

WRRC 2022
ANNUAL CONFERENCE

**Arizona's
Agricultural
Outlook: Water,
Climate, and
Sustainability**

July 12 | In-person Event
with Livestreaming

July 13-14 | Additional Virtual Programming

We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.

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Arizona's Agricultural Outlook: Water, Climate, and Sustainability



COLLEGE OF AGRICULTURE & LIFE SCIENCES
COOPERATIVE EXTENSION
**WATER RESOURCES
RESEARCH CENTER**

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AGENDA

TUESDAY, JULY 12, 2022 In-Person & Via Zoom Webinar

9:00 – 9:30 **REGISTRATION AND REFRESHMENTS**

9:30 – 9:45

Welcome

Sharon B. Megdal, Water Resources Research Center, University of Arizona
Ed Martin, Cooperative Extension, University of Arizona

9:45 – 10:15

Opening Keynotes: *Arizona's Agriculture, an Overview*

Mark Killian, Director, Arizona Department of Agriculture
Jeffrey Silvertooth, Environmental Science, University of Arizona

10:15 – 11:00

Highlight Talks – Part 1: *Arizona's Diverse Agriculture*

- **Tom Davis**, Yuma County Water Users Association - Irrigated Agriculture in the Yuma Area
- **David Proctor**, BKW Farms - Heritage Crops
- **Michael Kotutwa Johnson**, Indigenous Resilience Center, University of Arizona - Tribal Heritage Agriculture
- **Sarah King**, King's Anvil Ranch - Ranching

Moderator: **Faith Sternlieb**, Lincoln Institute of Land Policy

11:00 – 11:05

SPONSOR VIDEOS

11:05 – 11:50

Highlight Talks – Part 2: *Arizona's Diverse Agriculture*

- **Ashley Ellixson**, United Dairymen of Arizona - Dairy Farming
- **Phyllis Valenzuela**, San Xavier Cooperative Farm - Tribal Community Farming
- **Brandon Merchant**, Community Foodbank of Southern Arizona - Community Gardens
- **Dax Hansen**, Oatman Farms - Regenerative Organic Farming
- **Mark Beres**, The Flying Leap Vineyard - Viticulture

Moderator: **Faith Sternlieb**, Lincoln Institute of Land Policy

11:50 – 1:00	LUNCH (SHORT PROGRAM AT 12:45)	
1:00 – 1:20	Afternoon Keynote #1: Agricultural Renaissance A.G. Kawamura, Solutions from the Land	
1:20 – 2:20	Panel – Advancing Sustainable Agriculture in Arizona <ul style="list-style-type: none"> • Greg Barron-Gafford, School of Geography, Development & Environment, University of Arizona - Agrivoltaics • Murat Kacira, CEA Center, University of Arizona - Controlled Environment Agriculture (CEA) • David Dierig, Agro Operations, Bridgestone - Guayule • Andrea Carter, Native Seeds/SEARCH - Sustainability Through Diversity Moderator: Paul Brierley , Yuma Center of Excellence for Desert Agriculture, University of Arizona	
2:20 – 2:45	NETWORKING BREAK	
2:45 – 3:05	Afternoon Keynote #2: Sustainable Responses to Water Scarcity – Examples from Israel Uri Shani, Former Director of the Israel Water Authority	
3:05 – 3:55	Storytelling – Voices of Arizona’s Agriculture <ul style="list-style-type: none"> • Ron Rayner, A Tumbling T Ranches • Maegan Lopez, Mission Garden • Delia Carlyle, Ak-Chin Indian Community Moderator: Daniel Sestiaga Jr. , AIREs/Haury Indigenous Resilience Center, University of Arizona	
3:55 – 4:00	CLOSING REMARKS – END OF DAY 1	Register for the Virtual Programming July 13-14 
WEDNESDAY, JULY 13, 2022 – Via Zoom Meeting		
9:00 – 9:05	Welcome Sharon B. Megdal, Water Resources Research Center, University of Arizona	
9:05 – 9:55	Panel – Agricultural Perspective on Climate Change & Drought Adaptation <ul style="list-style-type: none"> • Kathy Jacobs, Environmental Science, University of Arizona - Overview of Climate Change & Drought • Cherilyn Yazzie, Coffee Pot Farms, Navajo Nation - Tribal Resilience • Stephen Miller, Pinal County Board of Supervisors - Colorado River Shortage Impacts & Responses • Eric Rosenbaum, Desert Control - Mitigating Desertification • Robert Masson, Cooperative Extension, University of Arizona - Drought Mitigation Research Moderator: Kathy Jacobs , Environmental Science, University of Arizona	
9:55 – 10:00	BREAK & SPONSOR RECOGNITION	
10:00 – 10:55	Panel - Innovative Partnership: N-Drip <ul style="list-style-type: none"> • Uri Shani, N-Drip - N-Drip Technology and History • Joshua Moore, Colorado River Indian Tribes - Experience and Opportunities with Drip Irrigation • Orestes Morfin, Central Arizona Project - Enabling Partnerships Moderator: Sharon B. Megdal , Water Resources Research Center, University of Arizona	

10:55 – 11:00

BREAK & SPONSOR RECOGNITION

11:00 – 11:55

Panel – *Water Policy Roundtable*

- **Tim Dunn**, Arizona State Legislature - Arizona Water Policy Legislation
- **Charlene Fernandez**, USDA Rural Development Office - Rural Assistance
- **Sarge Green**, California Water Institute, Fresno State University - Central Valley California

Moderator: **Sharon B. Megdal**, Water Resources Research Center, University of Arizona

11:55 – 12:00

CLOSING REMARKS - END OF DAY 2

THURSDAY, JULY 14, 2022 – Via Zoom Meeting

9:00 – 9:05

Welcome

Sharon B. Megdal, Water Resources Research Center, University of Arizona

9:05 – 9:55

Panel – *Agriculture, Water, and Public Health*

- **Channah Rock**, Environmental Science, University of Arizona - Irrigation Water Quality & Federal Regulation
- **Stevi Zozaya**, Lee Farms Yuma, AZ - Food Safety in Yuma
- **Noel Carter**, Buckeye Water Conservation & Drainage District - Salinity & Water Recycling
- **Peter Ellsworth**, Entomology, University of Arizona - Water & Pesticides

Moderator: **Valerisa Joe-Gaddy**, Water Resources Research Center, University of Arizona

9:55 – 10:00

BREAK & SPONSOR RECOGNITION

10:00 – 10:55

Panel – *Growing Our Future*

- **Linda Buchanan**, Yavapai College Viticulture Program - Agricultural Education
- **Grey Farrell**, Cooperative Extension, University of Arizona - Training Young Ranchers
- **Ross Rayner**, A Tumbling T Ranches - “Next Generation” Farmers’ Perspective

Moderator: **Valerisa Joe-Gaddy**, Water Resources Research Center, University of Arizona

10:55 – 11:00

BREAK & SPONSOR RECOGNITION

11:00 – 11:50

Closing Panel – *Arizona’s Agricultural Outlook*

- **Meghan Scott**, Noble Law - Outlook for Arizona Agriculture
- **Grady Gammage Jr.**, Gammage & Burnham - Urbanization & Agriculture
- **Pat O’Toole**, Family Farm Alliance - Water Sustainability & Agriculture

Moderator: **Sharon B. Megdal**, Water Resources Research Center, University of Arizona

11:50 – 12:00

CLOSING REMARKS AND ADJOURNMENT

THANK YOU FOR PARTICIPATING!

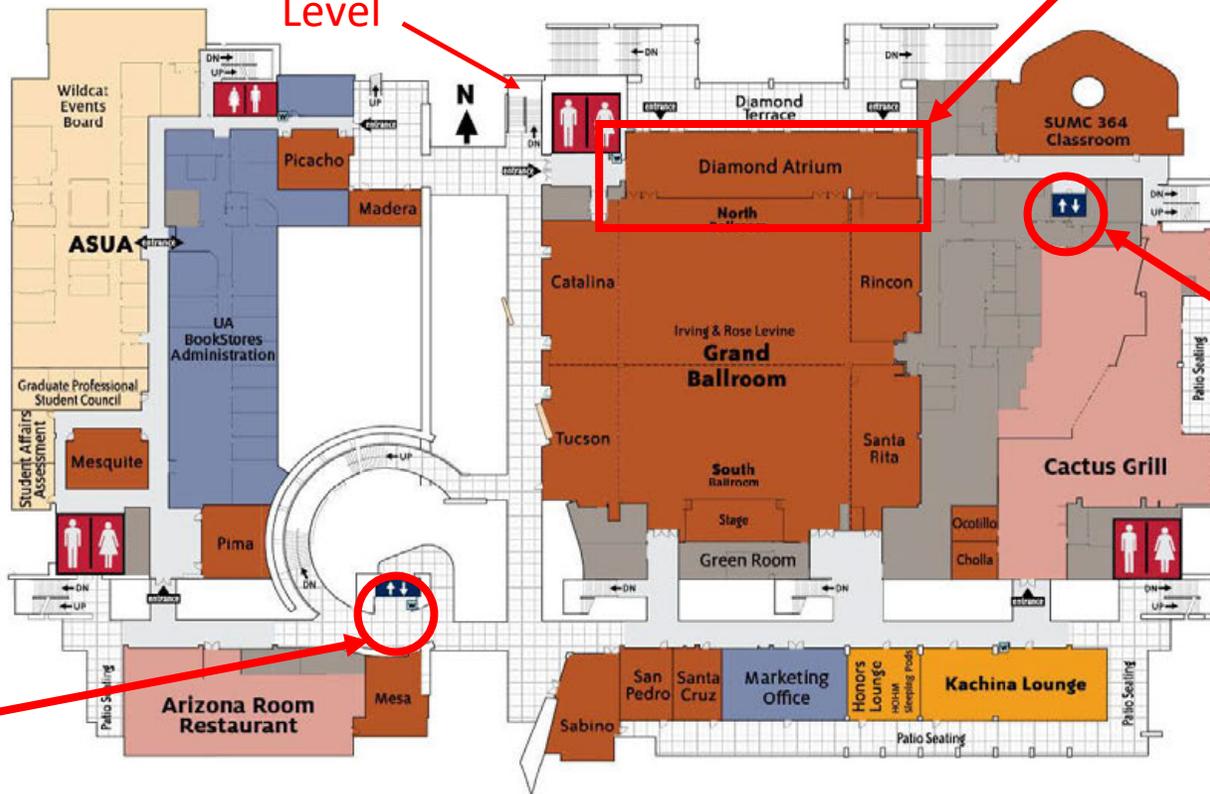
↑ To Second Street Parking Garage

Stairway
from Ground
Level

Conference
Registration

Elevator to
Main Level

Elevator to
Main Level



FLOOR PLAN KEY

ATM	Involvement	Rest Rooms	Services	Walkways
Elevator	Lounges	Restricted	Vending	Patios & Open Seating
Food	Meeting Rooms	Retail	Water	

The Student Union memorial Center (SUMC) is a place of restricted public access. The SUMC is intended for the use of student, faculty, staff, guests of the University, and participants in authorized on-campus activities. Loitering or interfering with this intended use is prohibited, and violators will be required to leave.

