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Water Policy Options as Arizona Adapts to a Drier Colorado River: A Perspective

Sharon B. Megdal

The Colorado Basin Context

On August 16, 2021, the U.S. Bureau of Reclamation announced the first-ever Tier 1 Colorado River shortage. The water delivery cutbacks, which went into effect on January 1, 2022, per the “Colorado River Interim Guidelines for Low Basin Shortages and Coordinate Operations for Lake Powell and Lake Mead” (2007 Interim Guidelines), are most significant for the Central Arizona Project (CAP). Governed by the Central Arizona Water Conservation District, CAP delivers water into Central Arizona for use by tribal, municipal and industrial, and agricultural users. The reason that CAP water users face the most severe cutbacks is because that, in order to secure approval of the 1968 Colorado River Basin Project Act authorizing CAP construction, Arizona had to agree that water delivered through the CAP canal would be junior in priority to California’s Colorado River water deliveries. This means that in deep shortage conditions CAP deliveries could be cut in their entirety before California would experience any cutbacks in water deliveries.

To say management of the Colorado River is complex is an understatement. Colorado River water is shared by seven states, 30 Tribal Nations, and Mexico. Within the U.S., the Colorado River Basin

is divided into an Upper Division and a Lower Division. Different formulas govern the distribution of water. Upper Basin water is distributed on a percentage basis but each of the Lower Basin states have a set amount of water that is expected to be delivered in non-shortage years. The 1944 Treaty for Utilization of Waters from the Colorado and Tijuana Rivers and of the Rio Grande between the United States and Mexico, which is implemented by the International



Colorado River Basin

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Boundary and Water Commission, includes a requirement that the U.S. deliver 1.5 million acre feet of water annually.

The 2007 Interim Guidelines were developed because, prior to their development, there had been no framework for sharing shortages of Colorado River water. The Colorado River storage system includes the huge Lake Powell and Lead Mead reservoirs. The low-flow conditions of the early 2000s signaled that it was time to establish a framework for shortage conditions. Though the basin has been experiencing low flows for most of the first 20 years of this century and the 2007 Interim Guidelines have been in place, the Lake Mead water level had not met the criterion for a Tier 1 shortage until this year. This is true despite there being what has been termed a “structural deficit” in the Lower Basin, meaning that more water is allocated to Arizona, California, and Nevada annually than can be expected during average river flow conditions.

About 10 years ago, water managers finally acknowledged what many had argued was the case – the Colorado River is overallocated compared to average flow conditions. The Lower Basin was overdrawing its water savings account (the water stored in Lake Mead). Unfortunately, over the past 20-plus years, deposits to storage have not kept up with withdrawals. Despite innovative, sometimes voluntary, approaches to “propping up” Lake Mead, the status of and prognosis for the system indicated that more actions were necessary.

Collaboration among the many water actors led to the Spring 2019 federal enactment of the Drought Contingency Plans (DCPs). The DCP for the Lower Basin called for implementation of Tier 0 cutbacks in water deliveries at Lake Mead elevation level of 1,090 feet above sea level. Tier 0 governed water deliveries for 2020 and 2021. Under Tier 0, CAP experienced cutbacks of 192,000 acre feet. The Tier 1 shortage in 2022 added another 320,000 acre feet, making the total cutback equal to 512,000 acre feet, about one-third of CAP’s annual deliveries under normal conditions and about 18 percent of Arizona’s annual Colorado River allocation of 2.8 million acre feet. Unfortunately, the health of the Colorado River system is only getting worse; the probabilities of deeper cuts are increasing by the month. Based on Reclamation’s monthly modeling, charts like those below are shared each month. The picture is getting worse more quickly than anyone expected. So, while one can hope or pray for the best, doing so will not prepare you for the adverse conditions that are in fact the “new normal.”

