ARROYO 2020

COMMUNITY-BASED SOLUTIONS TO LOCAL WATER CHALLENGES IN ARIZONA

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Arizona's communities, large and small, face water supply challenges that are distinct yet share common features. Communities throughout Arizona can learn from the experiences of their neighbors in tackling their own challenges. This *Arroyo* presents examples of these challenges and community-based solutions. It illustrates the themes that emerged from the Water Resources Research Center's (WRRC) 2019 conference, *Arizona Runs on Water: Scarcity, Challenges, and Community-based Solutions,* and draws on presentations and discussions from that conference along with supplemental information from conference speakers and other sources.

Introduction

Different systems of water management exist in Arizona for groundwater, Colorado River water, other surface water, and reclaimed water. Communities must navigate these differences as they seek solutions that take advantage of all available water resources and management options. Solutions can depend largely on location: local resources, uses, legal constraints, and stakeholder values.

Groundwater supplies approximately 40 percent of Arizona's water uses. Management of groundwater depends principally on whether or not the community is within an Active Management Area (AMA). AMAs comprise the most populous regions of the state, extending from Nogales on the southern border to Prescott near the geographic center of the state and include the Phoenix and Tucson metropolitan areas. Most state level groundwater management requirements apply only in AMAs.

A second level of regulation pertains to Irrigation Non-Expansion Areas (INAs), where Arizona's groundwater code limits irrigated acreage to pre-1980 levels. In the INAs (Douglas, Harquahala, and Joseph City) groundwater pumpers with non-exempt wells

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(wells that produce more than 35 gallons per minute) must file annual water use reports.

Colorado River water, which also supplies approximately 40 percent of Arizona's water uses, is primarily available along the river's main stem and within the tri-county (Maricopa, Pinal, and Pima) Central Arizona Project (CAP) service area. A limited number of Colorado River contracts are held for locations off the main stem like Quartzsite and La Paz County, and some CAP water will be made available for allocation to entities outside of the CAP service area, but these are relatively small exceptions.

Most rural communities are located outside of AMAs, although the Pinal AMA is still predominantly rural. Non-AMA Arizona also includes several metropolitan areas with populations over 50,000: Flagstaff, Lake Havasu City, Kingman, Sierra Vista, Douglas, and Yuma. For the most part, these communities rely primarily on a single water source and lack the redundant water supplies of the Central Arizona AMAs.

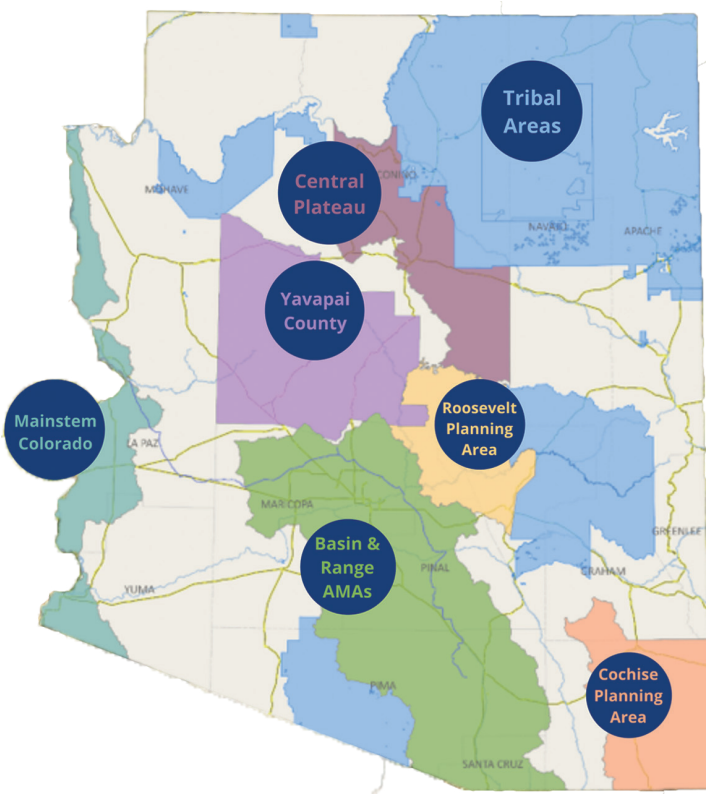
Outside AMAs, the Arizona Department of Water Resources (ADWR) has limited regulatory authority over groundwater use. Conflicts or issues that may arise are generally addressed by local entities working cooperatively. The statewide management rules that do apply include community water system reporting and well drilling regulations. While communities in AMAs have conservation mandates, pumping restrictions, and other legal guidelines for water management, other areas face both the challenges and opportunities that come with more individualistic water management.