Authority: ABOR Policy 7-201 • UA Campus Use Policy • A.R.S. § 13-2905, -2911

THIRD LEVEL





Arizona's Agricultural Outlook: Water, Climate, and Sustainability



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Arroyo



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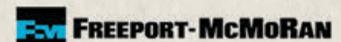
Cooperative Extension



Silver



Copper



THANK YOU TO OUR LUNCHEON PARTNER!



BABBITT CENTER
FOR LAND AND WATER POLICY

A Center of the Lincoln Institute of Land Policy



Southern Arizona Water Users Association

About SAWUA

The Southern Arizona Water Users Association (SAWUA) is comprised of 14 members including the largest water providers in the Tucson region, wastewater reclamation entities, and agricultural water users. SAWUA member agencies have water management authority to provide municipal water and wastewater service to over 900,000 residents in the Santa Cruz River Basin. Collectively, SAWUA delivers almost 200,000 acre-feet per year of potable water and treats over 64,000 acre-feet of wastewater annually.

Members meet monthly to discuss federal, state, and regional water policies and their impact to Southern Arizona. The Association coordinates in the development of effective water resource policy and planning in an effort to preserve and enhance the region's water resources' quality and quantity.

A key role for SAWUA is to provide one voice from Southern Arizona at the State Capitol and Legislature on water legislation and issues. By having a unified position, SAWUA has effectively protected and advanced water issues in the region. In addition, by being united, SAWUA has been able to collaborate with the Phoenix area Arizona Municipal Water Users Association (AMWUA) and the Northern Arizona Municipal Water Users Association (NAMWUA) on state-wide water policies.

SAWUA and its members work closely with the Arizona Department of Water Resources, Central Arizona Project, and Arizona Department of Environmental Quality and other governmental entities that affect water in Southern Arizona.

SAWUA believes it should exercise leadership and initiative to determine and encourage the most effective management of the region's sustainable supplies of quality water.

SAWUA is a voluntary nonprofit association organized in 1999.



Southern Arizona Water Users Association

SAWUA Members

The Southern Arizona Water Users Association (SAWUA) is comprised of 14 members including the largest water providers in the Tucson region, wastewater reclamation entities, and agricultural water users. The members meet monthly to discuss federal, state, and regional water policies and their impact to Southern Arizona.



Kai Farms



SAHUARITA
Water Company





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CONFERENCE SPEAKER/MODERATOR BIOS

Greg Barron-Gafford, *Professor, School of Geography Development & Environment, University of Arizona*



Greg Barron-Gafford is an Earth System Scientist who has been building the field of 'agrivoltaics' -the concept of co-locating agriculture and photovoltaics (renewable energy from solar panels). Greg began this work in southern Arizona to study the benefits across the food-energy-water

nexus, and over the years have developed a national and international program connecting with researchers in Colorado and Oregon (USA), and in Africa and the Middle East. Working to develop science-based solutions to help people adapt to the increasing pressures that come from a changing climate is a personal and professional goal.

Mark Beres, *President & CEO, The Flying Leap Vineyard*



Mark Beres is the President, Chief Executive Officer & co-founder of Flying Leap, a southern-Arizona vineyard, winery, distillery and distribution company headquartered in Tucson. Mark grew up in Walla Walla, one of Washington's most exclusive winegrowing regions. Mark is a

1991 graduate of the United States Air Force Academy and served our nation as a pilot in multiple roles. After retiring to Arizona in 2006, he worked for multiple programs across Raytheon's missile portfolio. Mark leads Flying Leap's core teams – agriculture, production, sales & marketing, and investor relations. Mark is also Flying Leap's Master Distiller and Chief Winemaker. In these roles, Mark leads the company's wine & spirits production teams, guides new product development, establishes the annual wine & spirits blends and manages Flying Leap's wine cellar and whiskey & brandy barrel houses.

Paul Brierley, *Executive Director, Yuma Center of Excellence for Desert Agriculture*



Paul Brierley was raised on a family farm in central California. After earning an Electrical Engineering and Computer Science degree and conducting applied telecommunications research, he returned to production agriculture and then served as Director of Organization at the Arizona

Farm Bureau. With a background in agriculture, research, leadership and politics, Paul was chosen to serve as the inaugural Executive Director of the University of Arizona's Yuma Center of Excellence for Desert Agriculture, which he has built into a highly effective research organization focused on usable results that impact the desert agriculture industry's pressing problems.

Linda Buchanan, *Workforce Development Coordinator, Yavapai College*



Linda Buchanan, M.Ed., Workforce Development Coordinator at the Regional Economic Development Center of Yavapai College, serves on the Board of Directors for the Sustainable Economic Development Initiative (SEDI) of Northern Arizona and the Verde Valley Archaeology Center. She is

a founding member of the Southwest Wine Center, represents education on the National Forest Service Yavapai Resource Advisory Council, and is active in multiple regional agricultural initiatives including the USDA Water for Ag Verde Valley Leadership Team, coordinated by the ASU Kyl Center for Water Policy. Buchanan believes that grassroots initiatives present the greatest collaborative opportunity to protect natural resources and facilitate regional conservation.

Delia Carlyle, Tribal Council Member, Ak-Chin Indian Community



Delia M. Carlyle currently serves on the Community Council and as the Chairwoman of the Arizona Indian Gaming Association. Ms. Carlyle's professional service is not limited within her Community. She has served on numerous boards and committees at the local, state and national levels. Ms.

Carlyle graduated from Maricopa High School in 1974, attended Haskell Indian Junior College and graduated from Central Arizona College in 2016. As a community and civic leader, Ms. Carlyle has been recognized many times for her service and contributions. Despite her accomplishments, Ms. Carlyle believes her greatest achievements are her children, grandchildren and great-grandchild.

Andrea Carter, AG Outreach and Education Manager, Native Seeds/SEARCH



Andrea Carter provides seed saving and agronomic consultation to collaborating farmers stewarding arid-adapted crops within the Native Seeds/SEARCH seed bank. She received her PhD in Plant Science from the University of Arizona where she specialized in arid land agriculture and the

physiology of drought tolerance in small grains. She believes elevating traditional agriculture, land use, and crop selection practices will be key to addressing agronomic challenges of the present and future.

Noel Carter, General Manager, Buckeye Water Conservation & Drainage District



Noel Carter's family homesteaded in the Buckeye Valley in the late 1890s and farmed in the Buckeye Water Conservation & Drainage District until the 1950's. They leased the farm and moved to northern Arizona to their cattle ranch until the mid-'70s when they returned to the farm in

Buckeye. Noel was born in the town of Buckeye, but then grew up in the Pacific Northwest. He came back to Buckeye in 2001 and ended up logging in northern Arizona from 2005 until 2013. Then he went into heavy civil construction until 2017 when he took this position as general manager of the BWCDD. Now Noel strives to serve the constituents of this district and protect their valuable water resource. This job brings it back full circle.

Tom Davis, General Manager, Yuma County Water Users' Association



Tom Davis is a native of Oklahoma and has a Bachelor of Science Degree from Oklahoma State University. Prior to assuming this position in 2007, he was Manager of Carlsbad Irrigation District located on the lower Pecos River in New

Mexico. Tom also worked fifteen years for the USDA-Forest Service. Six of those years as District Ranger on the Guadalupe Ranger District of the Lincoln National Forest. He currently serves as President of the Agribusiness and Water Council of AZ; the Board of Directors of the National Water Resources Association; the Advisory Council for the Family Farm Alliance; the Colorado River Citizens Advisory Board; President of the Yuma County Agricultural Water Coalition; and Vice President of the Yuma County Flood Control Board.

Dave Dierig, Manager, Bridgestone Agro Operations



Dave Dierig is the manager and Plant Breeder for Bridgestone Agro Operations in Eloy, Arizona since 2014, with efforts to bring guayule to commercialization through plant improvement, agronomy, establishing relationships with growers, and providing shrub to the Bridgestone

BioRubber Processing Center in Mesa, AZ. He previously worked for USDA, ARS where he was Director at the USDA National Genebank, in Ft. Collins, CO (2009-2014). He was also a Research Scientist working on guayule at the USDA, ARS, Arid Land Agricultural Research Center in AZ (1987-2009). His PhD is from The University of Arizona in Plant Genetics and Agronomy.

Tim Dunn, Arizona State Representative



Tim Dunn was elected in 2018 to the AZ House of Representatives. He currently serves as the Chairman of the Land Agriculture & Rural Affairs Committee and is a member of the Natural Resources, Energy & Water, and Ways and Means Committees. His chairmanship has helped

him protect the land, water, and agricultural interests of District 13 and rural Arizona. Tim is a lifelong resident of Yuma. He graduated from the University of Arizona with a B.S. in Agriculture and is currently working on a Masters of Legal Studies: Law and Economics Concentration. He is married to his wife Eileen Dunn, has two sons, Kirk and Timothy Ty Dunn, daughter-in-law Sierra, and granddaughter Coralee.

Ashley Ellixson, Chief Business Operations Officer, United Dairymen of Arizona



Ashley Ellixson completed a B.S. in Business Finance at Arizona State University and then earned a J.D. with a certificate in Science, Engineering, and Technology Law from Texas Tech University School of Law before moving on to receive an LL.M. in Agricultural Food Law from the

University of Arkansas School of Law. Ashley currently serves on committees and task forces for the Innovation Center for U.S. Dairy, National Milk Producers Federation as well as the International Dairy Foods Association. Ashley's love and passion for the dairy industry stems from being born and raised on her family's dairy in Gilbert, Arizona.

Peter Ellsworth, Professor & Extension Specialist, Maricopa Agricultural Center, Department of Entomology, University of Arizona



Peter Ellsworth is an Integrated Pest Management Specialist and Professor of Entomology at the University of Arizona. Posted at the Maricopa Agricultural Center for over 31 years, he maintains a statewide research and Extension program in IPM for cotton and other crops. He also directs the University's Arizona Pest Management Center. He holds degrees in entomology from the University of New Hampshire (B.S.), University of Missouri (M.S.), and North Carolina State University (Ph.D.). IPM programs he has helped develop and deploy have saved Arizona cotton growers more than \$600M since 1996 and prevented more than 35M pounds of insecticide active ingredient from entering the environment.

Grey Farrell, Extension Program Coordinator, University of Arizona



Grey Farrell, Jr., is the Extension Program Coordinator-FRTEP in Tuba City. He is responsible for Extension programs for the Western Navajo Agency, Navajo Nation in the areas of Agriculture/Natural Resources and 4-H Youth Development programs. Grey has 25 years of experience with the Navajo Nation Department of Agriculture-Tuba City. His previous work experience focused on assisting farmers and ranchers in conservation and management practices, he spearheaded the "Navajo Beef Project," and he was instrumental for the "Rez to Rail" program, a byproduct of Navajo Beef Project.