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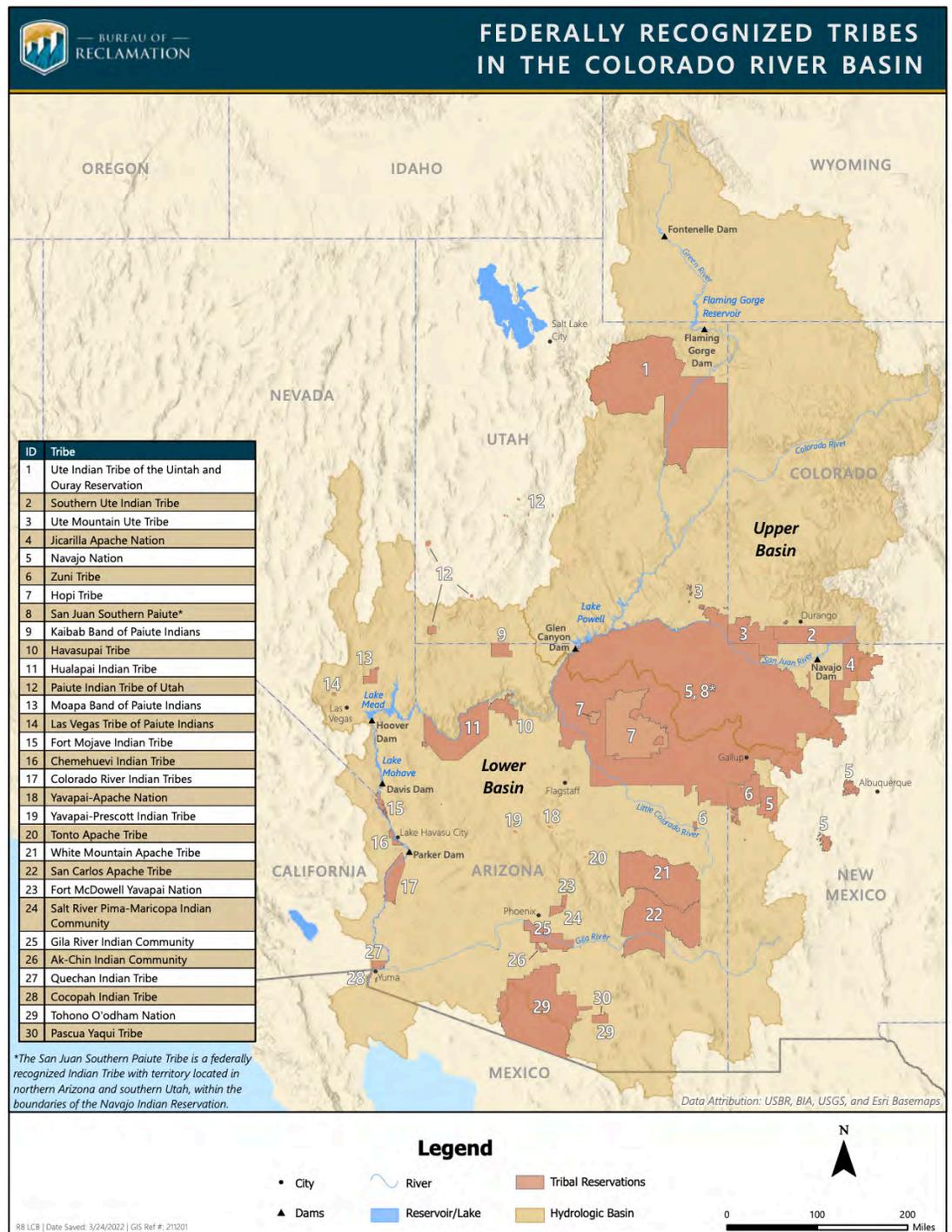
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Implications for Arizona