Because about 80 percent of Arizona's population lives in AMAs, communities in the rest of the state often receive less attention. The 2019 WRRC conference and this *Arroyo* have focused on what is happening beyond AMA borders.

Context and Content

Arizona communities outside AMAs have a diverse set of climates, economies, and water issues. The regions of Arizona sampled within this *Arroyo* are shown in the map on this page. They include the Central Plateau, Cochise Planning Area, Mainstem Colorado, Roosevelt Planning Area, Tribal Areas, and Yavapai County, as well as rural Pinal County in the Basin and Range AMAs region. They are based in part on ADWR planning areas, modified to focus the discussion on unique regional issues. For example, Yavapai County includes portions of several ADWR planning areas, and Tribal Areas are not in one region but spread out across the state.

The Central Plateau has the highest elevation and the most precipitation of the highlighted regions. Groundwater from deep regional aquifers is the primary water source, although some surface water also is available. Cities, including Flagstaff and Williams, generate most of the water demand.



Map of focal regions in Arizona. Source: Gerry Walker, Statewide Arizona Water Management

Conversely, the Mainstem Colorado, stretching from north to south on the western edge of the state, has the lowest elevation, the least precipitation, and the highest average annual temperatures of the regions. Its primary water source is the Colorado River and, while groundwater exists in the area, most water pumped from wells is considered Colorado River water. With water used primarily for agriculture, the cities (Kingman, Bullhead City, Lake Havasu City, and Yuma) account for only about 10 percent of the region's water demand.

Tribal Areas include 22 sovereign tribal communities located throughout the state, with a range of climatic conditions and water sources. As sovereign entities they are responsible for managing their water independent of ADWR regulation and often deal with a unique set of challenges.

Yavapai County, Cochise Planning Area, and Roosevelt Planning Area have similar climates with moderate elevation and variable precipitation depending on elevation. Largely rural Yavapai County includes the Prescott AMA, the only AMA outside the Basin and Range AMAs region. While the Prescott AMA depends mainly on groundwater, agriculture in the region primarily uses surface water. Agricultural water use in Yavapai County recently has declined, while population is growing in the Prescott AMA. The Roosevelt Planning District utilizes mostly groundwater. In the northern part, which includes Payson, most water use is municipal, while in the southern part, which includes Globe and Miami, mining is the principal water user. The Cochise Planning Area is almost entirely reliant on groundwater.

Arizona's Tribal Areas. Source: by Gerry Walker, Statewide Arizona Water Management

Agriculture uses the most water, and irrigated acreage is increasing. The Cochise Planning Area includes the Douglas INA, Willcox, and the Sulfur Springs Valley.

The Basin and Range AMAs region, with its wide, sloping alluvial basins, includes all of the AMAs except Prescott. The Pinal AMA is sandwiched between the Phoenix and Tucson AMAs and has a groundwater management goal that reflects its largely rural character and location between two expanding metropolitan areas. Its unique management goal requires sustaining the existing agricultural economy for as long as feasible, while considering the need to preserve groundwater for future non-irrigation uses.

This *Arroyo* discusses five ways people have approached water resource problem solving: 1) conservation measures, 2) water development projects, 3) new and re-emerging ideas, 4) stakeholder collaboration, and 5) community engagement. It details specific instances in which Arizona communities used these approaches to augment water supplies, improve water efficiency, and resolve potential conflict through collaboration, vision, and commitment. The final sections briefly highlight some resources available in rural Arizona, as well as legal and policy issues that affect the ability of rural areas to deal with water challenges.

Doing More with Less

Water management through conservation is a strategy that communities often implement. It is relatively inexpensive and can be a catalyst for community engagement and education.