Charlene Fernandez, Arizona State Director for USDA Rural Development Office



Charlene Fernandez has spent her career in public service. In 2021 Fernandez was appointed by the White House to be State Director of Rural Development at the United States Department of Agriculture. There she has led historic investment from Congress and the President in infrastructure and development in Arizona's most rural communities. Fernandez was elected to the Arizona House of Representatives in 2014. Her district in Southwestern Arizona contains many farmers and ranchers who contribute to the state's role as the United States' top producer of winter lettuce. Elected House Minority Leader in 2019, Fernandez was integral to the Drought Contingency Plan agreement in 2019, bringing states, tribal nations, farmers, and other stakeholders together to ensure a sustainable water supply for Arizona. Prior to entering elected office, she worked for Congressman Ed Pastor and Congressman Raúl M. Grijalva in constituent services in Yuma County office. Fernandez also served Governor Janet Napolitano as a liaison for the Arizona Department of Environment Quality. She is a former member of the Arizona Department of Agriculture's Food & Agriculture Policy Advisory Committee.

Grady Gammage, Jr., Partner, Gammage & Burnham



Grady Gammage, Jr., is one of the founders of Gammage and Burnham and has had a varied and diverse 40 year career in law and public policy in Arizona. His practice has focused on the political aspects of real estate, development and public policy. He has represented dozens of major commercial projects including high rise

offices, major industrial and office parks, retail shopping centers, residential projects, and master planned communities. In addition to being the primary private sector representative for developing the Urban Lands Act, he has also been at the forefront of urban development in Maricopa County, including deals with such public private projects as the Tempe Town Lake and Arizona's unique approach to redevelopment incentives. Grady served on the Central Arizona Project Board of Directors for 12 years and was president during when the CAP was suing the Federal Government over the multibillion dollar cost of the canal. The litigation was successfully resolved through a dramatic restructuring of the federal/state relationship.

Sarge Green, Project Director, California Water Institute, Fresno State University



Sarge Green is a water management specialist with the California Water Institute at Fresno State. His efforts at the Institute have included water policy, integrated regional water management and special water reports. Previously, Green was General Manager of Tranquility Irrigation District in Fresno County and before that a senior scientist at the Central Valley Regional Water Quality Control Board. He was on the California Water Quality Monitoring Council and served as Chair of the Water Quality Committee for the Association of California Water Agencies. He's currently a member of the Public Policy Institute of California, Water Policy Center research network.

Dax Hansen, Owner, Oatman Farms



Dax Hansen is a Partner in the law firm, Perkins Coie LLP, where he helps innovators transform and adopt technology and financial services. He has pioneered blockchain, payments, and fintech law. Dax owns a 665-acre historic family farm along the Gila River near Gila Bend, Arizona.

Oatman Flats Ranch reflects the significant cultural, historic and environmental treasures and challenges of the region. Oatman Flats Ranch is on a mission to conserve millions of gallons of water in the Gila River aquifer, regenerate the landscape and preserve the rich history of the farm and region. OFR is the Southwest's first Regenerative Organic Certified farm. Oatman Flats Ranch is achieving these results by growing regenerative organic White Sonora wheat and other low-water consuming native crops, selling premium consumer products made with those ingredients, and collaborating with preservation-minded stakeholders.

Kathy Jacobs, *Director, Center for Climate Adaptation Science and Solutions, & Professor, University of Arizona*



Kathy Jacobs is a professor of Environmental Science at the University of Arizona and Director of the Center for Climate Adaptation Science and Solutions (CCASS). From 2010 – 2013, Jacobs worked in the Office of Science and Technology Policy in the White House. She was director

of the Third National Climate Assessment, and the lead advisor on water science, policy, and adaptation. From 2006-2009 Jacobs was Executive Director of the Arizona Water Institute. She worked 23 years for the Arizona Department of Water Resources, including 15 as the director of the Tucson Active Management Area. She implemented conservation and sustainability rules.

Valerisa Joe-Gaddy, *Diné Post Doctorate Research Associate, Water Resources Research Center, University of Arizona*



Valerisa Joe-Gaddy is originally from Gallup, NM and is of the Diné (Navajo) people. Dr. Joe-Gaddy is an Alumna of the University of Arizona receiving both her PhD and MS in Environmental Science with an emphasis in microbiology. In addition, she was the 2018 recipient of the

prestigious Dr. Maria Teresa Velez Marshall Dissertation fellowship and a UArizona Sloan fellow. Prior to UArizona, she received her BS in Microbiology from New Mexico State University. Dr. Joe-Gaddy's research and extension interests include developing and validating methods to assess microbial water quality and communicating modern water quality and produce safety methods to growers. In addition, she is passionate about environmental science literacy and serving the Diné people through outreach and engagement. She founded the 2017-2018 UArizona's Indigenous Fresh Produce Trainings which focused on teaching American Indian farmers about food and water quality safety relating to the Food Safety Modernization Act.

Michael Kotutwa Johnson, *Assistant Specialist, Indigenous Resilience Center, School of Natural Resources & the Environment, University of Arizona*



Michael Kotutwa Johnson, is a member of the Hopi Tribe in Northern Arizona. Dr. Johnson is an Assistant Specialist with the School of Natural Resources and the Environment and the Indigenous Resilience Center at the University of Arizona. Dr. Johnson holds a Ph.D. in Natural Resources

from the University of Arizona. He is also a co-author on the Indigenous Chapter in the National Climate Assessment Five and has works published in academic journals as well as feature-based articles. Dr. Johnson also continues to practice Hopi dry farming, a practice of his people for millennia.

Murat Kacira, *Director, Controlled Environment Agriculture Center, University of Arizona*



Murat Kacira is director of the Controlled Environment Agriculture Center (UArizona-CEAC) and he is a professor in the Biosystems Engineering Department at the University of Arizona. He received his B.S. degree in Agricultural Engineering in Cukurova University in Turkey and M.S. and

Ph.D. degrees from Food, Agricultural and Biological Engineering from The Ohio State University. His research involves automation, environmental control, alternative energy applications, and resource use optimization in controlled environment agriculture systems including greenhouses and vertical farming-based plant factories with artificial lighting. He is a member of American Society of Agricultural and Biological Engineers (ASABE), American Society of Horticultural Sciences (ASHS), and International Society for Horticultural Science (ISHS) where he serves as chair of the Division Precision Horticulture Engineering under ISHS.

A.G. Kawamura, *Farmer & Founding Co-chair, Solutions from the Land*



A.G. Kawamura is a third generation produce grower and shipper from Orange County, California. From 2003 to 2010 he served as the Secretary of the California Department of Food and Agriculture. He is founding co-chair of Solutions from the Land, a nationally recognized non-profit

that is developing innovative and sustainable climate smart collaborations for 21st century agriculture. He serves on multiple boards and advisory committees including the Farm Foundation Board; Western Growers Board and former Chair; Roots of Peace Board; CSU Agricultural Research Institute, Board of Governors; Ag Advisory Committee for the Chicago Council; Bipartisan Policy Center, Ag & Forestry task force. For over 40 years Mr. Kawamura has pursued a lifelong goal to work towards an end to hunger and malnutrition. Locally, he is founding chair of Solutions For Urban Ag. He has worked closely with Regional Food Banks and stakeholders to create exciting urban ag projects that focus on nutrition, hunger, education and advanced food systems. As a progressive farmer, Mr. Kawamura has a lifetime of experience working within the shrinking rural and urban boundaries of Southern California. A.G. graduated with a BA from UC Berkeley and was a member of the California Ag Leadership Program.

Mark Killian, Director, Arizona Department of Agriculture



Mark Killian comes from a family that has been involved in Agriculture in Arizona for more than 100 years. His family farming and ranching operations spanned Colorado, New Mexico, Kentucky and California. Mr. Killian has been involved in Arizona State government since 1983. District 30 voters first elected him to the Arizona House of Representatives at the young age of 27. After 14 years in the Arizona House of Representatives, Governor Fife Symington appointed him to serve as the Director of the Arizona Department of Revenue where he served as its director for almost six years. In 2010, Governor Jan Brewer appointed Mr. Killian as a member of the Arizona Board of Regents. During his five-year term, he served as Board Chair, Vice Chair and Treasurer. In April 2015, Governor Doug Ducey appointed Mr. Killian the director of the Department of Agriculture. Mr. Killian was the prime sponsor of the legislation that created the Arizona Department of Agriculture in the early 1990s while serving in the Arizona Legislature.

Sarah King, Rancher, King's Anvil Ranch



Sarah King is a rancher and the Executive Director of the Altar Valley Conservation Alliance. Sarah and her husband, Joe, work on their family's cattle ranch in southern Arizona, which was founded in 1895. Sarah also serves as the Executive Director of the Altar Valley Conservation Alliance, which is a collaborative conservation organization founded in 1995 by ranchers in the Altar Valley to conserve the 600,000 acre watershed for future generations. Sarah serves on the boards of the Arizona State Parks, Arizona Farm Bureau, Pima County Farm Bureau, and the Friends of the Buenos Aires National Wildlife Refuge.

Maegan Lopez, Gardener's Assistant, Mission Garden



Maegan Lopez is a mom and a Teacher-aid at Ha:sañ Preparatory and Leadership High School. She is also a Gardener's Assistant & Cultural Outreach at Mission Garden. She started as a volunteer and began to form a strong connection to this amazing and resilient space. Her personal bond with cultivating plants comes from experiences and memories of her grandpa and his gardens in Sells and in her own village. Maegan come from a small community on the Tohono O'odham Nation called New Fields; it lies at the edge of the Nation and the US/Mexico Boundary.

Ed Martin, Interim Director, Arizona Cooperative Extension & Professor



Ed Martin is the chief administrator for over 600 employees who bring science-based research to help solve real-life problems to improve people's lives, communities, and the economy in the state of Arizona. With annual expenditures in excess of \$40 million, Arizona Cooperative Extension works with communities, schools, local governments, NGOs, and private industry to address the issues concerning the citizens throughout the state. Dr. Martin is also an Extension Irrigation Specialist and Professor in the Biosystems Engineering Department at the UA. With almost 30 years of working with on-farm irrigation management and strategies in Arizona, Dr. Martin has done extensive work in the Navajo nation and throughout the state. His work has concentrated on system design and management to help improve irrigation efficiency and reduce water applications. He has worked on crop water use, irrigation scheduling, and the effects of irrigation applications on groundwater quality. In 2021, he was inducted into the National Association of County Agricultural Agents Hall of Fame.

Robert Masson, Assistant Agricultural Agent, Yuma County Cooperative Extension, University of Arizona



Robert Masson began his agricultural career working as a USDA soybean breeding technician in North Carolina, conducting nursery, yield, and abiotic stress trials for a public soybean breeding program. The goals of the program were primarily focused on introducing genetic diversity from wild-type and plant introductions into elite breeding lines. He transitioned to private industry where he worked for Weaver Popcorn Company in Indiana as a research scientist developing and implementing quality and efficiency advancements for the Hybrid Research, R&D, Quality Assurance, and Grain Conditioning departments. He moved to Yuma, Arizona and continued his work in private industry working for RD4AG, an agricultural contract research company, where he performed agricultural field trial services for demonstration, product development and GLP Registration. He currently works as an Assistant Agricultural Agent for Yuma county where he works on addressing grower needs with research and connecting them with research specialists.