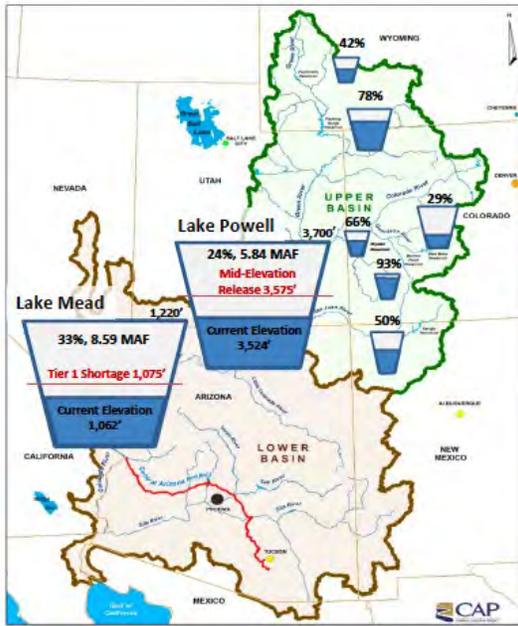
What do these Tier 1 cutbacks mean for Arizona water users? How is Arizona, which continues to grow, positioning itself for a long-term reality of less Colorado River water? The theme of complexity continues as we delve into a look at the Arizona water supply picture. Until the recent cuts in CAP water deliveries, about 40 percent of the 7 million acre feet used across Arizona was Colorado River water, with about an equivalent but growing percentage coming from groundwater. The remaining sources were other surface water supplies, such as Salt River Project waters, and reclaimed or recycled water. Groundwater is regulated pursuant to Arizona's 1980

Groundwater Management Act, as amended, in Active Management Areas (AMAs) only. The Central Arizona AMAs for the most part fall within CAP's service area and encompass Phoenix, the fifth largest city in the U.S., other cities in the Phoenix area, the Tucson region to the southeast, and large agricultural areas.¹ Lands of five Tribal Nations fall within AMA boundaries; however, the water use of sovereign Tribal Nations is not subject to state regulations.

There are different priorities of water deliveries within the CAP system. Historically, the lowest priority water



¹ AMA boundaries are not coincident with county boundaries but rather depend on hydrologic mapping. The three-county CAP service area includes Maricopa, Pinal, and Pima Counties.



Colorado River Water Supply Report

System Contents: 18.71 MAF

As of March 27, 2022

Last Year System Contents: 24.29 MAF

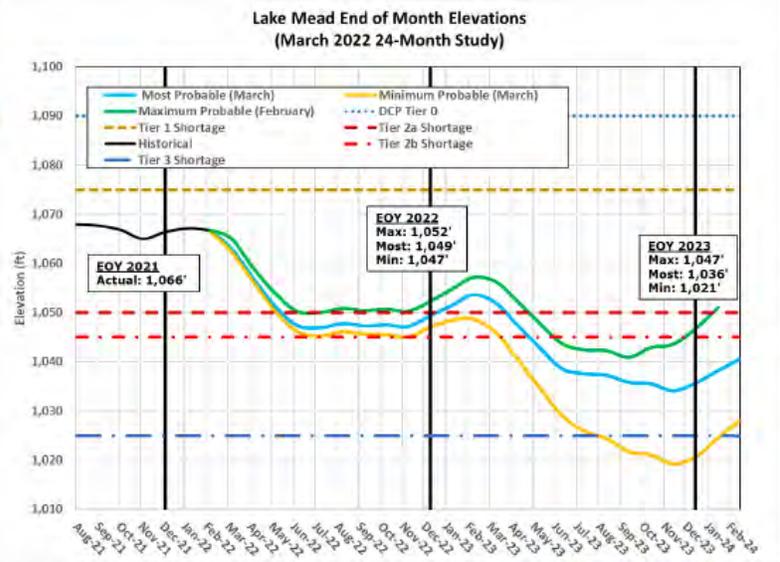
Reservoir Capacities (MAF)			
Reservoir	Current	Change*	Maximum
Lake Mead	8.59	-0.38	25.90
Lake Powell	5.84	-0.28	24.30
Flaming Gorge Reservoir	2.92	+0.01	3.75
Fontenelle Reservoir	0.15	-0.02	0.34
Navajo Reservoir	0.85	0.00	1.70
Blue Mesa Reservoir	0.24	0.00	0.83
Morrow Point Reservoir	0.11	+0.01	0.12
Crystal Reservoir	0.02	0.00	0.03

