Editor's note: This is the first of six stories for "Colorado River reckoning: Not enough water," an investigative series by the Arizona Daily Star that observes, at length, the future of the Colorado River.

The lifeblood of the West, the Colorado River, is slowly dying, its flows that nourish 40 million people in seven states shrinking without respite.

The planet keeps heating up, and the reservoirs that feed the
canals bringing water to lettuce and alfalfa fields and to faucets, toilets and lawns keep falling.

The state governments charged with the river's management are locked in a standoff over how to wean themselves from decades-long dependence on this water that borders on addiction. That dependence has been enshrined into the U.S. legal system through treaties, regulations, compacts, court decisions and statutes that collectively add up to the Law of the River.

People are also reading...

They can't agree on who should take the biggest cuts, despite pressures to do so from the federal government. Federal officials haven't followed up on their threat to impose a solution, other than to promise some fixes that will arrive in the future.

This web of problems and disputes is symptomatic of a water management system in the early stages of collapse, in the view of Justin Mankin, a Dartmouth University professor who helps lead a federal task force that's monitoring the West's 23-year drought.
Such a collapse would mean the laws, rules and governmental structures and policies that underlie this system would no longer be reliable, he said.

Not only would that call into question the system's ability to meet its obligations to deliver water to customers, it would also mean a whole new legal and political structure would have to be developed to govern water allocation and use, he said.

The backdrop to this drama is a century-old system of river water allocations for the states that everyone involved knows is unrealistic but which appears too entrenched to change. The allocations were set by the 1922 Colorado River
Compact, which recent investigative reporting has shown was based on assumptions about river flows that some scientists warned even back then were unrealistically high.

A collapse would likely mean the giant reservoirs Lake Powell and Lake Mead would have much less if any water for drinking, bathing and outdoor watering at the homes and businesses from Denver to Tucson to Los Angeles that now rely heavily on river water, Mankin said.

Farmers from Southern California's Imperial Valley to Yuma to Western Colorado who use river water for irrigation would find themselves in similar straits.

Electric power now serving about 5.5 million customers from Glen Canyon Dam and a group of smaller reservoirs in the river's Upper Basin and 8 million from Hoover Dam could also be cut off or severely curtailed.

"The on-the-ground impact is that nobody who uses water at the municipal, household, agricultural or industrial level, can rely on having sufficient water," he said.

The system is too ossified to respond nimbly and quickly enough to a changing climate, he said.
The remains of a big mouth bass lay in the silt just above where the shrunken Escalante River joins Lake Powell. Water from the depleted lakes Powell and Mead serves tens of millions of people in the West, but "there is not enough water as it stands for us to do everything we want," warns Dartmouth professor Justin Mankin.

Kelly Presnell / Arizona Daily Star

'Canary in a coal mine?'

For two years, Mankin has served as one of four co-leaders of a drought task force run by the National Oceanic and Atmospheric Administration. Its purpose is to better predict the timing and severity of droughts in the U.S., and to help the federal government insure that water districts, farmers, businesses, and public-resource managers have the information needed to cope with droughts as global warming increases the risks of them.
A geography professor at Dartmouth, Mankin made a point to note that he's a physical climate scientist, not a water policy scholar. His assessment of the Colorado River's problems are his own and are not related to the Drought Task Force, he said.

"Not many scientists are willing to say something like what I'm saying," Mankin said.

But others are also using the word "collapse."

On Aug. 16, Assistant Interior Secretary for Water and Science Tanya Trujillo said Interior is cutting river water deliveries to the three Lower Basin states next year to "avoid a catastrophic collapse of the Colorado River system." Arizona, California and Nevada are the Lower Basin states.

The same day, the Gila River Indian Community said in a news release "that the Colorado River system as a whole is on the brink of collapse."

To tribal officials, collapse would mean reservoirs Mead and Powell reaching "dead pool" levels, at which they could no longer deliver water, an attorney for the Gila community, Jason Hauter, said in an interview. The Gila community is headquartered in Sacaton, about 80 miles north of Tucson off Interstate 10.
"We are almost out of stored water" in the reservoirs, Hauter said. "We can only exist on what's in the system. For that to work you have to have a certain amount of water left behind in reservoirs that you can tap into. To do that, there will have to be reduction in use."

Mankin's vision of a systemic collapse runs far deeper than our falling reservoirs.

"The reservoirs, the regulatory framework, the Law of the River — they're not doing what they're designed to do. That sure looks like failure to me. The system is designed to buffer drought and provide certainty and it's not doing that," he said.

"There are always these competing demands on water out there. Somebody's going to lose. I don’t think that’s the water economy functioning. The water economy is failing."

He sees Lake Powell's highly uncertain status as a major symptom of the problems with water management across the West, asking if it's "a canary in a coal mine."

Satellite imagery from Google Earth shows Lake Powell from 1984 to 2020. To see how the water body has changed over
Unsustainable

As of now, the lake is not in immediate crisis. It stands nearly 40 feet above 3,490 feet, the level at which it no longer can generate electricity and at which its ability to keep delivering all the water it normally sends downstream to the Grand Canyon and Lake Mead would come under question.

But Powell is artificially propped up in a way that can't last.

The U.S. Bureau of Reclamation sent a half-million acre-feet of extra water downstream this past spring to Powell from the Flaming Gorge Reservoir in northern Utah, after sending about 161,000 acre-feet last year to Powell from Flaming Gorge and other upstream reservoirs. But bureau hydrologic engineer James Prairie told a water conference in Denver in August, "We probably have an opportunity to do it maybe two more times, and then there will be no more capacity" left for Flaming Gorge releases.

Also, the bureau cut releases from Powell to Mead by almost 500,000 acre-feet in April — an action that if repeated regularly will seriously deplete Mead.

Mead is already falling faster than Powell — 23 feet versus 16 feet since September 2021. It could fall farther still in 2023,
because the bureau says it's considering reducing deliveries from Powell to less than the 7 million acre-feet it delivered to Mead this year. That's the least water it's sent to Mead since 1964, when Powell was first filling.

"Is it a mark of a functioning water allocation system to have the two most important reservoirs in the West be unable to perform their basic functions?" Mankin asked. "If you can’t generate power out of Lake Powell or Lake Mead, or if you can’t use Powell as this kind of central bank for water
allocations in the same way anymore, and you are having to siphon water from upstream, and you are doing it in an unsustainable ways, with no end of drought on the horizon, to me that’s not the sign of a healthy, functioning water economy."

"There is not enough water as it stands for us to do everything we want. If you believe the climate projections, it suggests there is even going to be less to go around going forward. This system is just not built right, this system of power and profit around the allocation of water in the American West. It’s not in a position to be nimble and responsive in the face of an increasing trend to aridity."

He described the collapse as a slow one, taking years, maybe decades. 

"If the states of the West are having a hard time managing this drought now, that doesn’t portend sound drought management in the future," he said.
Commerce Secretary Herbert Hoover presides over the signing of the Colorado River Compact in Santa Fe, N.M., on Nov. 24, 1922. Warnings were ignored from the beginning that the brokered deal allocated more water to seven U.S. states than the river could provide.