Sharon B. Megdal, Director, Water Resources Research Center, University of Arizona



Sharon B. Megdal is Director of the University of Arizona Water Resources Research Center, an Extension Center and research unit in the College of Agriculture and Life Sciences. She is also Professor of Environmental Science, C.W. & Modene Neely Endowed Professor, and

Distinguished Outreach Professor. The geographic focus of her water policy and management work ranges from local to international. Current research projects focus on groundwater governance, managed aquifer recharge, and transboundary aquifer assessment. Engagement efforts include Indigenous Water Dialogues and Diversifying Voices in Water Resources. Dr. Megdal endeavors to bridge the academic, practitioner, and civil society communities. Recently, she completed 12 years as an elected member of the Central Arizona Project Board of Directors, and she is active in many professional organizations. Past state-level public service activities include the Arizona Corporation Commission, the State Transportation Board, the Arizona Medical Board, and several other boards and commissions. Sharon Megdal holds a Ph.D. in Economics from Princeton University.

Brandon Merchant, Health and Garden Education Coordinator, Community Food Bank of Southern Arizona



Brandon Merchant was born and raised in Yuma, Arizona. In 2001 he graduated from Peoria High School in west Phoenix and shortly afterward moved to Tucson where he has lived full time since 2009. Brandon, a certified Pima County Master Gardener, has been active in the Tucson garden

community for many years. In 2012 Brandon started Southwest Victory Gardens so he could share his knowledge and passion for gardening with others. In November of 2020, he joined the Community Food Bank of Southern Arizona staff full time as their new Health and Garden Education Coordinator.

Stephen Miller, Pinal County Supervisor & Central Arizona Water Conservation District Board Member



Stephen "Steve" Q. Miller is a proud Arizona native and current County Supervisor representing District 3 in Pinal County. Steve is an accomplished public servant with over 18 years of public service as a county supervisor, city council member, and CAP Board Member. In addition, he is

an active member of GWAIC, GUAC, and the Pinal County Groundwater Taskforce. Steve takes pride in representing the voice of his constituency. As a former small business owner and homebuilder, Steve understands what it takes to create sound policy that promotes sustainable growth and a healthy

local economy to meet the needs of the communities he serves. Steve is a firm believer in "community first" leadership and always leads by example.

Joshua Moore, General Manager, Colorado River Indian Tribes (CRIT) Farms



Joshua Moore is General Manager of the Colorado River Indian Tribes (CRIT) Farms. A member of CRIT, Mr. Moore grew up on the reservation and throughout his professional career, he has been passionate about creating pathways for Indigenous young peoples to enter the field of

Agriculture. He served as an Agricultural Science teacher at Patagonia Union High School for one year and then as an Assistant Agent for Pima County Cooperative Extension Service. In that position, he worked with agents Joshua Farella and Juan Arias to adapt the Peoplehood Model for positive youth development to Extension work. Mr. Moore earned a B.S. in Agricultural Technology Management and an M.S. in Agricultural Education Research from the University of Arizona College of Agriculture Life Sciences.

Orestes Morfín, Senior Planning Analyst, Central Arizona Project



Orestes Morfín, a senior planning analyst with the Central Arizona Project, is a water resources/water quality systems modeler and aqueous geochemist with 19 years of experience. Mr. Morfín's specialty areas include water balance modelling, modelling contaminant transport and loadings to surface water and pit lakes, treatment

options, desalination, and binational water management. He has worked on a variety of projects in the United States, Mexico, Canada, and Brazil. His educational background includes hydrology, contaminant hydrochemistry and geochemistry. He received a master's degree in hydrology from the University of Arizona College of Engineering and Mines in 2003.

Pat O'Toole, President of Board of Directors, Family Farm Alliance



Patrick O'Toole manages the Ladder Ranch, located on the Little Snake River along the Wyoming/Colorado border at the headwaters of the Colorado River. There, Pat and his family raise cattle, sheep, horses, dogs and children. They also raise birds, bats, bees and butterflies in a complex and

integrated landscape. The ranch supports several threatened species, including Upper Colorado fish and Greater Sage Grouse. The irrigated hayfields support wetlands for migratory birds and other wildlife. Battle Creek is an Audubon Important Bird Area. O'Toole is equally proud of the quality beef cattle, the excellent sheep and the fine fleeces produced by Ladder Ranch livestock. He is President of the Family Farm Alliance, representing irrigators in the West. He is currently Chair of the Intermountain West Joint Venture, and serves on other conservation-oriented boards.

David Proctor, Vice President, BKW Farms



David Proctor is the Vice President of BKW Farms, a 3rd generation family farm in Marana, AZ. Growing up on the Wong's farm he took an early interest in sustainable agriculture. With his involvement in Future Farmers of America in green house settings he thoroughly enjoyed cultivating vegetable crops. Using his experience and

partnerships with the University of Arizona he heads BKW's USDA organic oyster mushroom operation which uses byproducts from the organic wheat fields.

Ron Rayner, Farmer, A Tumbling T Ranches



Ron Rayner is a fourth-generation Arizona farmer and partner in A Tumbling T Ranches with his brother, two nephews, and son. Their family operation is in the west valley of Phoenix, in Goodyear and extends through Buckeye and Gila Bend. The Rayners have developed and adopted a

unique conservation tillage system on their entire Arizona farm that utilizes planting cotton with a no-till planter and limited tillage to complete their rotation between alfalfa, durum wheat, cotton, and sorghum silage. They also own farmland in California growing wine grapes. He formerly served on the CAP board and Groundwater Users Advisory Council for the Phoenix AMA.

Ross Rayner, Farmer, A Tumbling T Ranches



Ross Rayner is a farmer in Goodyear, Arizona where he works with his family, including his father, uncle, and two cousins, to farm over 5,000 acres of row crops. He is 29 years old and has a BS in Agricultural Economics from the University of Arizona as well as a Master of Legal

Studies in Law and Sustainability from ASU. The family farm, called A Tumbling T Ranches, was founded in 1946 has been innovating and applying conservation tillage practices for over 20 years. They grow cotton, wheat, alfalfa, and sorghum in Arizona, as well as wine grapes in the central valley of California.

Channah Rock, Professor & Extension Specialist, Maricopa Agricultural Center, University of Arizona



Channah Rock is a Professor and Water Quality Specialist with the University of Arizona Cooperative Extension. She was also recently named Endowed Professor in Extension, Fresh Produce Safety by the College of Agriculture and Life Sciences. Dr. Rock is PI on several projects relating to

microbial evaluation of water quality for the protection of public health. She current leads a multi-year Longitudinal Study evaluating growing practices and environmental impacts within the Southwest growing region. Additionally, Dr. Rock supports the CA and AZ LGMA's by providing science-

based recommendations. She holds a BS in Microbiology from New Mexico State University and an MS and PhD in Environmental Engineering from Arizona State University.

Eric Rosenbaum, Projects Manager, Desert Control



Eric Rosenbaum has been professionally involved in agricultural research for the past 22 years with a farm background and a passion for environmental issues. He has worked for multiple large companies including Monsanto Company and J.R.

Simplex Company on a variety of crops and crop protection products across the United States. In 2022, Eric took on the role of Project Manager for Desert Control Americas where he oversees the application of Desert Control's Liquid Natural Clay technology. He is excited to contribute to Desert Control's mission to combat desertification and reduce water usage in agricultural systems.

Meghan Scott, Attorney, Noble Law



Meghan C. Scott is an attorney with the Noble Law Office, licensed to practice in Arizona and California. With the Noble Law Office, she represents a number of irrigation districts in the Yuma area and the Bard Water District in California. She also handles legislative affairs for the Yuma Fresh Vegetable Association. She focuses

her practice on water and agricultural law, and also practices business and corporate law, contracts and contract negotiation, estate planning and administration, real estate law and civil litigation. Ms. Scott is the Assistant Coordinator for the Yuma County Agriculture Water Coalition and sits on the Board of Directors for the Agribusiness and Water Council of Arizona and the National Water Resources Association. With the Agribusiness and Water Council of Arizona, Ms. Scott recently helped form the Arizona Association of Women in Water and Agriculture. Ms. Scott was born and raised in Yuma, Arizona, and is the daughter of a third generation Yuma farmer.

Daniel Sestiaga, Jr., Program Manager, Indigenous Resilience Center, University of Arizona



Daniel Sestiaga Jr. is a member of the Ft. Yuma Quechan Indian Tribe of Arizona. He is the son of Daniel Sr. and the late Rosie Sestiaga. His paternal grandparents are Carlotta and the late Julio Sestiaga. His maternal grandparents are Rosie Montoya and the late Tomas Montoya and Virgil Jack.

Within his role, he liaises with UArizona faculty and administrators to further goals and objectives around strengthening teaching, research and outreach related to Indigenous resilience, links with tribal leadership through principles of respectful tribal engagement and collaborates with other external partners to execute successful and impactful outreach. Daniel earned his Master of Public Health at the University of Arizona.

Uri Shani, Chairman and Chief Technology Officer of N-Drip & Former Director of Israel Water Authority



Uri Shani is the Inventor, Chairman, and Chief Technology Officer of novel irrigation technology company, N-Drip. Professor Shani has a long-standing track record in both the public and private sector. His previously-held positions include General Manager and Chairman of the Israeli

Government Water and Sewage Authority, and Chairman of the Red Sea–Dead Sea Conduit Steering Committee. He was also General Manager of Kibbutz Yotvata, Chairman of Arava Export Growers, and SVP for novel technologies at ADAMA Ltd. A Professor Emeritus in soil and water sciences at The Hebrew University of Jerusalem, Professor Shani has published 70 peer-reviewed manuscripts and has 10 patents to his name.

Jeffrey Silvertooth, Professor & Extension Specialist in Agronomy & Soil Science



Jeffrey Silvertooth has responsibilities in leading a program directed towards the development of irrigated crop production management strategies that optimize the soil-plant system agronomically, economically, and environmentally. Studies of the soil-plant relationships, particularly

regarding nutrient and water requirements for cotton, chiles, cantaloupes, and other regional crops are principal areas of operation for the program. Salinity and sodicity management in agricultural soils are consistent and important aspects of this program. Silvertooth has been recognized as a Fellow for both the American Society of Agronomy and Soil Science Society of America.

Faith Sternlieb, Senior Program Manager, Babbitt Center for Land and Water Policy



Faith Sternlieb is a senior program manager for the Babbitt Center of Land and Water Policy, a center of the Lincoln Institute of Land Policy, where she manages the program Growing Water Smart, conducts research on agricultural water resilience, and forges strategic partnerships across the Colorado River Basin to foster collaborative

sustainable water practices. She received a bachelor's degree in anthropology and Latin American languages from the University of Maryland, a master's degree in agriculture through the Peace Corps Masters International Program, and a Ph.D. in earth sciences with a watershed specialty, both from Colorado State University.