Bullhead City, in Mohave County, is entirely dependent on Colorado River water, with a fixed allocation and a risk of curtailment if a shortage is declared. The city has undertaken significant water resources planning. In 2016, Bullhead City published its *Water Conservation Plan*, which noted ongoing and future conservation projects. An ordinance requires drought tolerant landscaping for all new multifamily, commercial, and industrial projects. The city also mandated low-flow plumbing fixtures in new residential and commercial construction and provides an incentive for retrofitting existing residential and commercial buildings with low-flow fixtures. Rebates are available for replacing turf with low water use landscaping, purchasing high efficiency toilets and washing machines, and using smart irrigation controllers. These efforts are estimated to have saved approximately 2,000 acre-feet of water per year since their implementation, an amount expected to accumulate year–over–year and increase with further retrofitting.

With a strong portfolio of long-standing conservation measures, Flagstaff continues to seek out new conservation opportunities. Its existing programs include free residential water check-ups, residential landscape and appliance upgrade rebates, commercial appliance upgrade rebates, rainwater container distribution, and a conservation certification program for businesses. The city also operates an extensive reclaimed water system. In 2018, Flagstaff started drafting a quantitative conservation optimization plan by comparing projected water savings from various conservation actions with their costs. The Proposed Optimized Conservation Program augments the existing program with smart metering, a landscape rainwater code, revised toilet rebate, showerhead/faucet code, school retrofits, and outdoor water budgeting for large lawns. Yielding potential 20-year water savings of 690 acre-feet over the existing conservation program, the optimized program delays the need for new water supply by about six years.

Across Arizona, agriculture offers important opportunities for water-use reduction. Yuma County has some of the most intensively farmed acreage in the country and supplies most of the head lettuce consumed in the United States in the winter. As a consequence, the average value of an acre of farmland in this area is among the highest in the country. Well-endowed with Colorado River water rights, Yuma County agricultural land generally supports two crops, such as lettuce and wheat, in alternating seasons. Converting to high-value winter vegetables, avoiding summer irrigation, and decreasing overall irrigated acreage have caused Yuma's agricultural water use to decline 15 percent since 1990. Many farms also have committed to upgrading their irrigation infrastructure to improve water use

Aerial photograph of Yuma County agriculture. Source: Gerry Walker. Statewide Arizona Water Management

efficiency. By one metric—the ratio of harvestable yield to evapotranspiration—average water use efficiency has doubled in Yuma County over the past 40 years.

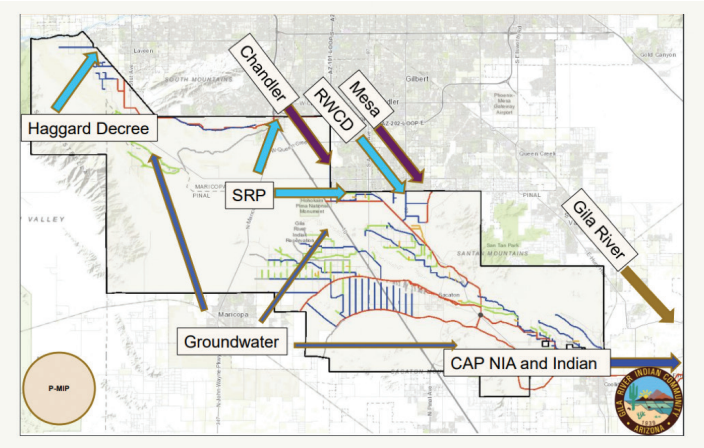
Developing Water Infrastructure Projects

Although often the most costly option, infrastructure projects that conserve, reclaim, and store water have contributed substantially to ensuring an adequate water supply for Arizona communities. New projects may be needed as water from existing reservoirs and aquifers is depleted, and groundwater pumping and stream diversions reduce stream flows.

The Gila River Indian Community (GRIC) uses nine different sources of water, each with a different quantity, quality, reliability, and cost. The goal of the GRIC is to manage its resources conjunctively to achieve a sustainable balance of groundwater and surface water. The Gila River is the least reliable of the community's sources. To help restore the river and balance water supplies, the GRIC constructed the Olberg Dam Underground Storage Facility. Their ADWR permit enables the GRIC to accumulate long-term storage credits that can be sold to generate revenue. The full-scale permit, issued in April 2018, allows the facility to operate until 2028 and store up to 200,000 acre-feet of water. The GRIC has constructed a second managed aquifer recharge project, which has undergone storage testing and was awaiting permit approval by ADWR in 2019.