U.S. Bureau of Reclamation

'A time of unbelievable change'

To get feedback on Mankin's views, the Star reached out to a range of Western water sources, including state and local water agencies, environmentalists, other academics and unaffiliated water experts. Reactions varied, with much of the disagreement centering not on the river's declining flows, but on his tracing the problems to the river's regulatory system.
At the root of that dispute is an ongoing debate over whether the centerpiece of the Law of the River — the 1922 Colorado River Compact — needs to be redone.

Since 2000, the river has carried a bit less than three-fourths of the 16.5 million acre-feet of water a year that the 1922 pact awarded to Arizona and the six other Colorado River Basin states and, later, to Mexico.

An investigative book, "Science Be Damned," found in 2019 that the states and Congress approved the compact despite warnings from a highly qualified scientist that the river wouldn't have enough water to meet its allocations.

Arguments that the compact needs to be revised have been countered by arguments this would usher in endless litigation that would needlessly delay action on the river's problems. This debate is likely to play out more intensely soon, as the federal government leads an effort to revise guidelines it uses to operate the river's reservoirs — guidelines that expire in 2026.

Colorado State University water researcher Brad Udall, long one of the most vocal scientists speaking out on the river's declining flows, said he doesn't disagree with much of what Mankin says, but, "I don't know that I like the word collapse. "It implies a building comes down and there’s nothing left.
That's the wrong metaphor. The word I might use is upheaval. We are in a time of unbelievable change, where everything is being rethought. Events are overtaking basically 100 years of the Law of the River very quickly. We will end up with some new way to operate the system soon," said Udall, a senior water and climate scientist for CSU's Colorado Water Center.

Download PDF
The next few years will be critical for the river in terms of how much flows down it, and how Western water leaders respond to that hydrology, he added.

"it could go from having a system that we're in control of right now to potentially complete chaos. The difference between those outcomes will be the leadership that
Colorado River management takes," he said.

"We've still got time to respond. We've got decision makers who deserve a chance to get this right. I'm confident the feds are not going to allow a collapse to occur."

But it's not just the Colorado River that's in trouble in the West, Udall emphasized.

The Rio Grande in New Mexico and Texas, the Klamath River in California and Oregon, and the entire Sacramento-San Joaquin river system in northern California also are seeing reduced flows, in part because of climate change and in part due to overuse, said Udall, who a decade ago was director and principal investigator for NOAA's Western Water Assessment program.

"It's important we understand the breadth of and the nature of the problem and the causes," Udall said.
An irrigator works at fixing a clogged sprinkler in a freshly planted winter vegetable field in the Yuma Valley. Farms in the seven Colorado River basin states use an estimated 70% to 80% of the Colorado River's water, so they will be the biggest targets for cuts.

Randy Hoeft, Yuma Daily Sun

'I don't see how this ends well'

Symptoms of a possible collapse, as Mankin sees it, come through clearly in the dramatic, recent change in the writings of New Mexico author-researcher John Fleck, a co-author of "Science Be Damned."

Long a guarded optimist about the river's future, Fleck took a deeply pessimistic tone in his "Inkstain" blog in late September, warning it's hard not to see "dead pool looming." The reservoirs will hit "dead pool" at levels so low that water
can no longer be extracted from them.

In his 2016 book "Water is for Fighting Over," however, Fleck wrote that even with climate change reducing its flows, he saw hope that the river could survive relatively intact.

For one, he recalled a series of water deals made among various parties showing their willingness to collaborate, most notably in a 2003 agreement in which Southern California users gave up the nearly 20% of their total take from the river because that exceeded the amount they have legal rights to. Second, he observed that "when people have less water, they use less water," noting that cities and towns across the West have repeatedly managed to conserve as the supply dwindles.

But today, while still believing shrinking water supplies can be conserved without significant damage to local economies or communities, he's frustrated that the basin states seem unwilling to do that.

"Climate change and drought have outpaced in the last several years the capacity of those tools to deal with our problems," he said in an interview, speaking of collaboration and conservation. "What I did not understand is how hard it would be to scale that up in a hurry."

Fleck started and finished his Sept. 27 blog post on the
'Five-alarm fire bad'

Fleck's post portrays the key players in ongoing water conflicts — Arizona, California and the federal government — as "boxed in" from taking action by various political and legal constraints, "while the water in the Colorado River’s big reservoirs is circling the drains."

Arizona, having given up 800,000 acre-feet of river water this year, is unlikely to give up more without substantial cuts from California, he wrote.

In California, officials have offered to cut their total river water use by 400,000 acre-feet, less than one-tenth of the state's total legal supply. But that cut won't be nearly enough for the Lower Basin to meet its share of the 2 million to 4 million acre-foot cut that federal officials are demanding of all seven river basin states. It would almost certainly require Arizona to put up far more than it's been willing to do to date, potentially precipitating a political and legal deadlock.

Fleck also ran through the latest negative Bureau of Reclamation forecasts for reservoir levels for the next two years. For Powell, the "minimum probable" forecast for the next two years shows it falling below the level at which Glen Powell
Canyon Dam can produce electricity starting in December 2023, and staying there for seven of the next eight months.

For Lake Mead, the "minimum probable" forecast shows it falling below 1,020 feet, compared to about 1,044 feet today, for every month from September 2023 through August 2024, and below 1,000 feet for the last three months of that period.

While those levels are well above 950 feet, below which Hoover Dam can't generate power, they're well below 1,025 feet, the level at which the most severe cuts to Lower Basin water users would occur under the 2019 Drought Contingency Plan.

"For those not steeped in the numbers, this is cracked-mud, five-alarm fire bad," wrote Fleck.

His post saw federal officials as "frankly boxed in" by the paralysis that always accompanies a looming election, by the Lower Basin states' unwillingness or inability to cut enough water use, and by the need to better include tribes in their discussions, among other forces.

"It's hard to look at all these constraints, the boxed-in-ness — on Arizona, on California, on the federal government — and not see dead pool looming," Fleck wrote.

Since Fleck's post was published, a new Bureau of
Reclamation action has given the researcher more optimism that something might be done in the coming year to stabilize the river's battered reservoirs. In late October, the bureau announced plans to approve a blueprint by August 2023 to reduce water use in the entire river basin.

One alternative it will consider is imposing its own solution, as it has threatened to do since mid-June. A second alternative would be for the bureau and the states to work out a solution collaboratively. While either solution would delay water use reductions until early 2024, the bureau also is raising the possibility it could cut water releases from both Mead and Powell much sooner if needed.

But Fleck told the Star he generally doesn't disagree with Mankin's view the system is on the edge of collapse.

"Clearly the system is failing us, meaning the interactions of physical infrastructure and water allocation rules," Fleck said.

Since Interior Department officials warned in June of the need to cut up to 4 million acre-feet a year of river water use, in particular, the system "has failed a really important test," he said.

"What you see right now is a whole bunch of people making the argument about what they've already given up and 'the
responsibility for the next actions must fall to others'," Fleck said. "There’s not enough water for all of us to be right."

Central Arizona Project construction in Western Arizona, 1979. The $4 billion canal system delivers drinking water from the Colorado River to Phoenix and Tucson and irrigation water for farms. Tucsonans currently drink only CAP water, but the project faces continuing cuts due to drought and climate change.