Phyllis Valenzuela, Catering Assistant, San Xavier Cooperative Farm



Phyllis Valenzuela combines contemporary foods with traditional crops to make savory, healthy dishes as a member of the Tohono O'odham Nation. Phyllis offers food tastings, presentations, traditional meal service for up to 50 people and cooking classes for youth and adults.

Cherilyn Yazzie, Owner, Coffee Pot Farms



Cherilyn Yazzie was raised on the Navajo Nation, Arizona and received her social work degree from the University of Arizona. She worked as a school social worker and program manager for nutrition services programs that emphasized working with the health of children and families. After

many years, she realized that something was "not clicking" and changed careers to become a farmer and owner of Coffee Pot Farms back on the Navajo Nation. Building an opportunity on the Navajo Nation for food access and solving issues that affect farmers, Coffee Pot Farms' focus is producing the highest quality produce and making it available to low income families. We grow good food for the health of our people. There is a sacred purpose to protect the land, the water, medicinal plants and seeds that turn into food, medicine and provide us with shelter. Cherilyn tends to rescue dogs, chickens and seedlings to grow the farm and has learned how much joy they bring to farm life.

Stevi Zozaya, Food Safety Director, Lee Farms



Stevi Zozaya is a Yuma Grown Food Safety Director at Lee Farms Produce. After graduating from the University of Arizona with a bachelor's degree in Animal Science with an emphasis in food safety in 2018, she began her career as a Food Safety Research Assistant with the UofA's Rock

Lab. In 2020, she transitioned into the produce industry with Lee Farms where she oversees approximately 4,200 acres in the Yuma Valley, as well as Bard and Tacna, growing primarily broccoli, cauliflower, iceberg, romaine, swiss chard, and kale during the winter season and cotton, wheat, sudan, and other various seed crops during the summer season.



WATER RESILIENCE - INDIGENOUS PERSPECTIVES

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Gila River Indian Community

INTRODUCTION

The water resilience of Native peoples to climate and other exogenous shocks has depended largely on the perseverance of the Native Tribes themselves and will depend increasingly on their own intentions and agency. The University of Arizona Water Resources Research Center's 2021 Annual Conference, *Tribal Water Resilience in a Changing Environment*, provided a platform for Native American participants to present and discuss their experiences, knowledge, and visions of water resilience. This *Arroyo* draws extensively on their words.

The history of relations between Native Americans and European settlers in North America has been fraught with tension and conflict. For centuries, colonial powers forcefully asserted control over North American Native people and their lands. This power dynamic led to the existence of a "dominant culture" that has continued

to disparage Tribal approaches and practices. Although some rights were secured by Native Tribes both by treaty and through federal court decisions, these rights were repeatedly violated as non-Native Americans pushed westward across what is now the United States. Rights to water were among the many disregarded by settlers, who frequently diverted water away from Tribal lands to support their own agriculture, mining, and growing municipalities. These often-sacred waters represent a vital aspect of Tribal identity and are fundamentally associated with many ancestral traditions and customs.

In the late 19th and early 20th centuries, some redress of Native American grievances regarding treaty rights was accomplished through legal action. A major change in the development of Indian law occurred in the 1970s, as a wave of Native attorneys emerged from law schools in the West, determined to advocate for the rights of their people. Notable among them was Rodney "Rod" Blaine



COLLEGE OF AGRICULTURE & LIFE SCIENCES
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Lewis, an Akimel O'odham (Pima) from the Gila River Indian Community (GRIC) in Arizona, who was a dedicated and tenacious Tribal lawyer. His efforts for GRIC culminated in the 2004 Arizona Water Settlements Act, by which GRIC's legal rights to water were recognized and quantified. Today, due in large part to the work of champions like Lewis, many of Arizona's 22 federally recognized Tribes find themselves able not only to provide for the water needs of their people, but also to affect water policy statewide and throughout the Colorado River Basin.

Despite the hard-fought legal victories of Native American activists over the last half century, Native people continue to face many water-related challenges. The Southwest, an arid region, is becoming hotter and drier due to climate change, placing enormous strain on water supplies for Arizona and neighboring states. Despite the development of water infrastructure on some Tribal lands, many Native Americans live without access to running water, an issue highlighted by the severity of the COVID-19 pandemic on the Navajo Nation. Native American leaders of today and tomorrow will have to deal with these water challenges, but they are aided in this task by their heritage and culture, their deep connections to their lands, and the progress made by those who came before them.

Much of the information and many of the quotations contained on the following pages are drawn directly from presentations given by Native American participants at the WRRC's 2021 Annual Conference. This *Arroyo* would not have been possible without these presenters and the perspectives and experiences they shared. Full video recordings of each of their presentations are available on the Water Resources Research Center website.

IDENTITY AND RESILIENCE: LINKED CONCEPTS

Identity

Where do we find our identity? This is a complicated question for people throughout the world, and especially so for Indigenous peoples living alongside a predominant culture different from their own. Deep connections to family, traditions, places, and beliefs foster a strong sense of identity among many Native Americans today. Indigenous identity is defined most prominently through an awareness of and connection to



Rod Lewis

Few people get the opportunity to change the lives of an entire community for the better. Even fewer possess the talent and determination necessary to seize that opportunity and turn it into reality. Rodney "Rod" B. Lewis, to whom the WRRC's 2021 conference was dedicated, was one such person. Rod Lewis was born into the Gila River Indian Community (GRIC), the son of Sallie and Roe Lewis of the Pima Indian Tribe. Growing up, he and his brothers John and Robert were accustomed to families in the community hauling water for their daily needs by horse and wagon. His father, a farmer and pastor, would pray during droughts as crops withered in the fields due to lack of water from their traditional water source—the Gila River. All this impressed on Lewis the importance of water and agriculture on Tribal lands, and from an early age he was always eager to listen to the advice of Tribal elders. After serving in the U.S. Army, he began to study at the University of California - Los Angeles, one of the few schools in the country to offer courses on Indian law. Advocating for treaty rights and Tribal sovereignty required expertise, and hiring outside attorneys was often prohibitively expensive for Native communities. Lewis was part of a cohort of Tribal attorneys graduating from law school in the early 1970s who were able to provide legal counsel to Native communities. He served as GRIC's general counsel beginning in 1978 and continued to work for the community throughout his life. In his career, he also represented the Tohono O'odham Nation and other Native communities in Arizona. He was a founding member of the Native American Rights Fund, a legal defense association designed to relieve the financial burden on Native communities in need of legal representation. In 1980, he became the first Native American to successfully argue a case before the U.S. Supreme Court. The crowning achievement of his career was securing billions of gallons of water for Arizona Tribes through the 2004 Arizona Water Settlements Act. This settlement, decades in the making, restored to GRIC the water the community needed to continue their traditional ways of life.

As a student of history, Rod Lewis understood that the experiences of previous generations would help justify and strengthen his case regarding Native water rights. He believed that moving forward to meet future obstacles required maintaining a connection to the past. Purpose driven and disciplined, he saw his work as part of an ongoing struggle to care for his community and lands. His daughter Katherine Lewis recalled that, after the passage of the 2004 Arizona Water Settlements Act, he did not take a break from his work but continued to advocate for GRIC and other Native communities. His son, GRIC Governor Stephen Roe Lewis, remembered his father would say, "It's eternal vigilance: when you watch over your natural resources, your water, you are caretakers, you are stewards of this."

Rod Lewis practiced this stewardship not only in his work, but also in his mentorship of other Tribal attorneys. He believed in being rooted in a community and recognized the influence his work had on younger generations of Native American legal professionals. He also hoped that through his work, GRIC might become a model for other Native governments to invest in their own people and create their own pathways forward. Because he saw that true water resilience is found at the intersection of law, policy, science, engineering, and tradition, he believed educating young people in those disciplines and in their history of water stewardship would ensure Tribal water resilience. Rod Lewis died in 2018 at the age of 77. Today, his legacy lives on in those who knew and worked with him, in those whose lives were touched by his work, and in the waters that flow through the Gila River Indian Community.

<https://wrrc.arizona.edu/dedicated-legacy-rodneylewis>

belief systems and cultural practices that have existed for millennia. These beliefs and practices vary among different groups with distinct ways of life but are linked by historic connections. Karletta Chief, a University of Arizona associate professor and member of the Navajo Nation, cited the example of creation stories that situate humans among the youngest members of creation to explain why humans were not given specific wisdom about the world and therefore are obliged to learn from other creatures and things.

For many Native peoples in the arid Southwest, the sense of an identity born out of shared history and customs is inextricably linked to the lands and waters of their homelands. Chairwoman Gwendena Lee-Gatewood of the White Mountain Apache Tribe summarized the relationship between water and Indigenous identity: “Water is the giver of life.” Other Tribal leaders and academics echoed this sentiment, describing water, personhood, and traditional ways of life, not as separate ideas, but as one and the same.

This profound identification with lands and waters is deeply felt when these things are degraded. Brian Golding, Sr., Quechan Economic Development Administration Director, described what happened when levee systems constructed on the Colorado severed the community's connection to the river. “We turned our back on the river, leaving it to invasive species and social deterioration.” Degradation of their physical and spiritual resources destabilizes Tribal economic security and inflicts cultural wounds, especially when Indigenous groups lack capacity to reverse the harms to their communities. Tribal Chairman Timothy Williams reflected that, as fishers, the Fort Mojave Indian Tribe had been in tune with the ecosystem before Hoover Dam was constructed. Although they were not farmers, tribal members had to build farming capacity to survive. The Tribe “may never recover from the devastation caused by the dam, but we are a resilient people.”



The Ak-Chin Have Been Farmers for Generations. Historical Photo Source: Ak-Chin Indian Community/Ak-Chin-Dak Eco-Museum

The Law of the River

Death is not the end
it is reaching the river
and reclaiming it.

It is becoming the river.
This is the Law of the River.

I have reached my river now
and I have reclaimed it for all eternity.

I am the river now
and the river is me.
This is the Law of the River.

But my journey to the river was always for you
and I have reclaimed it just for you.

And when you reach your river
you will find me there waiting for you.

And together we will become the river
and the river will be all of us together.

This is the Law of the River.

I have lived the Law of the River
with the river as my guide.

I am the river now
and the river is me.

This is the Law of the River.

by Willardene Lewis

Climate researcher Nikki Tulley spoke of how her grandmothers hauled water by wagon, made offerings and prayers with the water, and taught her the language of the land on the Navajo Nation. Living in a home without running water early in her life instilled in her the value of water as “the giver of life” entwined in her identity and her resilience since she was a child. Her grandmothers taught her that “everything has a purpose and a relationship to the overall ecosystem,” which she has continued to implement in her work and her studies.

Today, conceptions of identity among Indigenous peoples are also complicated by the need to function in both the predominant or mainstream cultural context and the traditional world. Navajo Nation President Jonathan Nez recognized that “our lens, our world view—that water is life—may be different from other world views.” This has meant, as Water Resources Specialist Jake Golden, a member of the Cherokee Nation, stated, “We must walk two paths: the mainstream path and the Native path.” As Native American communities work to exercise their sovereignty and bolster their water security in the face of climate change, a greater level of participation in the dominant culture is necessary. As Rod Lewis’ life and career demonstrate, walking the path between two worlds can lead to tremendous accomplishments.

