledge about water issues in Arizona and the Southwest. *Beyond the Mirage*, an interactive web experience and documentary, has since won several prizes, including a Rocky Mountain Emmy. The film continues to be screened, including at the Scottsdale Museum of Contemporary Art as part of the Scottsdale Canal Convergence event.

Arizona Project WET Educational Program

<http://arizonawet.arizona.edu/>

New science standards were approved by the Arizona State Board of Education on October 22, 2018. Arizona Project WET programs support the new standards. APW's water festival program, which in 2018 reached about 13,000 students, will enable 4th grade teachers to fully meet the standard: "Construct and support an evidence-based argument about the availability of water and its impact on life." In addition, APW's three AquaSTEM units, built using the Framework for the Next Generation Science Standards, will assist teachers in meeting the new standards. APW-facilitated learning about the groundwater system helped teachers meet new standards, such as, "Engage in argument from evidence about the availability of natural resources, occurrence of natural hazards, changes in climate, and human activity and how they influence each other" and "Construct a model that shows the cycling of matter and flow of energy in the atmosphere, hydrosphere, and geosphere." This effort directly reached more than 5,000 primary, middle, and high school students in Pima and Maricopa counties.

APW also implemented a novel Riparian Exploration aquaSTEM unit through a new partnership with the Arizona Department of Environmental Quality's Arizona Water Watch citizen science program. The new unit offers middle and high school students an opportunity to engage in a field day at Hassayampa River Preserve or Rio Salado Habitat Restoration Site. The partnership with ADEQ trains students to use citizen science protocols and collect streamflow and water quality data for the Arizona Water Watch program.



Kerry Schwartz, an Extension Specialist with Arizona Cooperative Extension and Director of Arizona Project WET, directs a statewide team focused on developing critical and creative thinking and water stewardship through STEM-focused education programs.

Betsy Wilkening is the Education Coordinator for the APW Tucson Program. She also led a NOAA-funded project promoting community resilience through STEM education that installed rainwater harvesting system in schoolyards and an Underwater Robotics & Engineering Design Academy.

Holly Thomas-Hilburn is Coordinator of Applied Programs for APW. She led the effort to develop the Aqua STEM program and worked closely with the Tucson APW team to integrate systems thinking across the program.

Chuck Dugan is the APW Pinal County Water Program Coordinator, whose work with partners and sponsors led to continued program funding and promotes a water conservation ethic in Pinal County.

Miriam Aleman-Crouch is the Senior Instructional Specialist for Arizona Project WET's Tucson Program. She also coordinated outreach events with program sponsors and schools to support STEM literacy.

Mary Ann Stoll is an Education and Technology Coordinator with Arizona Cooperative Extension at UA. She develops and delivers curriculum for APW's Aqua STEM Program and also designs, develops, and maintains APW's website.

Pam Justice, Senior Education Coordinator at the Maricopa County Cooperative Extension office, coordinates educational and outreach programs, including professional development in STEM literacy, water festivals, and Water Scene Investigations within the Gilbert, Higley, and Chandler school districts.

Julie Hasty is a Senior Instructional Specialist with Arizona Water Festivals, for which she recruits and trains volunteers, organizes festival logistics, and develops community partnerships.

Sandra Hurlbut is the Community Coordinator leading the Aqua STEM program in Maricopa County. She also assists in System Thinking-based professional development workshops and academies and APW writing projects.

Students pictured: Andrea Bennett, Annapurna Chitnavis

STAFF & ORGANIZATION

Staff

<http://wrrc.arizona.edu/personnel-directory>

Faculty members Megdal, McLain, and Kerry Schwartz are each responsible for their individual research, Extension, and education programs. As Director, Megdal supervises support and programmatic staff. A five-person professional staff—Susanna Eden, Ashley Hullinger, Jacob Petersen-Perlman, Elia Tapia, and Claire Zucker—carries out research, Extension, and education projects that focus on enhancing the capacity of stakeholders and communities to tackle water resource issues. Schwartz supervises educational professionals at the WRRC (Miriam Aleman, Chuck Dugan, Holly Thomas-Hilburn, and Betsy Wilkening) as well as other APW professionals are located in county Extension offices.

Bernadette Capossela assists the Director in administrative matters and Leslie Bonilla assists with financial matters. Bonilla's administrative home is the Department of Soil, Water and Environmental Science, which has shared a business center with the WRRC since January 2018. A team responsible for implementation of core outreach and engagement programs meets weekly to coordinate communications and related activities.

A cadre of outstanding students supports the WRRC's work in important ways. A list of WRRC students can be found in Appendix B: Supplemental Information.