Joan Rennick / Tucson Citizen

Cycles of 'crisis and neglect'

The reservoirs whose water is “circling the drains” have been essential in making the American West habitable, Mankin noted.

“The structures that we built on the Western landscape are gigantic, massive interventions in local hydrology. These
reservoirs have been essential for providing water to do a whole host of things, from growing food to recreating to generating power. They are designed to do so when there isn’t enough water to fall from the sky. We made these massive interventions to assure water supplies in times of drought,” he said.

So far, he thinks they’ve done “OK” and that one could argue they’ve managed to operate well during the last 20 years of “megadrought.” But he added: they’ve never really flourished.

“This latest drought has kind of revealed how vulnerable this system is, how the water economy of the West has been operating at an incredibly thin margin for decades,” he said. “For awhile, the margins were favorable. But this drought has kind of shown that this water system in the American West is not well adapted to climate change."

Mankin's larger point is that the strategies officials have pursued so far — drawing emergency water from upstream or cutting deliveries to downstream users — “just kick the can down the road and deepens our vulnerability.”

Probably his biggest concern is that the states and federal government continue managing the river and its reservoirs through various cycles of “crisis and neglect.”
“A crisis is something you manage over the short term to get back to normal, and so the response is really centered around returning to normal. The focus on returning to normal often obscures the structural processes that led to the crisis to begin with,” Mankin said. “Focusing on drought as a crisis obscures any meaningful evaluation.”

For one, he cited the $2 million, two-year study the Bureau of Reclamation launched in early 2022 to investigate ways to continue producing electricity at Glen Canyon Dam if Powell drops below 3,490 feet.

“The idea of investing a whole bunch of money to continue to produce hydropower from Glen Canyon Dam, maybe it is a strategy to pursue, but it’s not clear that strategy is borne of clear-eyed, holistic long-range planning to insure that you get the greatest bang for your buck,” he said. “It’s entirely within the realm of possibility that Reclamation could go through this arduous process of lowering the water level where power could be generated, and in a few years time, we’ll be right back where we are now. I don’t think anybody would be surprised.”

The question of how to keep providing power from the two dams for the long term is one the states and Reclamation have yet to really contend with, he said.

"That leaves a lot of people who rely on that power in limbo,"
he said. "The more the strategy is to hold onto the status quo rather than being clear-eyed about sustainably sourcing energy for people, given the current hydroclimate in the West, the more that is creating uncertainty."

Today, as the basin states and federal government struggle to find ways to immediately cut their water use, Mankin said it’s positive to see “the right people are alarmed,” but he doesn’t think the crisis has reached a point leading to restructuring how water is allocated.

"A cut in water use doesn’t fix structural issues. A cut is a short-term solution.”
Boulder Dam's mighty water intake towers are shown in this picture of the gigantic electric power project from 1938, as Lake Mead was filling. Today that power serves 8 million customers in the West. But federal forecasters say Lake Mead's water level could drop so low in a few years it couldn't generate power.

Associated Press

Some say the river compact isn't the problem

Asked how he would fix the West’s structural water problems, Mankin replied, “The short answer is, I do not know.”

But he doesn’t see the current system tied to the 1922 compact as sustainable.

"What is the value of a regulatory framework that assumes a climate we no longer have? I’m not a lawyer but that strikes me as a fallacious premise for a legal framework that is so crucial to well-being in the West."

"I think that the extent to which the Law of the River is grounded in an annual allocation of seven million acre-feet a year of water to the Upper and Lower basins, then that is not really tenable, is it?"

But the compact and other elements of the Law of the River have long been the glue that many water leaders believe has held the river system together through a century of water surpluses and shortages, and of court fights and
congressional conflicts.

That point was driven home last month, in a letter to the Bureau of Reclamation from the seven river basin states' top water officials. They argued the Law of the River "must be the foundation" for how new rules for operating reservoirs are written.

Besides the 1922 Compact, the Law of the River also includes a 1948 compact governing the four Upper Basin states and a 1944 treaty awarding Mexico 1.5 million acre-feet a year of river water, the states said.

"The new operating rules should not interfere with the right of any state to administer and regulate water within its boundaries in relation to the appropriation, use, and control of water. The existing framework provides legal certainty regarding management of the Colorado River System and its infrastructure. It also allows for collaboration and consensus which helps avoid the uncertain outcomes that result from litigation," said the letter, whose signers include Arizona Department of Water Resources Director Tom Buschatzke.

The letter acknowledged that the last 20 years of drought and increasing aridity on the river have highlighted the system's vulnerabilities that the new rules should address. To improve operations at Lake Powell and Lake Mead, the new operating rules should address risks and opportunities
resulting from increased variability in river flows, including climate change impacts, and produce mechanisms to restore the depleted reservoirs, the letter said.

Instead of calling for structural change in river management, the Sept. 1 letter from the states said balancing water use and river depletions with available supply "is the foundation for sustainable management under Post-2026 operations. This should include the advancement of meaningful water conservation programs across all sectors and transparent and accurate accounting of depletions and available supply."

Asked separately to comment on whether the river system is on the verge of collapse, ADWR and the Southern Nevada Water Authority declined.

In an email to the Star, Adel Hagekhalil, general manager of Southern California's Metropolitan Water District, also didn't respond to that question, but said the Colorado River Compact isn't the problem — it's drought, climate change, and the resulting declines in runoff and reservoir levels.

"The challenges before us are significant. We must immediately respond to the dropping levels of Lake Mead and Lake Powell, while at the same time seeking ways to bring longer-term balance to the river through post-2026 operations. These unprecedented conditions caused by climate change require unprecedented and bold actions
'anchored in integration, innovation and inclusion,' Hagekhalil wrote.

"The good news is, we have the legal foundation on which to build short- and long-term solutions. We are not starting from scratch. The Colorado River Compact provides both legal certainty and the flexibility needed to adapt to our changing future," said Hagekhalil, adding that tackling drought and related issues "is tough enough, without adding unnecessary litigation and uncertainty."

**We'll all have to live with less, permanently**

Everyone who relies on Colorado River water, including Southern California, is going to have to live with less, permanently, Hagekhalil said.

Other river basin water users recognize that, and that's why the various states signed off on a drought contingency plan in 2019 and a less sweeping "500-plus" plan last year to make additional cuts in Lower Basin water use, he said. That's also why Nevada and Arizona have invested in Metropolitan's plans to develop one of the world's largest water recycling facilities, he said.

"And it is why we will continue our work at the negotiating table to find immediate and long-term solutions."
But Eric Kuhn, a Colorado researcher, author and former water district general manager, predicted at a recent water conference in Colorado that river flows are now dropping so fast that in a few years, rather than renegotiate or amend the compact, "we will ignore all provisions" except for its first article, which simply lays out its purposes.

"So many fundamental changes are needed, and time is so short, we don't have time to rethink the Law of the River," said Kuhn, who co-authored "Science Be Damned."

The compact's allocations of 16.5 million acre-feet a year don't work with a river that has carried barely 12 million since 2000 and about 10.5 million since 2018, he said. Even more pessimistic forecasts of 9 million a year have very low probabilities but aren't totally unrealistic, he said.