Traditions often underscore the bond between a people and their lands. As these traditions are often rooted in specific lands that may have been home for countless generations, the identity and resilience of Native people are not only connected to their history,

but also to their lands and waters. Colorado River Indian Tribes Council Member Tommy Drennan spoke to the deep connections of river Tribes with the waters upon which their ways of life are founded: “Our people grew their crops on the banks of the river, lived off the animals and the bounty that were maintained by the river’s ecosystems. Our songs and stories are tied to the river, and our historical methodology of sustaining life and agriculture in an arid desert environment are preserved within them.”

On the Hopi Mesas, Michael Kotutwa Johnson’s practice of traditional Hopi dryland farming has linked him to his ancestors and their lands. These farming techniques evolved over millennia to preserve soil moisture as a response to arid conditions, allowing growers to continue to farm and find bounty in the same lands for countless generations.

In addition to applying their allotment of Colorado River water directly to domestic, commercial, or agricultural uses, the GRIC has elected to create a series of Managed Aquifer Recharge (MAR) projects where Central Arizona Project (CAP) water is used to replenish groundwater supplies. To support the community’s water needs, the projects pump stored water from rehabilitated wells. Additionally, the flagship project, MAR 5 (cover photo), saw Colorado River water delivered by CAP directly into the channel of the Gila River, creating an active riparian habitat and returning flowing water in this stretch of the river. Rod Lewis’ daughter Katherine Lewis described the impact of the restored Gila River flows on the community:

“With the opening of the MAR 5, those of you who happened to be there, you saw firsthand the resiliency of our people and the spiritual tie of the water to our people. We had community members who wanted to touch the water, feel the water, because they hadn’t seen it in so long, and they were so appreciative of having it back in such a beautiful environment. We are a river people, and it was a reawakening of ourselves as a river people, with this water being returned back to our community.”

Revitalization of the river has led to a new sense of identity among GRIC members that today’s Tribal leaders hope to continue to develop in future generations.

Resilience

Resilience is a multifaceted concept that expresses itself differently in each Native community. At its core, resilience refers to the ability of a person or community to continue to thrive during and after disruptive shocks. Percy Deal, Tó Nizhóní Ání board member, spoke of the role his parents and grandparents played in preparing him “for [a] life challenge, before it happens, during, and after. To be prepared for the unexpected. When it happens, how to handle it, how to resolve it, and understand why it happened.”

One academic conception of Tribal resilience, described by Karletta Chief, involves identifying factors that contribute to a household’s or community’s ability to respond positively to an exogenous disruption. Thus, from Tribal perspectives, resilience frequently includes carrying the culture and traditions of ancestors into the future.

Chief described her grandmother maintaining her livelihood when coal mining destroyed her land and contaminated its water. She spoke of her parents

Australian Aboriginal Scholarship on Resilience

“[Indigenous resilience] is the ability to have a common connection and belonging to one’s land, family and culture: therefore, identity. Resilience allows the pain and suffering caused from adversities to heal. It is the dreaming, where the past is brought to the present and the present and the past are taken to the future. Resilience is a strong spirit that confronts and conquers racism and oppression, strengthening the spirit. It is the ability to thrive not just survive in today’s dominant culture.”



Marion Kickett, an Aboriginal scholar and educator, conducts research on the resilience of Aboriginal Australians and seeks to understand why many Aboriginal people are unable to live in two cultures successfully. A Noongar leader from the Balrdong language group, Kickett was born in York, Western Australia, and grew up on the

York Aboriginal Reserve, impoverished but surrounded by extended family. She draws personal resilience from her family’s traditional lands, her family, her identity, her spirituality, her culture, and her education, as well as from the various adversities she has encountered throughout her life. Her work as director of the Centre for Aboriginal Studies at Curtin University Perth includes an effort to define resilience from an Aboriginal perspective and establish links between Indigenous resilience with physical and mental health. Her definition is useful in considering the role resilience plays among colonized Indigenous cultures worldwide. From conversational group interviews with Aboriginal people across Australia, a method rooted in the oral traditions of Indigenous Australians, she drew out a definition of Indigenous resilience as a continuous process through which one’s sense of culture and identity is cultivated based on positive factors, while negative factors such as anger, oppression, shame, and racism are let go.

maintaining their language and culture despite being taken from their homes and made to attend American Indian boarding schools thousands of miles away. Throughout these hardships, Chief’s family preserved their traditions and passed them on to her. She attributed their resilience to the connection they had with their ancestors, echoing Marion Kickett’s conclusion (see sidebar) that the adversities faced by colonized



COVID-19 Spotlighted the Failures of Water Infrastructure on the Navajo Nation. Source: Crystal Tulley-Cordova <https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/pdfs/Crystal-Tulley-Cordova-WRRC-2021-Conference.pdf>

Indigenous peoples further strengthen their sense of resilience.

While anecdotes paint a picture of the foundational elements of Tribal resilience, a body of academic work led by Native researchers is helping to define Indigenous resilience. Chief identifies five categories of factors that contribute to Tribal resilience at the household, community, or Native Nation levels: socioeconomic, political, infrastructural, environmental, and spiritual/cultural. The impact of an exogenous shock to an Indigenous community depends on how robustly supportive factors in these categories are established. The recent outbreak of COVID-19 on the Navajo Nation provides an example in which the lack of developed water delivery infrastructure adversely impacted the ability to respond to the pandemic in the short term. The effects of and responses to COVID-19 on the Navajo Nation highlight the urgent need to develop the resilience factors that equip Indigenous peoples to navigate future adversities.

WATER RIGHTS AND SETTLEMENTS

The progress in establishing legally defined Tribal water rights, represented by the 2004 Arizona Water Settlements Act, did not occur in a vacuum. It resulted not only from the tremendous work and dedication of Rod Lewis and others, but also from significant legal precedent and water settlements dating back to the early 20th century. The Constitution of the United States authorizes the President to enter into treaties with the advice and consent of the Senate; and these treaties, along with congressional legislation and executive orders, recognize Tribes' rights within the U.S. legal system. Treaties are grants of rights from tribes, with concomitant reservations of rights - to land, water, and resources like hunting and fishing - by tribes. Treaties

and the establishment of Tribal reservations provided the legal structure from which various court cases involving federally recognized tribes, and the decrees, settlements, and congressional actions resulting from them, have been possible.

Legal precedent continues to play a crucial role in advancing equitable solutions to Tribal complaints. Because of the influence of this legal history on current issues, they are worth exploring at length.

Two significant early cases were *U.S. v. Winans* (*Winans*, 1905) and *Winters v. U.S.* (*Winters*, 1908). *Winans* focused on fishing rights and *Winters* focused on water rights. Together, these cases created precedent that the reservation of Tribal lands implied the reservation of associated rights. *Winans* involved lands along the Columbia River ceded in a treaty by the Yakima Nation, which retained rights to use of the lands. The court's ruling, as articulated by Heather Whiteman Runs Him, director of the Tribal Justice Clinic at the University of Arizona James E. Rogers College of Law, "established the principle that a treaty is not a grant of rights to the Indians, but a grant of rights from them," and Tribes retain all rights not otherwise specifically enumerated in the treaty. This ruling provided foundational support for what would come to be known as the Reserved Rights Doctrine, which has been used since to assert federal and Tribal reserved rights to water.

Winters dealt with a dispute that arose over "non-Indian water" diversions occurring upstream of the Fort Belknap Reservation in Montana. The reservation had been established by a treaty that did not specifically enumerate water rights. The Supreme Court's ruling noted a "conflict of interpretation" and determined that terms of treaties are to be construed in the way the "Indians" would have understood them. This ruling established the *Winters* Doctrine, which fixed the priority date of Tribal water rights as the date a reservation was established, making them almost always the oldest (most senior) water rights in western basins.

Arizona v. California further developed the *Winters* Doctrine decades later (1963). In that case, the U.S. Supreme Court rejected the idea that Tribes must have signed a formal treaty with the United States to have a water right. The court found that the nature of reserved rights was consistent across reservations, even if they were established by agreement or executive order after the United States had ceased making treaties with Tribes.

Arizona v. California is also notable for articulating the "practically irrigable acreage" (PIA) standard as a metric for quantifying Tribal water rights on the assumption that Native people would be farmers. Thus, it should be unsurprising that Native producers make up 60 percent of the agricultural producers and manage 80 percent of the farmland in Arizona. The PIA standard was modified through a later reinterpretation of *Winters* described below.

STATUS OF TRIBAL WATER RIGHTS IN ARIZONA

SETTLED OR DECREED

- Cocopah Indian Tribe (AZ v. CA, 1963)*
- Colorado River Indian Tribe (AZ v. CA, 1963)*
- Fort Mohave Indian Tribe (AZ v. CA, 1963)*
- Quechan Indian Tribe (AZ v. CA, 1963)*
- Ak-Chin Indian Community (1978/1984)
- Salt River Pima-Maricopa Indian Community (1988)
- Fort McDowell Yavapai Nation (1990)
- Yavapai-Prescott Indian Tribe (1994)
- Pueblo of Zuni (2003)
- Gila River Indian Community (2004)
- White Mountain Apache Tribe (2010)

NOT YET FULLY SETTLED OR DECREED

- Navajo Nation (Partial, 2005, 2020) (LCR Adj.)
- Hopi Tribe (LCR Adj.)
- San Juan Southern Paiute Tribe (LCR Adj.)
- Pascua Yaqui Tribe (Gila Adj.)
- San Carlos Apache Tribe (Partial, 1992) (Gila Adj.)
- Tohono O'odham Nation (Partial, 2004) (Gila Adj.)
- Tonto Apache Tribe (Gila Adj.)
- Yavapai-Apache Nation (Gila Adj.)
- Havasupai Tribe (Gila Adj.)
- Hualapai Tribe (Partial, 2014)
- Kaibab Band of Paiute Indians

*Refinements and adjustments to AZ v. CA were made in 1964, 1966, 1979, 1983, 1984, 2000, 2006

Gila Adj: Gila River Adjudication

LCR Adj: Little Colorado River Adjudication

TABLE 1. Status of Tribal Water Rights in Arizona. Source: Modified from Robyn Interpreter
<https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/WRRC-Pre-Conference-Interpreter-8-13-21.pdf>

Another pivotal Tribal water rights case, *The Confederated Tribes of Colville Reservation v. Walton* (Walton, 1981), centered on establishing the priority date for the water rights of individual Tribal members. The case applied the 1952 McCarran Amendment, congressional legislation that allowed the U.S. to be made subject to the jurisdiction of state courts, including for the adjudication of Tribal water rights. This ensured that, if a stream adjudication was already underway in state court, a federal court would not later step in to adjudicate on its own. In *Walton*, the state court recognized that the water rights of individual allottees (Tribal members who had been allotted water from the Tribe's water right) have the same priority date as the Tribe's water right.