* With respect to previous month's report



Mead End of Month Elevations – March 24-Month Study

- Projected 2023 Conditions:
 - T1 = Max Probable
 - T2a = Min and Most Probable
- Anticipated 2024 Conditions:
 - T2b = Most Probable
 - T3 = Min Probable

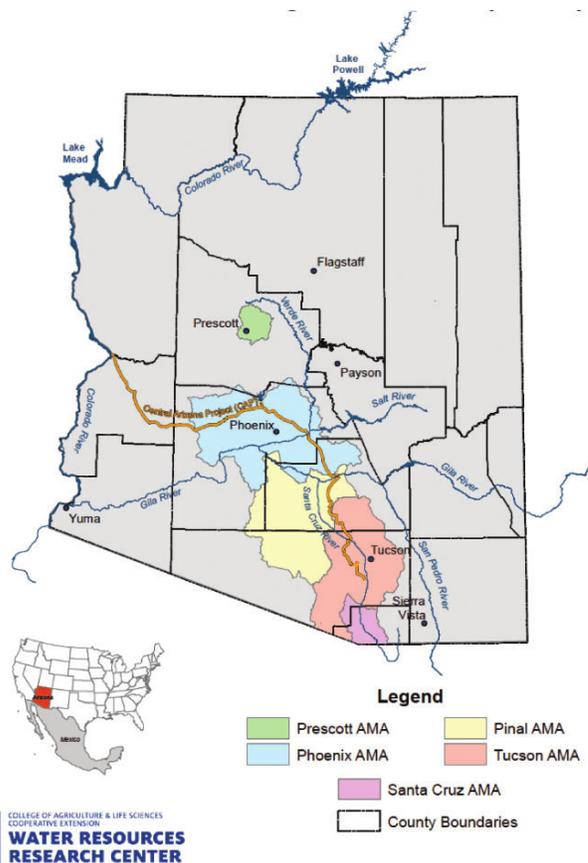


Source: Central Arizona Project, April 2022 Colorado River Water Supply Report to the Central Arizona Water Conservation District

has been what has been called “excess water” or water that was not ordered in a given year but available for use. Recent cutbacks have wiped out the prospects of there being excess water for water banking or other uses. The next lowest priority is water use by agricultural users within the CAP system. The Tier 1 cutback in CAP water deliveries has eliminated all the water known as “ag pool” water. Though there may continue to be some CAP water available to non-Indian agricultural users in the Central Arizona AMAs, the loss of the entire 300,000 acre-foot ag pool is severe and has significant ramifications. It should be noted that on-river agricultural users of Colorado River water, such as those in the Yuma region and Tribes do not experience these cutbacks. These distinctions in priorities are important. All of Arizona Colorado River water use is not junior to California, and not all agricultural water use is of lower priority to non-agricultural water use. CAP water deliveries overall are