Flows that low "would force major, major changes in how we do business," Kuhn said in an interview. "We're already in an era of doing things very differently than we thought we were at a few years ago."

'You are taking peoples' property rights'

Jennifer Gimbel, a water expert at Colorado State, strongly disagrees with Mankin's arguments, particularly his view that the Colorado River Compact needs overhauling. Gimbel is a senior water policy scholar at CSU's Colorado Water Center.
She's also a former official of the Bureau of Reclamation and the broader Interior Department, and a former Colorado governor's representative in Colorado River water negotiations.

Gimbel defends the water rights system encouraged by the compact that's known as prior appropriation, in which those with earlier water rights have higher priority to river water than those who got their rights later. In the Lower Basin, the earliest rights are held by tribes and numerous non-Indian farming districts, while the Central Arizona Project's rights are among the very latest, dating to Congress' approval of CAP in 1968.

"The West was populated under the prior appropriations system and many states' constitutions provide for the prior appropriation system. It's a pretty solid method of administering water rights," one based on the theory that water rights are property rights, she said.

Gimbel also disputes Mankin's view questioning the value of our legal water management framework.
Environmental activist Frank Colver makes his way over the dried and cracking silt left where the Escalante River joins Lake Powell in Glen Canyon National Recreation Area, Utah, on May 13, 2022. The receding water of the lake has the river cutting through the decades of accumulated silt to form a delta where it meets the lake.

Kelly Presnell / Arizona Daily Star

"What else is there if you change that framework and you change water law? You are taking peoples’ property rights and you'll have to pay for it.

"If you completely change it, what do you change it to? We are very oriented on states' rights. The only way you could change it is to a federal system for managing water. I just don’t see that happening."

"We all know they divvied up the river with more water at the time than there is now," Gimbel said. "Fixing that goes back
to demand management. How can we operate the river so everyone is sharing the risk of aridification, yet continue to grow our robust economy to feed people and give them water for health and welfare?"

Unlike Mankin, Gimbel sees the reservoir system as still functional, while acknowledging it’s been under a lot of stress.

“He acknowledges the reservoirs were built to capture water in the good years to sustain us in the bad years. They’ve done that. We’ve maintained our economy for the last 20 years on the Colorado River. There’s obviously issues now with the Colorado River, but the reservoirs in general, they are doing what they are supposed to do.

“I don’t agree that the system is on the edge. The hard part is when you have the two largest reservoirs in the country on one river system, the way they been operated over the last 20 years, maintaining overuse of water by the Lower Basin, that is where we’re hurting,” Gimbel said.

To her, fixing things is a matter of experimenting and trying alternative management strategies. The seven states have done that twice now — first when they approved operating guidelines for the reservoirs in 2007, second when they approved separate drought contingency plans for each basin in 2019. Neither has worked as well as officials had hoped,
"considering the climate we have," she said.

Today, "I feel a lot more optimistic than Professor Mankin," she said. "He acknowledges there's a lot of very smart people working on this. These people have shown themselves to be capable of thinking outside the box.

"They are innovative. They are creative. They all have constituencies they have to report to. One of their challenges is just getting the political will in each of the seven basin states to try something different, as well as getting the federal government to agree to do something different."

'Yes, we're in the early stages of collapse'

Much less optimistic is Kathleen Ferris, director and chief counsel for the Arizona Department of Resources nearly four decades ago and today a water lawyer, policy analyst and researcher.

"I've never seen a situation where every single person in water I know is equally concerned. Many times in the past, people would say 'we can make it through this and through that. We just need a few good years. We just need to work a little harder.' No one is saying that anymore. Anyone who is responsible is saying we've got a real big problem here," Ferris said.
“Yes, we're in the early stages of collapse. I’m seeing the headlines, and the fear among the people who should know the most about this, the water managers. They're not so sure we can get through this when they used to say we could,” said Ferris, a senior research fellow at Arizona State University's Kyl Center for Water Policy and a legal counsel and policy adviser for the Phoenix-based Arizona Municipal Water Utilities Association.

Part of the reason it’s been hard for the basin states to reach consensus on cutting water use is that it’s not clear people have a good understanding of what the options are, Ferris said.

If Mankin says "this 100-year-old system doesn’t conform with reality, what does?" she asked. "Is it replumbing the reservoirs? Is it taking down Glen Canyon Dam? And I’m not hearing the government talking much about what might be done.

“I hear them saying, 'We’re going to try to figure out a way to get water out of Lake Powell below dead pool.' That’s just creating another problem to me. How long can that last? That is a short-term fix for a long-term problem. Because if it reaches dead pool, and you take the water out that's still there, there’s nothing there left,” Ferris said.

“I would like to be optimistic about the future of the Colorado
"We have to change the way we live," she said. "Our priorities have to change. We have to really think hard about growth and how we're going to get from here to there. We have to live within our means, but first we've got to figure out what our means are and go about living within those means."

Our team on this investigation

Reporter Tony Davis graduated from Northwestern University and has written about Southwestern environmental issues for more than 40 years for newspapers including the Albuquerque Tribune, the Tucson Citizen, High Country News and the Arizona Daily Star, which he joined in 1997. He was named Journalist of the Year in 2020 by the Arizona Press Club and has received many other reporting awards, including from the national Society of Environmental Journalists and the regional Best of the West. He can be reached at 520-349-0350 or tmdavis@tucson.com.

Photojournalist Kelly Presnell joined the Star in 2003 after working for papers in Kansas, Virginia and North Carolina. He has won six National Press Photographers Association Regional Photographer of the Year awards, two Best of the West awards and honors from the National Association of Hispanic Journalists, as well as being named Photographer...
of the Year by both the Arizona Press Club and the Arizona Newspapers Association. He can be reached at
kpresnell@tucson.com.

Photos: The receding waters of Lake Powell, Glen Canyon National Recreation Area

Tom Wright hikes past the beached marker for Willow Canyon where it joins with the Escalante River, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star
A big horn sheep stands with the moon as a backdrop, looking over Fiftymile Creek, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star
Tom Wright walks through the shaft of light peeking through the narrow openings of the formation called the Subway in Fiftymile Creek, accessible since the waters of Lake Powell have fallen dramatically.

Kelly Presnell Arizona Daily Star
A narrow sliver of sky is visible overhead through the narrow opening of the formation called the Subway, Fiftymile Creek, accessible since the waters of Lake Powell have fallen dramatically.

Kelly Presnell Arizona Daily Star

The dark streaking, called Desert Varnish, is from the seepage of oxidation in the rocks, and is beginning to erase the "bathtub ring", the lighter colored marks left by the waters of Lake Powell on canyon walls, Fiftymile Creek, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star
The remains of a small boat, underwater for years, reemerges due to receding water levels of Lake Powell in the Glen Canyon National Recreation Area, Utah.

Kelly Presnall Arizona Daily Star

Frank Colver makes his way over the dried and cracking silt left where the Escalante River
joins Lake Powell, Glen Canyon National Recreation Area, Utah. The receding water of the lake has the river cutting through the decades of accumulated silt to form a delta where it meets the lake.