Two major water rights adjudications, the Little Colorado River and the Gila River respectively, began in the 1970s, with the goal of quantifying the rights to use appropriable water from these two rivers and their tributaries. These cases include federal claims for water for Tribal reservations along with claims of many non-Native water users. These adjudications, which are ongoing, have included many decisions that affect Tribal water rights. During the adjudication of the Gila River and its tributaries, the court relied on the conclusion of Justice Joseph McKenna in the *Winters* case that the purpose of a federal American Indian reservation is to serve as a "permanent home and abiding place" for the people living there. Because reservations need water for domestic use, irrigation, Tribal development projects, other economic uses, and any traditional cultural practices and religious uses, water sufficient for these uses is reserved. In addition, the Gila River adjudication extended federal reserved water rights to some water that had been considered groundwater under state law.

This history of litigation, adjudication, negotiations, and congressional actions has had a tremendous impact on many Native communities that previously had experienced disputes and uncertainty over water entitlements. As a result of negotiation and adjudications, 14 Arizona Tribes have settled or decreed water rights. As of August 2021, 11 other Tribes are still working to secure quantified water rights (see Table 1).

One example of the effects that water settlements have on Native communities comes from Rod Lewis' own community. In accordance with the 2004 Arizona Water Settlements Act, GRIC holds the largest entitlement of Colorado River water delivered to any entity via the CAP canal. This entitlement has enabled GRIC to plan and implement a strategy for restoring the community's economic vitality and Gila River heritage.

When the promise of federal funding plays a role in reaching agreement, as is usually the case, water settlements and consequent congressional actions have two major stages. The first is the settlement itself, consisting of the agreement among the state, federal, and Tribal parties, as spelled out in legislation approved by Congress. The second is "appropriation" by Congress of the money the tribe requires to take possession and make use of the water. Congressional follow-through is often needed before a settlement can yield its promised resilience and long-term sustainability.

One example of this two-part process is the water rights history of the White Mountain Apache Tribe, whose lands are located on the major headwaters of the Salt River—a vital supply of water for agriculture and domestic use in and around the Phoenix Metropolitan area. Disputes over Salt River water continued throughout a century of conflict between the Tribe and downriver water users. Lacking resources for infrastructure to store

KEY LEGAL CASES FOR TRIBAL WATER LAW

Case Name	Decision	Tribes	Key Conclusions
U.S. v. Winans	1905	Yakima Nation	Tribes retain all rights not relinquished in the treaty
Winters v. U.S.	1908	Fort Belknap Reservation	Priority date of Tribal water right is date that reservation was established; treaties to be construed as the “Indians” would have understood them
Arizona v. California	1963	Various Colorado River Tribes	A signed a formal treaty with the U.S. not needed for Tribes to have a water right; “practicably irrigable acreage” (PIA) water right quantification standard
The Confederated Tribes of Colville Reservation v. Walton	1981	The Confederated Tribes of Colville Reservation	1952 McCarran Amendment (1952) applied to adjudication of Tribal water rights in state courts; individual allottees with water rights have same priority date as Tribe
General Stream Adjudications of All Rights to Use Water in the Gila River System and the Little Colorado River System	Ongoing	Various Arizona Tribes	1999: federal reserved water rights extended to some water considered groundwater under state law; 2001: “permanent homeland” standard reserves sufficient water for domestic use, irrigating arable lands, Tribal development projects, other economic uses, traditional cultural practices, and religious uses

TABLE 2. Chronology of Significant Legal Decisions and Key Conclusions Relevant to Tribal Water Law. Source: WRRRC

and distribute water, the Tribe watched its water flow away. As the city of Phoenix grew, the White Mountain Apache faced water outages and declining water quality. In 2009, the Tribe entered into a Water Rights Quantification Agreement with nine cities in the Phoenix Metropolitan area, several major water stakeholders in the area, including irrigation districts, and the state of Arizona. This settlement agreement prompted the U.S. Congress to pass the 2010 White Mountain Apache Tribe Water Rights Quantification Act, which authorized, among other things, funding for the development and operation of a sophisticated water delivery network on the White Mountain Apache Reservation. Named the White Mountain Apache Rural Water System, this delivery network, when completed, will include a dam and accompanying storage reservoir, a pumping plant, water treatment facilities, and over 50 miles of pipeline for distribution. Without the 2010 settlement and subsequent congressional appropriations, none of this infrastructural development would have been within the Tribe’s financial capability. Now, for the first time, all communities on the Tribe’s lands will be provided with a secure supply of safe, clean drinking water, and there is hope that the system will provide additional commercial and recreational benefits. The water system is an essential step toward Tribal water resilience for the White Mountain Apache. In a future characterized by climate extremes and water variability, the 2010 settlement should ensure a long-term and reliable water supply for current and future generations.

PARTNERSHIPS

Across Arizona, partnerships among Native and non-Native entities have been essential to the achievement of water resilience goals. These

partnerships may take many forms, including cooperative agreements between Native communities, participation in Tribal organizations, and collaborations with both public and private non-Native entities. Expressing sentiments shared by other Tribal leaders, Navajo Nation President Nez emphasized that dealing with water issues requires collaborative efforts. The passage of the 2004 Arizona Water Settlements Act, the development of the White Mountain Apache Tribe’s water delivery infrastructure, and the establishment of the MAR 5 wetlands are three examples of achievements that would have been much more difficult, if not impossible, without strong partnerships.

Inter-Tribal partnerships play a crucial role in cultivating resilience and accomplishing community goals. For example, Tribes, including the Navajo Nation and Colorado River Indian Tribes (CRIT), aided the Hopi when flooding created a state of emergency on the reservation. The Native American Rights Fund (NARF) is another example of inter-Tribal partnerships. NARF was founded in 1970 to provide legal expertise and support to Tribes, Native organizations, and individuals who might otherwise have been unable to afford adequate assistance or representation. The organization formed and governed by members of various tribes, has successfully represented the interests of Native American communities in hundreds of major cases.

John Echohawk, a NARF founder and contemporary of Rod Lewis, knew water rights would be among the principal legal issues faced by Native communities throughout the country. The establishment of NARF ushered in numerous successful suits upholding treaty rights that had been suppressed or ignored. Since its foundation, NARF has provided legal support for more than 275 Native groups and contributed to the

development of influential Indian law principles and precedents.

In addition, instances of successful partnerships between Native communities and non-Native entities are plentiful. A well-known example concerns the COVID-19 pandemic, when the Navajo Nation worked closely with



Integrating Drip Irrigation Technology into CRIT Irrigation Practices is Increasing Water Use Efficiency. Source: Joshua Moore <https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/pdfs/Joshua-Moore-WRRC-2021-Conference.pdf>

multiple non-Native entities to build 59 transitional water points to serve communities at greatest risk of viral infection because they lacked access to running water for sanitation. These partners included the U.S. Department of Health and Human Services, the University of Arizona, and Johns Hopkins University, among others. The Navajo Nation also has worked with the U.S. Geological Survey for years to monitor and describe aquifers on Tribal lands. In La Paz County, CRIT partners with CAP, the University of Arizona, and the micro-irrigation company N-Drip to develop practices that will improve irrigation water efficiency. The partnership with N-Drip has involved CRIT farmers in the development of new knowledge about irrigation water efficiency, which in turn is expected to ease the transition away from flood-based irrigation.

In addition, common Native and non-Native goals can be achieved through partnerships. GRIC and CRIT are currently working with the U.S. Bureau of Reclamation, CAP, and the Arizona Department of Water Resources (ADWR) under Arizona's implementation plan for the Colorado River Basin Drought Contingency Plan (DCP) to actively conserve and store water in Lake Mead, reducing the probability of severe shortage. GRIC also is partnering with the Salt River Project on a program of aquifer storage to create water credits for those developers and water providers who must show ADWR they have rights to a sufficient quantity of water for planned growth.

A SEAT AT THE TABLE

Until recently, Native peoples were not routinely invited to participate in high-level discussions involving water issues in Arizona. During the drafting of the 2007 Colorado River Interim Guidelines for Lower Basin Shortages, later augmented by the DCP, Native tribes were not among the agencies and organizations invited to the negotiating table. Instead, the Bureau of Indian Affairs acted as liaison with Tribes that held claims to Colorado River water. In the 15 years since, Tribal involvement has increased in developing solutions to the myriad water problems faced by western states.

Contributing to Policy Solutions

As conflicts between Native tribes and non-Native water users have given way to negotiations or adjudications, Tribes throughout the region with secure quantified water rights have become essential participants in policy discussions.

Tribal Sovereignty

Tribal sovereignty is a critical concept that many people outside of Tribal communities do not understand. Tribes have a right to self-determination, and it is through their inherent sovereignty that they enjoy this right. Tribal sovereignty underpins the capacity to take actions that further community values. It empowers Tribes to decide what is important to them and then design and implement action plans based on those decisions. Hopi Tribe member Carrie Joseph described Tribal sovereignty as the ability to practice and continue to express “who we are as Hopi people” without interruption and without interference from external policies.

Tribal sovereignty is interpreted not only as a right, but also as an obligation. Fort Mojave Indian Tribe Chairman Timothy Williams expressed the generally shared conviction that, as sovereign Tribes, “we have to take care of our own with our own.”

The history of Tribal sovereignty in the United States is contentious. Although Tribal sovereignty is implicit in the U.S. Constitution, in practice Tribes often have found themselves unable to actualize their sovereign rights. The conflict between Tribes' right to self-determination and restrictive federal and state legislation has existed since the founding of the United States. Over time, mistrust has characterized relations between Indigenous populations and the populations that displaced them.

Efforts continue to define statutory and regulatory jurisdiction on issues relating to the land and people of sovereign Tribes. For example, tribes are challenging rules found in some congressionally enacted water settlements that impose restrictions on off-reservation use of Tribal water. Efforts, like these, to remove restrictions on Tribal sovereignty are playing out through litigation and negotiation, as well as through the legislative process. In fact, the quickest way to remove some water use restrictions may be through convincing lawmakers to change the law.

An example of the shift toward Tribal inclusion in policy planning occurred in 2014, when Reclamation initiated a collaboration with the Ten Tribes Partnership, a coalition of Upper and Lower Colorado River Basin Tribes, to produce the Colorado River Basin Ten Tribes Partnership Tribal Water Study. The goal of the study was to learn the perspectives and positions of each of the ten partner Tribes as a vital followup to Reclamation's 2012 report on Colorado River water demand and supply, which lacked Tribal participation. Reclamation Commissioner Camille Calimlim Touton described honoring Tribal relationships as "paramount to the mission of the Bureau of Reclamation." The 2009 Water Rights Quantification Agreement between the White Mountain Apache Tribe and various stakeholders in the Phoenix Metropolitan area put an end to over a century of dispute over water and paved the way for funding and constructing essential infrastructure on the White Mountain Apache Reservation.