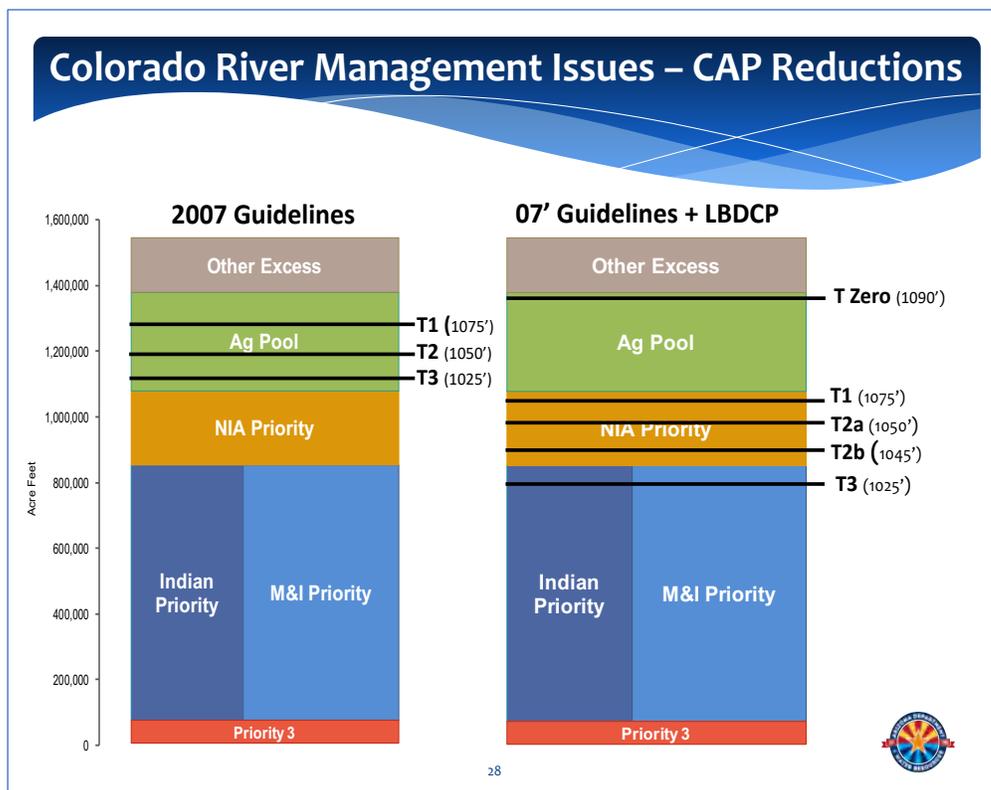
junior, and, within the CAP, water deliveries to non-Indian agriculture are of low priority. After ag pool water is cut, the category known as non-Indian agricultural (NIA) priority water is next to be cut. This category's name is a remnant of past plans for how agricultural water use of water delivered by the CAP would convert to municipal and industrial water use as agricultural lands were developed. Those holding contracts for NIA water are not agricultural water entities but rather Tribal Nations, cities, and others. The highest priority water categories within the CAP system are Indian and Municipal & Industrial (M&I). Note that some entities hold water contracts for multiple types of CAP water. Even these high priority uses risk being cut should Tier 3 cutbacks be ordered. There is one category of water delivered by the CAP that is of higher priority than other deliveries of water, as shown at the bottom of the block diagram. The diagram shows cutbacks in CAP water deliveries under the 2007 Interim Guidelines on the left compared to cutbacks with the 2019 Lower Basin DCP (LBDCP) overlay.

Recognizing the low priority of CAP water deliveries, Arizona has not been sitting idly by. In the mid-1990s, when more Colorado River was available than could be used directly, Arizona utilized a strong legislative and regulatory framework for water recharge and established the Arizona Water Banking Authority (AWBA) (Megdal and Seasholes (2014) and Seasholes and Megdal (2021)). The AWBA has stored underground millions of acre feet of Colorado River water for firming the water supplies of M&I and Indian priority water users when shortages hit those sectors. To date, that water remains in storage. Fortunately, some water



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Map showing Arizona AMAs. Source: University of Arizona Water Resources Research Center



Source: Ken Slowinski, Arizona Department of Water Resources

suppliers have not had to rely on their current CAP water allocations to meet current demands and have stored water for their future use.