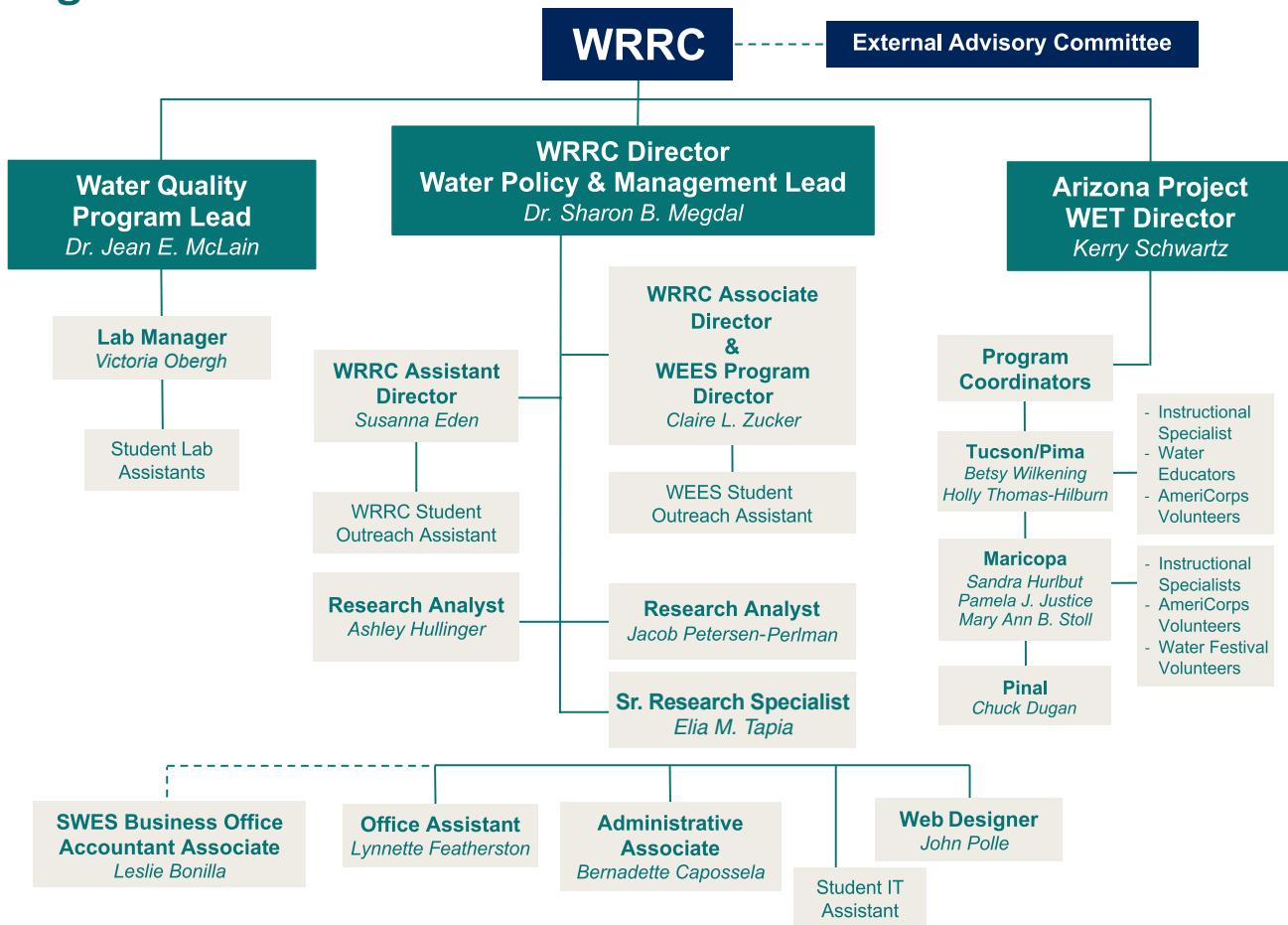


Leslie Bonilla, the WRRC's Accountant Associate, processes accounts payable and accounts receivable transactions, reconciles accounts, and performs various other accounting duties.

Lynette Featherston, Office Assistant, fields inquiries and greets visitors to the WRRC in addition to maintaining our contacts databases, assisting administrative staff, and handling exceptional tasks as they arise.

Bernadette Capossela, Administrative Associate, provides administrative support to the Director and carries out a wide range of administrative duties and operational functions for the WRRC.

Organization



Facilities

The WRRC facility is open to the public and provides a reception area featuring informational materials on water-related topics and the Sol Resnick Conference Room, a space for water-related meetings. Lynette Featherstone, greets visitors and callers and maintains the Center's public spaces.