Kelly Presnell Arizona Daily Star

A warning buoy sits high and dry far from the end of the closed public boat ramp at Bullfrog Bay, Glen Canyon National Recreation Area.

Kelly Presnell Arizona Daily Star

A line of tires that were once breakwaters at Bullfrog Bay Marina are now stranded on the rocky landscape high above the current water levels at the Glen Canyon National Recreation Area, Utah.
A pedestrian ramp lies well above the water levels at Bullfrog Bay in the Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star

A stranded wakeless zone buoy sits on the cracking silt outside the new shores of the Bullfrog Bay Marina, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star
The end of the ferry ramp ends well short of the new water levels of Bullfrog Bay on the Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star

An early riser watches the sun come over the low waters of Bullfrog Bay Marina, Glen Canyon National Recreation Area, Utah. The lighter colored areas on the canyon wall mark previous water levels.

Kelly Presnell Arizona Daily Star
A group of river rafters drift west on the current of the San Juan River outside Mexican Hat. The San Juan feeds Lake Powell.

Kelly Presnell Arizona Daily Star

The tops of a few cottonwood trees begin to poke out of shrunken water of Lake Powell, Fiftymile Creek, Glen Canyon National Recreation Area, Utah.
The remaining large water craft and house boats are crowded together in one of the last areas of water deep enough to support them at Wahweap Mariana, Glen Canyon National Recreation Area, Page, Ariz.

The waters of Lake Powell are twenty to thirty feet below the end of the public boat ramp at Wahweap Mariana, Glen Canyon National Recreation Area, Page, Ariz. Personal non-powered craft still use the ramp to unload, but must be carried up and down the banks to reach the water.
A view north from the Wahweap Marian Overlook show the shrunken waters around the marina in Glen Canyon National Recreation Area, Page, Ariz.

Kelly Presnell Arizona Daily Star

The underside of Gregory Natural Bridge, passable for the first time in almost 50 years, over the Fiftymile Creek, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star
The moon rises over Gregory Natural Bridge, passable for the first time in almost 50 years, over the Fiftymile Creek, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star

The exposed penstocks (intakes to the power turbines) on Glen Canyon Dam in the Glen Canyon National Recreation Area, Page, Ariz. The water level is at its lowest since 1967, when the dam was still being initially filled.
A group of sightseers get a look at the Glen Canyon Dam during a boat tour of Lake Powell, Glen Canyon National Recreation Area, Page, Ariz.

Kelly Presnell Arizona Daily Star

A small fishing boat ties up on the breakwater just outside the intakes for the Glen Canyon Dam, Glen Canyon National Recreation Area, Page, Ariz. The penstocks (water intakes to the power turbines) are revealed for the first time since 1967 when the Lake Powell was being filled.

Kelly Presnell Arizona Daily Star
Swimmers and bathers use the jagged shores of the newly exposed banks of Lake Powell just above the Glen Canyon Dam, Glen Canyon National Recreation Area, Page, Ariz.

Kelly Presnell Arizona Daily Star

The Glen Canyon Bridge lies in front of electrical towers with feeder lines rising from the hydroelectric plant in the Glen Canyon Dam, Page, Ariz.

Kelly Presnell Arizona Daily Star
Glen Canyon Dam from Glen Canyon Bridge, Page, Ariz.

Kelly Presnell Arizona Daily Star

Small power boats on the Colorado River head upstream just below the Glen Canyon Dam,
Wade Quilter walks through the remains of cottonwood and Russian olive trees washed down and joined with silt to form a natural dam where Willow Canyon joins with the Escalante River, Glen Canyon National Recreation Area, Utah.

The remains of a big mouth bass lay in the silt just above where the Escalante River joins Lake Powell, Glen Canyon National Recreation Area, Utah.
The formation known as The Cathedral in the Desert on Clear Creek, Glen Canyon National Recreation Area, Utah. The re-emergence of the formation is drawing sightseers after being submerged for some 50 years.

Kelly Presnell Arizona Daily Star
the Desert on Clear Creek, Glen Canyon National Recreation Area, Utah. The re-emergence of the formation is drawing sightseers after being submerged for some 50 years.

Kelly Presnell Arizona Daily Star

Frank Colver takes a quiet moment and plays a handmade flute near the waterfall in the formation known as Cathedral in the Desert on Clear Creek, Glen Canyon National Recreation Area, Utah. The re-emergence of the formation is drawing sightseers after being submerged for some 50 years.

Kelly Presnell Arizona Daily Star
Jake Quilter walks down the newly cut banks of Clear Creek just outside Cathedral in the Desert, Glen Canyon National Recreation Area Utah. The sand is silt left behind by the receding waters of Lake Powell.

Kelly Presnell Arizona Daily Star

The tops of cottonwood trees that used to be under a hundred feet of water in Lake Powell are visible again in Clear Creek, Glen Canyon National Recreation Area, Utah. The deep
water preserved the remains of the trees.

Boaters have to zig-zag through the rocks emerging due to receding waters of Lake Powell, Glen Canyon National Recreation Area, Page, Ariz.

Several images combined for a panoramic view of the Colorado River where it runs through the what once was Hite Marina in the Glen Canyon National Recreation Area, Utah.
A couple of sightseers take in the view from Hite Overlook over the Colorado River and the closed Hite Marina, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star

Lone Rock, jutting out of the dry bed, would usually be surrounded by Lake Powell but is now well clear of the water, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star
Tires that used to hold the lines well below the surface of Lake Powell are suspended over the water at Antelope Point Marina, Ariz.

Kelly Presnell Arizona Daily Star

Sightseers twenty or thirty feet above get photos of the low water levels of Lake Powell from the public boat ramp at Antelope Point Marina, Ariz.

Kelly Presnell Arizona Daily Star
The pedestrian access ramp ends abruptly twenty feet over the new Lake Powell surface at Antelope Point Marina, Ariz.

Kelly Presnell Arizona Daily Star

The entrance to the pedestrian access ramp of the Antelope Point Marina is taped off after being cutoff from the docks due to receding waters of Lake Powell.

Kelly Presnell Arizona Daily Star
Contact Tony Davis at 520-349-0350 or tdavis@tucson.com. Follow Davis on Twitter@tonydavis987.

Subscribe to stay connected to Tucson. A subscription helps you access more of the local stories that keep you connected to the community.

Be the first to know

Get local news delivered to your inbox!

Tony Davis

Tony Davis
Reporter

Tony graduated from Northwestern University and started at the Star in 1997. He has mostly covered environmental stories since 2005, focusing on water supplies, climate change, the Rosemont Mine and the endangered jaguar.
At Glen Canyon, receding waters reveal a cathedral—and shift debate

Tony Davis  15 hrs ago

Editor's note: This is the second of six stories for "Colorado River reckoning: Not enough water," an investigative series by the Arizona Daily Star that observes, at length, the future of the Colorado River.

It was a scene many Southwestern water experts thought they'd never see.

Certainly not at Lake Powell, the nation’s second biggest
reservoir, playground for millions of boaters and fishers each year. It's a place both beloved and hated after its creation three generations ago — by damming the Colorado River — obliterated a transcendent natural landscape with water hundreds of feet high.