Arizona water users have engaged in innovative partnerships to leave water in Lake Mead and/or ameliorate the burden of delivery cutbacks. Because Arizona's designated negotiator on Colorado River matters – the Director of the Arizona Department of Water Resources – requires legislative approval to sign on to interstate-federal water agreements, Arizona's negotiations on these challenging matters are necessarily inclusive. Arizona is alone among the Basin States in requiring legislative approval. Though intra-Arizona deliberations have at times been turbulent, many have pointed to Arizona's DCP consultative and deliberative process as exemplary. Not all the within-state actions are embraced by all Arizona parties. For example, actions to financially support the irrigation districts as they increase groundwater pumping to partially replace the lost surface water, concern those who see a return to greater groundwater reliance as counter to Arizona's efforts to reduce groundwater overdraft. Yet the irrigators have rights to use groundwater. Not only was their support needed at the Legislature, but there are serious concerns about the economic dislocation to farmers, along with their connected businesses and communities.

It is the Pinal AMA, a largely agricultural AMA in the central part of Central Arizona that is the epicenter of questions about the Colorado River shortage impacts. The Pinal AMA has a groundwater management goal different from the other AMAs, who all aspire to achieve safe-yield or a balance of groundwater withdrawals with natural and artificial recharge. The statutory management goal of the Pinal AMA (PAMA), however, is to allow the development of non-irrigation water uses and to preserve existing agricultural economies in the PAMA for as long as feasible, consistent with the necessity to preserve future water supplies for non-irrigation uses (A.R.S. § 45-562(B)). This region between Phoenix and Tucson continues to attract non-agricultural businesses and their workers. Update to the Arizona Department of Water Resources' groundwater model for the region has brought attention to the imbalance between the expected groundwater demands and groundwater supplies available for use per existing groundwater regulations. Coupled with the focus on the region's agricultural water use have been serious questions about the ability of the non-agricultural development to occur as expected by landowners and developers.

In fact, non-renewable groundwater remains a primary water source for many. Growing populations and economic activity have stressed groundwater resources throughout Arizona, especially in areas outside the AMAs, where there are no groundwater regulations, nor are there water conservation or metering requirements. Groundwater's "invisibility" makes it difficult to know water in storage, and water quality information can be limited. Recognizing these water pressure points, Arizona's Governor Ducey established the Governor's Water Augmentation, Innovation, and Conservation Council to assess the challenges and consider options to address them. In addition, in 2022 Governor Ducey proposed formation of and funding for an Arizona Water Authority, with legislative authorizing language being formulated during the ongoing legislative session. At the same time, some local communities are advocating for formation of new AMAs, something that has not occurred since the Santa Cruz AMA was "carved out of" the Tucson AMA in 1994. In actuality, no new lands have become subject to AMA groundwater regulations since the 1980 adoption of the Groundwater Management Act. In the past and currently, legislative proposals to authorize other regional approaches to water management have stalled due to lack of consensus. Nevertheless, many of the policy options are under discussion. While not all are new, pilot projects, renewed interest, and/or variations in their characterization are generating more robust discussions. Others remain on the back burner. The following discussion summarizes some of these options.

Policy Options and Opportunities

Conservation: No one questions the value of using less water, though there may be questions about what happens to the water conserved. Is it used to support growth? Or more cropping if by the agricultural sector? Though there may be great potential in some places for water savings due to conservation, many water users or suppliers in the AMAs have water conservation programs in place. What could help guide investment in

incremental water conservation programs is an approach like that of Southern Nevada Water Authority, where they have calculated the expected impacts of water conservation programs on gallons-per-capita-per-day water consumption. (Pellegrino (2022))

Greater efficiency: Especially in the agricultural sector, conservation is not necessarily the same as more efficiency. (Frisvold et al. (2018)) Installation of novel drip irrigation systems through pilot programs are enabling measurement of the change in water use as well as yields as farmers irrigate fields previously receiving flood irrigation with drip irrigation that relies on gravity-fed rather than highly pressurized water deliveries. Recent legislative activity has considered providing incentives for installation of higher efficiency irrigation technologies. Some of the pilots are being undertaken without incentives; others involve partnerships among water agencies and farmers, including tribal farming entities. Research and pilots related to different crops, such as guayule, which is used for production of rubber products, continue.