The presence of representatives from CRIT, GRIC, and the Tohono O'odham Nation during the drafting of the DCP was a major step toward ensuring Arizona Tribes have a seat at the negotiating table. During the DCP negotiations, both GRIC and CRIT worked toward acceptable solutions with government agencies, farm associations, water and energy organizations, business advocacy groups, and irrigation districts from across the Southwest. While these negotiations were not always harmonious, they resulted in a robust framework for dealing with ongoing drought in the Colorado River's Lower Basin. In total, the basin-wide Colorado River agreement included Mexico, all seven Colorado River Basin states, and Reclamation. Of the negotiations, then-Arizona Senator Martha McSally said, "It has never been more important for Tribal, state, and other stakeholders to work together to address shared challenges—like protecting the water supply for millions of people. The DCP agreement serves as an example of the progress that can be made when stakeholders come together to tackle critical issues."

Speaking to the importance of Tribal representation in high-level discussions concerning the Colorado River, CRIT Tribal Council Chairwoman Amelia Flores remarked, "We must remain active and vocal for what we want for our people and for the life of the river." Arizona Native people are keenly aware that, despite recent strides, maintaining their position as equal negotiating partners will require continued assertion of their voices and their rights. For example, Flores maintained that saving the life of the Colorado River requires direct and immediate action. It is only through maintaining a seat at the table that CRIT will be able to secure federal legislation to overcome restrictions on rights to develop and protect environmental resources on its lands. GRIC Governor Stephen Roe Lewis amplified Flores' sentiment when he stated it is necessary to have Native Americans



U.S. Bureau of Reclamation Commissioner Camille Calimlim Touton Speaking at the WRRRC 2021 Annual Conference. Source: WRRRC

involved in every aspect of local, state, and federal policymaking and governance.

Integrating Traditional Knowledge

As climate change strains already overallocated western water supplies, Tribes may hold the keys to regional water sustainability. Around the world, Indigenous peoples make up less than 5 percent of the world population and protect 80 percent of global biodiversity on a mere 25 percent of the planet's land. These pockets of biodiversity can be protected by creating conditions in which Indigenous cultures can survive. Hopi farmer Johnson, who holds a Ph.D. from the University of Arizona, said, "We need to listen to [Indigenous people]. The dominant culture has been trying this and that, but without the help of Indigenous people, I don't know if they'll ever be able to solve some of these environmental problems." The cultures that have supported this biodiversity for millennia have much to teach dominant cultures around the world, but they can only do so if their voices are heard.

Water hauler and former Navajo County Supervisor Percy Deal echoed these sentiments, "Having Native Americans consistently at the table will help everyone come together to overcome these [water] issues."

NARF Executive Director John Echohawk said tribes will be involved in addressing the crisis caused by climate change. Describing his father's thoughts, Rod Lewis' son John B. Lewis underscored the fact that "climate change is real and climate action is necessary on the part of Tribes and Tribal communities." Tribal reservations are usually remote and without commercial development, making them particularly vulnerable to climate shocks such as drought and flooding. Native American communities will always be among the first to be adversely impacted by global climate change. Selso Villegas, executive director of water resources for the Tohono O'odham Nation, said of Mother Earth, "We are giving our mother a fever," and we owe her better care. Only through maintaining the ability to advocate for themselves and the environment can Native Americans integrate their vital contributions

into efforts to mitigate the adverse impacts of climate change.

VISION – HOPES, WARNINGS, AND EXHORTATIONS

After all that has come before, what comes next? The answer depends on the extent to which Tribal sovereignty governs the development of plans and actions, the amount by which partnerships among Native communities and between these communities and non-Native groups can contribute to advancing shared goals, and the degree to which a plurality of pathways to resilience are encouraged. While Arizona Tribes have made tremendous strides in the last 50 year in terms of self-determination, water resilience, and participation in policymaking, they continue to face immense water challenges.

These challenges are driven chiefly by a lack of essential services on Tribal lands and are exacerbated by a changing climate. Drought is the most apparent — but not the only—climate-related water difficulty threatening Native communities in the arid Southwest. As mentioned earlier, the Hopi Reservation experienced extensive flooding in 2021, leading Chairman Timothy Nuvangyaoma to declare a state of emergency. The incidence of intense and damaging flood events is likely to increase in the future as weather patterns become more erratic. In the coming decades it will fall to succeeding generations to continue the work of those who came before them: building water resiliency and carrying on the traditions of their ancestors.



Hopi Farmer Shares His Knowledge with the Next Generation. Source: Michael Kotutwa Johnson <https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/pdfs/Michael-Kotutwa-Johnson-WRRC-2021-Conference.pdf>

Blessings for Water

by Ofelia Zepeda

I've imagined the Gila River as it ran through the desert with all its bounty
Where today the children say they can hear the river running
I've touched the waters of the White River in eastern Arizona
And I have put my foot in the slow currents of the San Pedro
I have ridden the waves of the Colorado and rested on its flows
Paying homage to the deities and spirits that call the canyons home
I've seen the Rio Grande run rapids in the north and meander through the flats of southern New Mexico, where whooping cranes rest on their way home
I've lived in a place called Red River where there was no river, but was named for a movie
I live near the Rillito River, a river named twice, a river that can flow with the best during rainy winters and rich summer monsoons
A dry riverbed most of the year, harboring the homeless and those alone
As for large bodies of water, we must pray at their feet and give gifts
I have done so and record them here to be witnessed
I have offered blessings at the Pacific Ocean in San Diego, Los Angeles, La Jolla, and Ventura Beach, surrounded by vacationers and dogs chasing frisbees
I've offered a prayer at a dry, hot desert beach at the Gulf of California, with only Mexican fisherman caring for their nets as my alibi
I've humbled myself on the black beaches of Hawai'i, twice on the beach at Waikiki, oblivious to bronze bodies and surfers who would testify
I've offered blessings only once at the Atlantic Ocean, at Martha's Vineyard, with a woman who shook a language from sleep as my witness

A related concern is diminished flow in the Colorado and other rivers in Arizona. While their senior rights to water have placed some Tribes in a position to assume statewide leadership roles in developing water policy, Native leaders suspect that non-Native entities will eye their water as Arizona's supply diminishes. Native communities also face many challenges resulting from centuries of political and economic disenfranchisement. Many Tribes' water rights have yet to be adjudicated or settled and many Native Americans still live in homes with no access to running water, a public health threat underscored by the COVID-19 pandemic.

Looking ahead, today's Tribal leaders, like Rod Lewis before them, understand that teaching younger generations the importance of water is crucial to building a water-resilient future. Native leaders are interested in formalizing mentorships between community members with expertise in fields like law, policymaking, and water engineering and young Tribal members just beginning to assume their roles in the community. John Lewis emphasized the importance of mentorships, saying it is "always in our best interest to create positions and support our own people. That will be how we get things done."

Modeling the resiliency of their elders and their land can empower young Tribal members to learn about and protect their natural resources and build Tribal knowledge and capacity for the future. Katherine Lewis, echoing the sentiments of her father and brother, emphasized the importance of showing the younger generations what is possible by recognizing and modeling the dedication and purpose of older generations. Jesse Navarro, a specialist in government affairs for the Tohono O'odham Nation, said, "We need to pray for our strengths, the water, the safety, and the health of our people. We need the younger generation to get educated and to understand the sacred element of water. We need to advocate for the rights of water."

Possession of legally robust, quantified, and extremely senior water rights have put Tribes in a position to shape water policy in Arizona and throughout the West for decades to come. In addition to the central policy position given by their settled and decreed water rights, Native communities have seen a shift in recent years to greater mainstream acceptance of Native ways and greater attention to Native voices in mainstream culture. The next generation of Native leaders may well find their impact extending far beyond the borders of their communities and exercising substantial influence over dominant cultural attitudes toward water management. Navajo leader Percy Deal, retelling his father's story, said, "The Creator, after making Mother Earth, [gave] instructions to Diné telling them ... always remember you do not own the land... The land belongs to the Creator. You are only a steward... Should you not follow these instructions, there will be consequences." These include drought, water shortages, wildfires, climate changes, and coronavirus, Deal added. Many people outside of Native communities now seem prepared to learn those lessons.

Today, new forms of Tribal resilience are created through the reconciliation of Native knowledge and

spirituality with science. Governor Lewis said, "The community believes that the only way to address difficult issues like drought is through innovation." A new generation of Native American professionals is well placed to innovate water management. Just as Rod Lewis had hoped, a growing number of these young professionals in the fields of law, water policy, natural resources management, and engineering are beginning to integrate Indigenous perspectives with these disciplines. When calling upon younger generations to retain Tribal seats at crucial negotiating tables, Echohawk said the time has come for Native Americans to "get educated and be ready to deal with these issues at the legal and technological level." He continued, "Tribes will need them. We need all the help we can get. Our people are well-equipped to [deal with these issues] if they get that education, because they will be crucial to our future in the West."

Chairwoman Gwendena Lee-Gatewood of the White Mountain Apache Tribe said, "We owe it to [children] to guide, protect, and nurture them to be sure that this next generation is strong and will care for the resources that we have. Our Creator then also will bless us

for teaching his children, and life goes on as we know it."

For Arizona's Tribes, the future looks both promising and challenging. To navigate through conditions that reflect a lingering legacy of colonialism and worsening climate change will take vision and persistence. Fortunately, in recent decades, Native peoples have had cause for optimism. By maintaining strong connections to history, tradition, and culture; by encouraging the professional development of their young people; and by continuing to advocate for their rights, Arizona's Native communities will prevail in the face of current and future challenges and contribute to water resilience for all.



A Hopeful Sign Posted on the Navajo Nation. Source: Percy Deal <https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/pdfs/Percy-Deal-WRRC-2021-Conference.pdf>

Acronyms

ADWR: Arizona Department of Water Resources.

CAP: Central Arizona Project, which operates the canal bringing Colorado River water to Central Arizona.

CRIT: Colorado River Indian Tribes, including the Mohave, Chemehuevi, Hopi, and Navajo Tribes.

DCP: Drought Contingency Plan, an agreement among the seven Colorado River Basin states and the U.S. Bureau of Reclamation attempting to forestall catastrophic declines in reservoir levels at Lake Powell and Lake Mead.

GRIC: Gila River Indian Community, including the Akimel O'odham (Pima) and the Pee-Posh (Maricopa) Tribes.

MAR: Managed Aquifer Recharge, projects that replenish groundwater.

NARF: Native American Rights Fund, a Tribal organization that provides legal expertise and support to Tribes and Native organizations and individuals.

Reclamation: U.S. Bureau of Reclamation, the federal agency that owns and operates the Colorado River storage and distribution system.



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We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.

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Brian McGreal graduated in December 2021 with a MS in applied econometrics and policy analysis from the University of Arizona Department of Agricultural and Resource Economics. He will pursue a Ph.D. in applied economics at Oregon State University beginning in fall 2022. Since 1988, Susanna Eden has held various positions at the university's Water Resources Research Center, including 10 years as assistant director. She holds a Ph.D. from the UArizona Department of Hydrology and Water Resources (now Hydrology and Atmospheric Sciences). Taylor McHugh is a Coverdell Fellow and UArizona graduate student in landscape architecture.

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