But there it was, in a small side canyon, maybe six miles upstream of the main lake — a marvel that had been underwater for most of six decades: A ribbon of water tumbled down a 75-foot-tall slickrock face in a massive grotto of red, pink and orange Navajo sandstone.

People are also reading...

It is a place aptly named Cathedral in the Desert before the U.S. built Glen Canyon Dam and flooded it out.
Sightseers explore the formation known as Cathedral in the Desert in Glen Canyon National Recreation Area, Utah. The cathedral has reemerged — revealing a waterfall that's some seven stories tall — after being submerged for decades by manmade Lake Powell.

Kelly Presnell / Arizona Daily Star

A group of river advocates who knew of Cathedral's historic reemergence approached the grotto in May via a trickling stream, first by power boat, then on foot. It was a short walk to Cathedral from where the creek slows to a trickle and hits sand, but it seemed like a visit to a lost world.

They were joined by a group of high-school teens and college students who swam, splashed and frolicked in the greenish-hued natural pool, about waist deep, where the waterfall landed.

While sunlight barely peeped through the closed-in canyon walls, it radiated intensely off the slickrock and reflected off a bit of the pool. The sandy ground surrounding the pool rose sharply to form a bluff, maybe 15 feet high.

One moss-covered wall section looked like iridescent fish skin, with water seeping from the shiny slickrock. All the walls dripped with desert varnish, orange-yellow to black coating often found on exposed rock surfaces in arid environments, composed mainly of clay minerals, oxides and hydroxides of manganese and iron. Cathedral lies at the end of Clear Creek, connecting to the Escalante River, which itself winds around six miles of reddish brown slickrock.
before connecting with the main lake body on the Colorado River.

One of the river advocates, a white-haired, white-goateed 87-year-old retired electrical engineer named Frank Colver, played a haunting, improvised melody on a flute he’d made four years ago from an elderberry tree branch he’d gathered in Southern California’s San Bernardino Mountains. He wore a forest green cap that said “Damn Dam” and a brown Grateful Dead jacket. The younger crowd fell silent as Culver played, then applauded when he finished.

Cathedral in the Desert’s reappearance underscores a huge transformation. It’s one of many areas of historic Glen Canyon now returning to public view as Lake Powell keeps falling, dropping precipitously because of drought and climate change.

Cathedral and the rest of Glen Canyon had been underwater sanctuaries for most of the past 60 years — hidden beneath Powell’s rising waters since the federal government closed the dam’s gates in 1963, creating the lake that straddles the Arizona-Utah border.

A lot of anger and angst had poured since then from environmentalists in the forms of novels, polemics, songs, protests and essays over the loss of the canyon.
The flooding of its slickrock, its pinkish sandstone walls, its rounded hoodoo sculpted rock structures, the raw, reddish hues of the muddy river, its green pools, the cottonwood and willow trees, the ancient Native American petroglyphs and other ruins, and the sheer serenity of the canyon's atmosphere — all combined to inspire a movement, first to honor Glen Canyon’s lost world, then to fight for its restoration.

To many critics, Glen Canyon Dam was one of the U.S.'s biggest environmental mistakes of the 20th century.

In the 1960s and ’70s, nature-lovers were ignited first by Edward Abbey’s essay on a trip down Glen Canyon in his “Desert Solitaire,” and then by Abbey’s novel “The Monkey Wrench Gang,” a fanciful account of a group of eco-raiders who plotted — but never actually tried — to blow up the dam.
Glen Canyon Dam under construction in 1963. This view from upstream, behind the dam, reveals the eight penstocks that feed water through eight massive generators in the power plant, producing electricity for 5 million customers in the West, including some in Phoenix.

U.S. Bureau of Reclamation

In the 1980s, the radical group Earth First! dropped a 300-foot-long plastic “crack” down the dam to protest its presence.

The next decade, the nonprofit Glen Canyon Institute was founded in Utah to push for draining of the lake and to ultimately “Fill Mead First,” by putting all the water stored in Lake Powell in Lake Mead, lying downstream of the Grand Canyon.

These efforts failed because they encountered more
powerful economic, political and hydrologic realities. For one, Lake Powell has been a huge recreational spot of its own, drawing millions of visitors annually and thrilling boaters.

State and federal water officials paid no heed to the environmental protests and efforts, since they counted on storing water at Powell for eventual delivery downstream to Arizona, California and Nevada to meet their legal obligations under the 1922 Colorado River Compact.

Another reason is the dam generates electricity for about 5 million people living in seven states, including summertime peak load power for the Phoenix area.

But now in Glen Canyon, new cottonwood and willow shoots are sprouting. Older, dead cottonwoods are jutting 25 and 50 feet from receding waters.

Ancient rock formations long submerged now protrude 50 to 75 feet or more into the air. More waterfalls, pools and grottos like those in Cathedral are emerging. At Cathedral itself and in many other places, strips of desert varnish are slowly covering the canyon walls and beginning to replace the trademark white bathtub ring that shows how far the lake’s waters have dropped. Over time, the varnish will rust into a darker red as it covers the bathtub ring.
“This is a dream come true, hiking into Cathedral in the Desert,” said flutist Colver, a retired electrical engineer, as he approached the waterfall and pool. “Woo-hoo!”

As water in one of the nation's largest reservoirs recedes, geologic features hidden for nearly 50 years are revealed in Glen Canyon National Recreation Area in Northern Arizona. Video courtesy of Glen Canyon Institute, 2022

Glen Canyon Institute, 2022

But this dream wasn’t realized by adroit lobbying, timely litigation or a change of heart among public officials. It was the product of the biggest environmental disaster in modern recorded history, one that calls into question the survival of the water delivery system on which 40 million people in the West depend.

Global warming, triggered by the burning of fossil fuels, is blamed by many scientists and a fistful of studies for up to half the decline in annual Colorado River flows of at least 20% since the start of this century.

Those declines lowered Lake Powell’s water level by about 170 feet from July 1999 to 3,523 feet in mid-May, when an Arizona Daily Star reporter and photojournalist spent seven days on the lake, including accompanying Colver and his fellow river advocates on their visit to Cathedral in the Desert. Just in the past year, the lake had dropped 38 feet by the week of that visit.
While Powell rose more than 15 feet in the two months after that trip due to normal spring-summer runoff and other factors, it started declining again in mid-July and is expected to keep falling for many more months.

Conditions on the river are dire enough that, in June, the U.S. Bureau of Reclamation ordered the seven river basin states including Arizona to come up with a plan by August to reduce their use of river water by up to 28% starting next year. That didn’t happen, and the bureau didn’t carry out its threat to impose its own water cut plan on the states.

That left it uncertain what, if anything, will be done to reduce a water imbalance on the river between supply and demand that’s approaching 3 million acre-feet a year. That’s about three times as much as the Central Arizona Project canal system delivers annually to cities and farms in this state’s parched midsection.
The tops of a grove of cottonwoods in Lake Canyon poke up through decades of accumulated silt, now drying and cracking after resurfacing due to the drastic drop in water levels of Lake Powell in Glen Canyon National Recreation Area.