Water reuse: In many parts of Arizona, water reuse is a substantial component of water supply portfolios. For years, effluent from metropolitan Phoenix has been used as cooling water for the Palo Verde Generating Station operated by Arizona Public Service. Many communities have ordinance requiring golf courses irrigate with reclaimed water. Some recharge their treated wastewater for meeting non-potable demands for water through storage and recovery. Rules have been adopted in Arizona allowing for direct potable reuse, although no water provider is currently engaged in direct potable reuse. It is recognized that wise reuse is every bit as important as wise “first use” of water. An advantage of water reuse is that the water is locally generated. Included in this category is grey water use at individual households. Increased use of gray water by households means less water flowing into centralized wastewater treatment plans for use by the owners of plant outflows. Also, as water use becomes more efficient, household wastewater flows may decrease.

Desalination: Though Arizona does not abut a sea or an ocean, seawater desalination has been of interest, particularly in collaboration with Mexico. Through the International Boundary and Water Commission, a binational study ([Full Report](#) and [Executive Summary](#)) of the potential for large-scale seawater desalination in the Sea of Cortez was completed in 2020. Though this highly collaborative study suggested feasibility, there are many yet-to-be explored questions about such a binational effort in terms of cost, environmental implications, and institutional feasibility. Some talk about it in the context of an exchange: Arizona would help pay for production of water to be used in Mexico in exchange for some of Mexico’s Colorado River allocation. Others speak to the possibility of piping the water into the United States. It is clear that working through the many jurisdictional layers and across multiple election cycles at the state and federal levels would be necessary. Possibilities to desalinate in-state brackish groundwater exist, but regulations for disposal of the brine are pending and legal questions regarding the groundwater itself, particularly in the AMAs, have been raised. Though there are some mechanisms for multi-party collaboration within Arizona to fund infrastructure that would be too expensive for a single entity, these opportunities are not active. Questions about the feasibility of restarting or rebuilding the Yuma Desalting Plan also remain.

Moving water: Moving water from one part of Arizona to another comes up in different contexts. One is the transport of Colorado River water from the western boundary of Arizona into Central Arizona. This option, which is unpopular with many along the Colorado River, is seen as an option for meeting growing water needs in Central Arizona. The transfer from landowners in Cibola, Arizona to Queen Creek, Arizona, pending approval by the federal government, is an example. Others have been proposed but not realized for various reasons. Another opportunity is moving groundwater. Though in the late 1980s Arizona enacted legislation limiting movement of groundwater from one basin to another, some exceptions were allowed. One area from which groundwater can be moved is the Harquahala Valley west of Phoenix. Per the CAP’s System Use Agreement, the CAP canal could be used for transport of that water, provided that water quality requirements are met. These and related issues are active, including legislation that would enable a private entity to join public entities as eligible to build infrastructure needed for the project. Note that both options discussed here do not augment Arizona water supplies. The first transfers use from agricultural lands in Western Arizona to municipal use in Central Arizona. The second would also transfer water that would/could be used by agriculture in the

Harquahala Valley for municipal use in Central Arizona. A key difference is that the first would be considered renewable water because it is mainstem Colorado River water. In the second instance, the water to be moved is non-renewable groundwater. Some “out-of-the-box” and out-of-region options for moving water include moving water from another region of the United States to Arizona. Multiple ideas have been articulated, including moving floodwater from the Midwest to Arizona via a northern route that could feed into Lake Powell. While some consider such ideas as totally infeasible, others would like to see them investigated, much like the opportunity for binational desalination has been investigated.