About 75 miles northeast of the GRIC, the Town of Payson occupies rocky terrain with few local opportunities for water development. The town operates 43 wells, which tap their limited groundwater supply. Local groundwater cannot support the growth Payson is experiencing. Over the years, the town has taken a comprehensive approach to ensuring an adequate water supply. To the extent possible, the city has enacted strict conservation requirements for new development. In addition, after the wastewater treatment facility was upgraded in 1989, Payson started work on the Green Valley Park water reclamation project to capture the value of its wastewater. Since the park's completion in 1998, a leaky bottomed lake in Green Valley Park recharges approximately 400 acre-feet per year, or roughly a quarter of Payson's municipal water use.

Payson also invested in obtaining water from the C.C. Cragin Reservoir, formerly known as Blue Ridge Reservoir, 25 miles away. A $54–million investment financed rehabilitation of the approximately 50-year-old reservoir, as well as construction of a 15-mile-long pipeline and a new treatment plant to deliver and treat the reservoir water. The effort began in 1994 and construction started in 2008 with financial and technical assistance from the Water Infrastructure Finance Authority and the US Bureau of Reclamation. The new treatment plant began operating on June 1, 2019, and water distribution started in July.



Gila River Indian Community water sources. Source: David Dejong, Gila River Indian Community: Innovative Solutions to Manage Multiple Water Resources

In Mohave County, two smaller water projects are ongoing in Kingman and Bullhead City. Kingman is located in the Hualapai Basin, where water use quadruple in one year, from 8,000 acre-feet in 2015 to 32,000 acre-feet in 2016, due to new agricultural development. Since 2017, Kingman has been developing a recharge project that uses an injection well to pump reclaimed water from its wastewater treatment plant into the aquifer. The project replaces approximately half of Kingman's estimated 3,000 acre-feet of groundwater overdraft. Bullhead City operates a pilot program to add reclaimed water from its wastewater treatment plant to the Colorado River's groundwater zone through two injection wells.

C. C. Cragin Reservoir. Source: USDA's Forest Service

This is water that previously had evaporated from wastewater ponds. In the four years after its opening in September 2017, it is expected to introduce 8,800 acre-feet of water to the Colorado river system as a hedge against shortage.

The Cochise County Conservation and Recharge Network aims to sustain the San Pedro River through aquifer recharge. The network exists as a partnership among Cochise County, the Town of Bisbee, the City of Sierra Vista, The Nature Conservancy, and the Herford National Conservation District. Through the combined efforts of these entities, seven recharge sites are being developed along the San Pedro River from Tombstone to the U.S.-Mexico border. These include sites for effluent and stormwater recharge and erosion control. The projects have demonstrated the effectiveness of relatively inexpensive infiltration technology, and hydrologic response monitoring and modeling indicates that the projects will sustain baseflow in the San Pedro until 2075.

Thinking Outside the Box

After communities use the more traditional tactics of conservation and reclaimed water, they look for new solutions that suit their distinct needs and constraints. Strategies such as rainwater capture, groundwater remediation, and alternative industries are emerging in rural Arizona.

The sudden, recent increase in water usage in the Red Lake area of the Hualapai Basin galvanized Mohave County to implement a rainwater harvesting project that enhances aquifer recharge. Instead of allowing the rainwater to evaporate, the county's washes have been modified to slow water flow and thus increase groundwater recharge. This strategy not only mitigates overdraft, it also improves the health of the watershed.

Looking to exploit every possible water source, Payson developed a project that involved pumping and treating approximately 360,000 gallons per day of groundwater that had been contaminated with dry cleaning fluid and gasoline. The treated water was originally recharged, but upgrades to the treatment system from 1998 to 2013 allows the treated water to be delivered to the drinking water system.

Lake Havasu City, another Mohave County community entirely dependent on Colorado River water, has pursued aquifer recharge with reclaimed water. Unlike Bullhead City, however, Lake Havasu City could not recharge directly to Colorado River groundwater zone because its treatment plant is too far from the river. Instead, it pumps reclaimed water into a depression, located in mountains northeast of the city, allowing the water to seep underground to join the river system.

Working to solve water challenges outside of municipal areas, the University of Arizona's Dr. Karletta Chief received a $3 million National Science Foundation grant to develop a workgroup for indigenous food, energy, and water systems within the Navajo Nation. She is working alongside graduate students to develop more efficient methods of subsistence agriculture and off-grid devices for energy production and water purification. To ensure the project is a partnership, the graduate students live in a Navajo community for weeks at time to immerse themselves in the problem and work alongside community members.