FUTURE DIRECTIONS

Late in 2017, the UA Senior Vice President for Research requested that a Periodic Review and Request for Reauthorization of the WRRC be conducted to assess strengths and challenges and guide future activities. The review was carried out in the first half of 2018. A Periodic Review Committee was tasked with recommending whether to continue or sunset the WRRC and, assuming continuation, what measures and strategies would better position the Center to advance the purposes of the University and CALS and benefit Arizona. After recommending continuance, the committee made a series of recommendations, which were distilled by CALS, Extension, and UA administration:

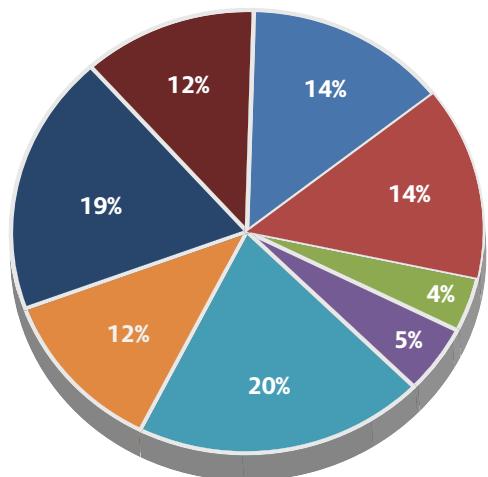
- Continue outstanding research and outreach activities in water policy and management, water quality, water education, and international projects.
- Continue and strengthen interaction with rural communities and tribal nations.
- Fully define and deepen connections with the Cooperative Extension System.
- Work with the UA Foundation, WRRC External Advisory Committee and Research Development to develop a strategy for endowment funds.

In response, the WRRC has reached out to Cooperative Extension Directors, met with representatives of tribal nations, developed connections with stakeholders in multiple rural communities, and continued to focus on high-quality applied research, engagement, and outreach. WRRC programs demonstrate the Center's commitment to these efforts. In addition, the WRRC is working through UA and CALS development offices to identify and pursue new funding sources.

FINANCIAL REPORT CY 2018

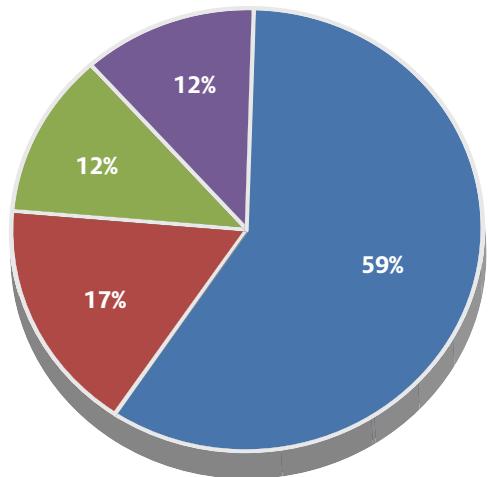
The majority of financial support for the WRRC continues to come from grants, sales and service activities, and gifts. Of the total revenue in 2018, 40 percent came from government awards. Support of the staff and appointed personnel continues to be the Center's largest expense, accounting for 76 percent of total expenses. The WRRC accessed carryover balances from 2016 and 2017 to cover an increase in expenses in 2018.

Operating Support & Revenue



State Appropriations	\$263,885
Federal Grants	\$330,646
WRRA / NIWR Funds	\$76,594
State Grants	\$94,500
Private or Other Grants	\$363,791
Sales and Service Activities	\$218,829
Technology and Research Initiative	\$342,874
Gifted Funding	\$211,590
Total	\$1,826,114

Operating & Program Expense



Salaries and Wages	\$1,109,965
Fringe Benefits	\$323,648
Operating Expense	\$231,514
Program Expense	\$225,858
Total	\$1,890,984

Notes:

Operating Support & Revenue

State Appropriations: State General Fund and tuition collections appropriated to CALS by the State of Arizona.

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

WRRA / 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, 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 and administration (indirect costs); UITS network funding fees (access to University communication systems for staff); background checks; membership dues; subscriptions; building and equipment maintenance and upgrades; employee training; Brown Bag seminar series; Arroyo Annual publication; and conference.

Program Expense: Includes University and lecturer's fees, participant support and temporary labor; subcontractual research agreements for 104(b) grants at Northern Arizona University; printing and publications; communications; office, research, educational, and general supplies; employee travel; conference registration fees; facility and vehicle rental; and meetings and workshops.

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The updated Arizona Water Map Poster is available exclusively from the WRRC for \$12.00 (plus tax and shipping).

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350 N. Campbell Ave. • Tucson, AZ 85719 • (520) 621-9591