Kelly Presnell / Arizona Daily Star

At Powell itself, the water level declines have triggered a host of problems for visitors. All but two of a dozen boat ramps are totally or partially closed because the water is too low for the ramps to reach. A crucial marina about halfway up the lake has closed indefinitely. Some popular destinations on the lake are now difficult or impossible to reach, and the future of reservoir operations remains an open question.

But the question is no longer: Should Lake Powell be manually drained? If the lake keeps sinking, it could eventually drain on its own.

Nor is the question, as many Glen Canyon advocates have
framed it in the past, still: Should we "Fill Mead First?" Even if all of Lake Powell’s water were emptied into Lake Mead, Mead would be barely half full.

It’s now: Will the lake drain on its own, before humans can figure out how to “save” it?

And, should authorities plan for that, or should they plan and hope that the colossus that is Lake Powell, its five marinas, its thousands of houseboats, its 186 miles of waterways and its shorelines that exceed the length of the Pacific Coast, will outlast its skeptics?

Light as through stained glass

In July 1954, folksinger, Hollywood actress and Colorado River runner Katie Lee encountered Cathedral in the Desert during what was to be the first of her 16 rafting trips through Glen Canyon before Lake Powell drowned it.

A half-century later, Lee, by then an activist dedicated to getting the dam removed, described that first visit to Cathedral in her book, “Glen Canyon Betrayed”:

“On to more stringy pools, up over boulders slick with algae, into an immense cathedral. A stone altar stands dead center under the dome ... Here the light seems to come through blue-purple-rose stained glass high above. It filters down
onto the altar, on top of which lies an eroded sheaf of rocks resembling a gigantic book with its pages open!

“There are three of those cathedrals, each with its stone altar beneath the overhang, each with the eerie light from the nave. Our ‘oohs’ and ‘ahs’ blend with the whispering water,” wrote Lee.

Then, in the early 1970s, after Powell had flooded Glen Canyon and its tributaries, the debate over lake and canyon flared in print, when author John McPhee took environmentalist David Brower and just-retired Bureau of Reclamation Commissioner Floyd Dominy for a boat tour of the lake for his environmental classic, “Encounters with the Archdruid.”

Brower, who had just left his job as Sierra Club director, told McPhee, “The magic of Glen Canyon is dead. It has been vulgarized. Putting water in the Cathedral in the Desert was like urinating in the crypt of St. Peter’s.”

Dominy, the dam's biggest booster, shouted back, according to McPhee: “Don’t give me the crap that you’re the only one who understands these things. I’m a greater conservationist than you are, by far. I do things. I make things available to man. Unregulated, the Colorado River wouldn’t be worth a good goddam to anybody. You conservationists are phony outdoorsmen.”
Part of Cathedral briefly reappeared in the early to middle 2000s, when the Colorado River Basin endured a shorter and less intense drought that brought Powell down to a then-record low of about 3,555 feet in April of 2005.

Katie Lee, then 85, was boated to Cathedral by an NPR reporter that spring. “And I hear the waterfall and I can remember that sound really well, 'cause it fell into this beautiful pool and the pool was only about as big as this part where we are right now. You know, just a little circular pool right here. That's all it was,” said Lee.

Mourning what was still lost, though, Lee added, “The canyon wrens are gone because there's no trees here, but you would hear the canyon wrens, and they were the Glen Canyons, and you'd hear the trees rustling a little bit with the breeze blowing by. So there's a lot missing.”

Huge snows fell that year, boosting the reservoir by 50 feet. Cathedral and other remnants of the pre-dam Glen Canyon were inundated again.
Tom Wright, an archaeologist and Glen Canyon Institute member, feels the water oozing from the rocks in the formation known as Cathedral in the Desert.

Kelly Presnell / Arizona Daily Star

'Close to a religious experience'

Colver, of Newport Beach, California, and three others who belong to the Glen Canyon Institute led the Star to Cathedral and several other once-vanished canyon landmarks in May via pontoon boat. The Salt Lake City-based group has fought for 25 years to see the dam decommissioned and the river run free and wild again.

Their boat left from Bullfrog Marina, a once-vibrant boat departure spot that was close to empty that day due to the record low water levels.
As he sat in the boat waiting to take off, Colver spoke of his first trip to Glen Canyon in 2011. It was an extraordinarily wet year, in which Powell jumped another 50 feet to 3,660 feet by mid-summer after having fallen considerably since 2005.

“There were no birds, no flies. All the vegetation was dead. It was a dead world,” Colver recalled.

But Colver was able to see increasingly large sections of Cathedral in separate trips in 2014, 2019 and 2021. Each time, the waters of Clear Creek leading to the canyon dropped a little lower, forcing him to walk a little farther: 50 feet in 2014, a quarter-mile this year. Cathedral’s visible waterfall also kept growing, from about 25 feet eight years ago, to virtually the entire, pre-dam elevation of at least 75 feet this time.

As Colver and his colleagues walked up Clear Creek, Cathedral’s walls were so narrow that one could barely see an opening in the sky. Dead cottonwoods were poking out of the stream leading to it. The canyon walls along the creek bled many colors — orange-red of the native sandstone, deep brown, white and green where algae had grown.

Institute member Tom Wright of Tempe, a professional archaeologist, was the first member of the Glen Canyon Institute group to arrive at Cathedral on this trip. Hearing the partiers park their boat behind him, Wright rushed toward
the grotto, then stopped just before reaching it, to say a short, silent prayer of gratitude, he said later.

The 67-year-old Wright said he had figured he had a one in a lifetime chance of seeing Cathedral, but he now hopes this was the first of many trips there.

"It was not only something close to a religious experience for myself," he said, "it was like wow, the impossible has become possible."

**Affection for lake and canyon**

As the teens and students entered the grotto, several took turns swinging on a rope across the pool that someone had previously, somehow, attached to a canyon wall. A member of the institute eventually cut the rope so people couldn’t swing on it anymore.

One participant on the trip, 22-year-old Zack Douglas of Bozeman, Montana, pronounced the scene at Cathedral “so cool,” but said that after making a handful of trips to Lake Powell, “every time it makes me want to move here. I hope it doesn’t drain. I hope it fills back up completely.

“Maybe it was a mistake to build it but it’s not right to take it down. Maybe they should only fill it 30 feet,” said Douglas.

Watching them cavort in Cathedral’s pool were Susan and
Reid Leland, an Ogden, Utah, couple who’d brought their three children, ages 18 to 22, so they could all see the lake “before it dries up,” Susan Leland said.

“We do love the lake. I understand it would be better if it were a canyon in its natural state. But even if it’s going down it still has value,” she said.

The Lelands had, with another family, paid close to $8,000 to rent a 75-foot-long houseboat for a week’s trip through the lake. Two days earlier, however, a massive windstorm with gusts blowing at 100 mph had torn off the boat’s roof, and they were now touring by ski boat.

"If the lake were gone, I would miss it," Reid Leland agreed. "It offers so much enjoyment." Having been to the lake many times and read up on the water issue, he sees the lake’s problems.

“They created a huge reservoir of water. It was like a bank. We created a huge savings account full of water. With more population, we made more withdrawals than deposits. It feels like we are on the verge of collapse,” he said. “The question is, how is it sustainable?"