Marketing and other mutually agreed-upon transactions: The two examples above can be considered examples of water marketing. In general, market mechanisms involving multiple buyers and sellers interacting through some sort of platform is non-existent in Arizona. Yet, there is a market for the long-term water storage credits that have been accrued pursuant to Arizona’s water storage (recharge) and recovery framework (Bernat and Megdal (2020)). Other opportunities typically involve private negotiations between a buyer and a seller. Private negotiations are allowed of public entities, with only the final vote for the transaction being made public for bodies subject to open meeting laws. A large purchaser of long-term storage credits has been the **Central Arizona Groundwater Replenishment District**, which is required to replenish groundwater use by its Central Arizona members. Efforts to meet required water cutbacks or voluntarily leave water in Lake Mead have involved payment for non-use of water as agricultural lands are fallowed. The contexts for these transactions are many and can be complex.

Rainwater and stormwater capture: Individual household efforts to capture rainwater either actively through cisterns or passively, through swales and directing gutter water to trees, can help augment indirectly the water supplies of a region by substituting rainwater for water delivered through the potable water system. How much of that water would have eventually made its way into the water system relied upon by water suppliers is not quantified, but considerations of whether some of that might have become surface water subject to appropriation by downstream users does not seem to be an obstacle. Arizona law is quite permissive as to individual household installation of rainwater systems, as it is for individual gray water systems. Questions about rainwater harvesting for larger footprints do exist and are indicative of need for study of what water would make it into a stream versus lost to evaporation, for example, and the costs of mechanisms to capture stormwater for recharge.

Designing the built environment: An opportunity for improving the supply-demand imbalance is designing communities and building for lower water use. As a state that continues to grow, with large, planned communities, innovative design could contribute to reduced calculations of water demands. Arizona has the potential to lead in showing how to live in the desert.

Part IV – Moving Forward

Arizona is a large and diverse state. Population and business growth continues. Agricultural activities are growing in some parts of the State. Colorado River water is an extremely important source of water for Arizona, but it is not the only Arizona water source facing stress. Many parts of Arizona rely almost exclusively on non-renewable groundwater. Some areas are facing the same groundwater overdraft problems that led to the enactment of the 1980 Groundwater Management Act. In addition, water management issues remain for the Active Management Areas. The policy options and opportunities discussed above are not necessarily new. Many, though not all, were discussed in the **2014 Arizona Strategic Vision for Water Supply Sustainability**. However, that document has not been used to guide regional and statewide water planning. While stakeholders have participated productively in meetings of various steering groups, councils, and committees, Arizona does not have a State Water Plan to guide its forward direction. Discussions to form a statewide Arizona Water Authority to pursue options for augmentation include significant funding, funding that has not previously been on the table. There are many questions regarding the scope and governance of the authority. What sorts of projects would it undertake? How would local communities engage? What kinds of partnerships are envisioned? The

need for action is recognized statewide, though perhaps not surprisingly, not all agree on the forum or approach.

Robust discussion and debate are welcome – if they lead to action. Bold actions are required so that Arizona can chart its water future. As many note, one can hope or pray for the best, but the necessary course of action is to plan for the worst. Unfortunately, Colorado River conditions are only getting worse. No one holds the crystal ball to know how bad they will go. In April 2022, concerns about the level of Lake Powell resulted in unprecedented actions to keep Lake Powell from falling below the level necessary for electricity generation and for the regular flow of water downstream of the dam. Actions to increase releases into Lake Powell from Flaming Gorge reservoir and decrease releases from Lake Powell to Lake Mead were announced by the Department of the Interior and agreed to by the seven Basin States. Much more is needed, particularly in Central Arizona, which bears so much of the brunt of the expected cutbacks. Collaboration and partnerships are needed so that we can adapt to these drier conditions. Some of the efforts require significant advance planning. A key question is whether we in Arizona will identify the pathways forward proactively or respond reactively to crisis. Perhaps adapting to drier Colorado River conditions will require both proactive and reactive actions as we maneuver these uncharted waters.

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