The burgeoning Arizona wine industry presents an alternative to the types of farming typically associated with Arizona. Wine grapes grown on 1,650 acres in Arizona in 2019 generated an estimated $33 million while using 1,500 acre-feet of water. This translates to roughly $22,000 per acre-foot. For comparison, cotton generated approximately $245 per acre-foot of water in 2017. Of course, the conditions needed for vineyards differ from those for cotton, and in most cases vineyards would not replace cotton fields.

Working Together

Collaboration among different stakeholders can often reveal mutual goals and lead to mutually beneficial outcomes. Water development efforts across the state have relied on partnerships to achieve the scale necessary to justify and finance projects and efforts to restore the environment, while bolstering community resilience and economic development.

To use the restored C.C. Cragin Reservoir, Payson worked with the Salt River Project (SRP) to obtain the rights to surface water from the reservoir. The town

Wine grape operation. Source: Rod Keeling, Cochise County: Agriculture and Water Resource Implications

initially had been distrustful of SRP due to previous conflicts over water rights; however, through the process of negotiating restoration and use of the reservoir, they developed a good working relationship. As a result, they agreed in 2008 on a new 3,000 acre-feet surface water right for Payson.

In the mid-1990s, Pinal County joined with five cities, five irrigation districts, and two privately owned water utilities to establish the Pinal County Water Augmentation Authority, which describes its goal as "the development of responsible, collaborative, and sustainable water planning and management in the Pinal AMA" within the boundaries of Pinal County. When there is a water issue to be solved, the executive director, a former AMA director, works with the cities as if he were a staff member. The authority also helps the City of Eloy and Town of Florence accrue long-term storage credits from their CAP allocations by subsidizing an arrangement with local irrigation districts to irrigate with CAP water instead of groundwater.

The Friends of the San Pedro River is an organization of local community members dedicated to conservation and restoration of the San Pedro. The organization promotes community collaboration to support preservation of this last major free-flowing river in the Southwest and ecologically important area for migrating birds. The organization coordinates closely with the US Bureau of Land Management, which manages the San Pedro Riparian National Conservation Area, and engages with the local community and its leaders to promote the river as an essential resource.

Building Management Capacity

Capacity building means increasing the resources, such as knowledge, experience, and cooperation, that enable communities to identify and implement solutions. It promotes understanding of water issues and expands the range of potential solutions through direct engagement of all the parties who have a stake in solving a community water challenge. In all cases, capacity building efforts seek to develop community awareness and motivate action.

In the rural Upper Gila Watershed, the WRRC facilitated creation of an oral history timeline that records shared memories of community members. The timeline displays floods, fires, and other important events correlated with hydrological records. Building upon the engagement created through the oral history timeline, WRRC also developed water supply and demand scenarios for the Morenci-Clifton region, Gila Valley, and Duncan Valley. These scenarios projected best- and worst-case water supply conditions using easily interpreted graphs to illustrate potential scarcity.

The Cobre Valley Water Forum and the Gila State of the Watershed are recent community gatherings that fostered engagement, provided information, and increased trust and communication among participants. Thus, they built the cooperation needed in these communities to make the most of limited resources.

Another engagement effort began in 2014 with a series of community forums put on by the Colorado River Indian Tribes' Tribal Council for the purpose of sharing information on water resources, shortage conditions on the Colorado River, and the status of the Tribes' irrigation project. The forums addressed community concerns over potentially losing access to Colorado River water and led directly to a proposed water code, which included guidelines for the Tribes' water management decisions. Community members overwhelmingly approved the water code, an accessible resource for community understanding of their water situation.

Engaging citizens in water quality monitoring is the goal of Arizona Water Watch, an Arizona Department of Environmental Quality (ADEQ) program. Initiated in 2017, the program builds understanding about water quality and adds data to the ADEQ's database. It provides

Arroyo Intern Emily Joiner

The WRRC's summer intern, Emily Joiner, graduates from the Department of Agricultural and Resource Economics with an MS in 2020. Her research focuses on defining economic resilience for rural communities and others. She is a strong believer in the value of communicating research to non-academic audiences.

Cobre Valley Small Town Forum on Water, Miami, Arizona, September 6, 2018. Source: Ashley Hullinger, UArizona WRRC

training, quality assurance tools, and equipment to volunteer water monitors who register online for biannual in-person training. After completing training, citizen scientists go on to record metrics such as water chemistry, E. coli, and habitat data. These data are then made available on the Arizona Water Watch online data forum. In 2019, monitoring areas included Butte, Fossil, Granite, Miller, Oak, and Sabino Canyon creeks; the Gila, Santa Cruz, San Pedro, and Verde rivers; and Luna and Rainbow lakes.

Resources

Reaching outside of the local community can be essential to realizing ongoing or future solutions. Many governmental and academic institutions can assist by providing technical, educational, and financial resources. The *Arroyo* contains only a small sample of these resources.

The Water Infrastructure Finance Authority states on its website that it provides loans to Arizona communities for "construction, rehabilitation, and/or improvement of drinking water, wastewater, wastewater reclamation, and other water quality facilities/projects." WIFA offers funding through two loan programs: the Clean Water Revolving Fund, which serves wastewater treatment utilities, and the Drinking Water Revolving Fund, which provides assistance for drinking water systems. The loan programs eliminate closing costs and charge below-market interest rates. Another WIFA initiative, the Technical Assistance Program, offers funding to help water and wastewater facilities that apply to one of the revolving funds to prepare for construction of an infrastructure project. In 2019, WIFA provided support to the White Mountain Apache Housing Authority, the Payson Water Company, the City of Douglas, and the Town of Marana. In addition, rural communities with populations of less than 10,000 can seek assistance from the Rural Water Infrastructure Committee, a partnership of various federal and state agencies.

Located at Sacramento State University in California, the Region 9 Environmental Finance Center (EFC) works with small to medium-sized communities to build capacity and provide education on financing issues. The EFC is particularly focused on stormwater asset management to enable public utilities to make investments in water infrastructure. The EFC provides tools for data collection, cost estimation, and performance measurement to municipalities interested in stormwater utility planning. It also offers GIS services to small communities for asset mapping and spatial analysis.

The US Geological Survey's Restoration Assessment and Monitoring Program works with Arizona farmers to prevent the farmland degradation that results if farmers abandon fields due to water shortages. When the soil in abandoned fields begins to degrade, other problems follow, including dust storms, spread of invasive species, wildfire, and loss of ecosystem function. The program encourages farmers to stabilize soil by reintroducing native plants, which are better adapted to an arid environment than other species. Additionally, farmers can begin to produce native plant seeds that can be sold to restore other farms.

As a land-grant university, the University of Arizona has a mission to bring research to communities statewide, and numerous programs partner with stakeholders to solve water resource challenges. At the Water and Energy Sustainable Technology (WEST) Center, the university works with Pima County and others on issues relating to water contamination, water treatment system functions, and potable water reuse.

University of Arizona/Pima County Water and Energy Sustainable Technology (WEST) Center. Source: Ian Pepper

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It is a resource for testing technologies on a large scale to find the best technological answers to water quality questions.

Conclusion

Arizona is facing critical water challenges as its population grows, its economy expands, and temperatures rise. The likelihood of future shortages on the Colorado River looks virtually certain. Pressures on groundwater resources are increasing in many parts of the state. The on-the-ground reality of these challenges is prompting communities across Arizona to look for ways to stretch and/or augment their water supplies. Collaboration and innovation are common themes, along with conservation programs and infrastructure projects. Many resources exist to assist community efforts; only a few are listed here.

Important challenges remain, notably in the weakness of water management tools available at the local level outside AMAs. For example, existing criteria for establishing new INAs prevent ADWR from basing its determinations on projected data. Reliance on existing rates of decline led ADWR to deny a petition to designate the San Simon sub-basin of the Safford Basin in southeastern Arizona as an INA in 2015 and to decline a request by the Mohave County Board of Supervisors in 2016 to initiate INA designation proceedings for the Hualapai Valley Basin and the Sacramento Basin, despite the potential for serious future groundwater depletion. Situations like these have prompted calls to redefine INA criteria. In Cochise County's Sulphur Springs Valley, large capacity wells for irrigating new plantations of nut trees such as pistachios and almonds have caused shallow domestic wells to go dry. The resulting tensions between agricultural and residential stakeholders have hindered efforts to resolve the problem. New legal tools may be needed to solve these water issues. Sharing lessons through conferences, publications, and other media can spark ideas and actions, increasing the pool of viable solutions to remaining challenges.

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