He said he understands why many think the dam shouldn't have been built, but he also thinks it would be wrong to let the lake drain.
"Two mistakes don’t make a right," he said. "It’s a question there’s no right or wrong answer to."

Dark streaks of "desert varnish" above Fiftymile Creek, a result of seepage of oxidation in the rocks, is beginning to erase the bathtub ring — the lighter colored marks left by receding waters of Lake Powell.

Kelly Presnell / Arizona Daily Star

**Ironic recovery due to climate change**

Wade Quilter, 25, who guided the institute’s pontoon boat up the Escalante River toward Clear Creek, recalled that his parents had taken his family to Powell every year from the time he was a toddler until he was a high school senior. He got a glimpse of Cathedral back in the mid-2000s when he was 8, seeing 3 feet of the waterfall with the lake rising to the waterfall’s lip.
His parents brought him to Powell to ride in ski boats but he eventually transitioned to rock climbing and dirt biking. By 2015, Quilter was leading rafting trips down Cataract Canyon, which collides with Powell well upstream of Bullfrog Marina.

Now, heading into his senior year of college and preparing to apply to medical school, Quilter said he wants to spend more time seeing Glen Canyon come back, and to bring high schoolers there. He wrote a college research paper on Glen Canyon based in part on research done by the institute, and joined the group this year.

“This lake is dropping so fast. I want to be part of it. I want to see this actually happen, to come out here and run trips.

“This canyon is healthier without a lake in it. A river is supposed to flow. It’s not supposed to be stagnant. We are going to have to learn to manage the water better,” Quilter said.

That Glen Canyon is recovering due to climate change he sees as an irony and a silver lining to the climate crisis that’s bringing droughts, flooding, extreme heat waves and worsening wildfires across the globe.

“Recovery can serve as a wake up call to deal with climate change,” he said.
While it’s easy to get “down and out” about climate-related problems, focusing on things like Glen Canyon’s recovery can also trigger positive environmental change, Quilter said.

“The negative makes us feel hopeless. The more we can get people to love nature, the better off society will be, in the sense of working toward ways to fix our climate problem.”

The underside of Gregory Natural Bridge, passable for the first time in almost 50 years, spans Fiftymile Creek, Lake Powell, Glen Canyon National Recreation Area.

Kelly Presnell / Arizona Daily Star

Seeing another Glen Canyon icon

From Cathedral, Quilter guided the boat back to Escalante River, then farther upstream to Fiftymile Canyon and a view of another Glen Canyon icon: the Gregory Natural Bridge. Its
sandstone span dominates the surrounding landscape, forming an arch that curves over the canyon.

More spectacular red rock foundations surround the bridge, including a spire topped by a sharply formed peak.

The bridge spans about 175 feet from side to side, while the arch rises about 25 to 30 feet above the water. That’s well below the 75-foot elevation that pioneering Colorado River guide Norm Nevills saw at the bridge when he first spotted it in 1940.

Nevills, the first commercial Colorado River guide, popularized the natural bridge, leading boating and hiking tours there. But it never really became popular until the gates closed on the dam in 1963. Then, visitors flocked to see it before the rising waters overwhelmed it.

“A striped patina of desert varnish graced the massive structure. Cottonwoods formed a trembling border of green. Natural bridges are themselves uncommon, even in the Colorado Plateau, but beautiful Gregory, considering the arid setting, was a rarity: the rock canopy spanned a perennial streamflow,” wrote author Jared Farmer in a 1995 article for the Utah Historical Quarterly.

Rich Ingebretsen, the Glen Canyon Institute’s founder, joined the May camping trip on its second day. As the group walked
toward the bridge down Fiftymile Canyon, he recalled Gregory was the “showpiece” for the legendary river guide Nevills, who led rafting trips down Glen and Grand Canyons in the ‘30s and ‘40s, including one featuring future Arizona Sen. Barry Goldwater.

“Norm Nevills would have people hike to Gregory Bridge. He made them think it was better than to hike to Rainbow Bridge" (the famed Rainbow Bridge National Monument, on Powell’s southern shore). "He had flights go to Gregory Bridge,” Ingebretsen said.

Before it was submerged, the top of the bridge span was about 200 feet high. The bridge was completely covered by the reservoir in 1969 and remained out of view until sometime in 2021, when Powell descended into record low water level territory.

“A lot of the arch is still under water,” Colver said. “We don’t know how much silt has built up since it was flooded. Who knows how long it will be before the whole opening will be visible?”

Just east of the bridge, the institute’s boat stopped at the foot of an alcove, at least 100 feet above the water level. You had to trudge up a sandy hillside to reach it; Colver recalled boating right up to it back in 2004.
As the group prepared to depart the alcove, someone spotted two desert bighorn sheep gracing a red-topped ridgeline standing a ways east of the Gregory bridge. By then, evening was approaching, and a full moon in the east sky formed a backdrop.

“That’s a good omen. It’s a good place to be. You can get spiritual with it — a place where nature and spirituality connect,” Wade Quilter said. “Moments like this show what’s going on — there’s a whole lot more than us.”

**Anger over 'stupid' dam**

The Subway, a 90-minute, tunnel-like experience on foot, lies a couple miles and a different geologic universe upstream of Gregory Natural Bridge along Fiftymile Canyon. The walls of Fiftymile Canyon tower several hundred feet high and at their closest meet a few feet apart.

Down below, you walk along a creek bed that frequently and abruptly widens and narrows. Sometimes the canyon is wall-to-wall water, forcing you to get your feet wet and at times your pants, too. Desert willows, baby cottonwood shoots and green thistles line the banks.

As Glen Canyon Institute founder Ingebretsen navigated the Subway, he spared no invective in his attacks on the dam and reservoir he’s fought to drain for 26 years.
Now 69, he’s an emergency room physician in the Salt Lake City area, and doubles as an adjunct lecturer for the University of Utah’s Department of International Medicine and at several other universities.
Ingebretsen recalled first seeing Glen Canyon in the early 1960s as a child, on a Boy Scout trip. The lake was being filled, but remained very low, and he could see that the dam’s top parts were still being finished.

There, he hiked up the since-inundated Forbidding Canyon, and slid down some pools in neighboring Bridge Canyon after seeing Rainbow Bridge there. He recalled walking up a trail through a tall, narrow canyon, with “skeeters and tadpoles” flying around little pools.

As they walked, a guide told them, “Enjoy it. It’s going to be underwater in a year,” Ingebretsen said.

After the hike, the scouts crossed the river to an alcove, across from Forbidding Canyon where they ate and watched birds flying around.

"The guide, again, told us that this would be under water,
and no one would ever see it again. It made me sad. It was pretty and I did not understand why they would cover it up.”

As a teenager in the early ’70s, Ingebretsen went back to some of the same spots with a high school group in a boat, from which he saw water covering the trail that he had hiked a decade earlier. Again, hurt and anger overcame him.

“It took millions of years to create Glen Canyon. That dam destroyed it in 20 years,” Ingebretsen said.

He feels the biggest reason for the dam’s presence is that the Upper Colorado River Basin states of Colorado, New Mexico, Utah and Wyoming wanted the project to keep some of the river’s water for themselves. The dam was targeted for a remote corner of Utah and Arizona, too far from most of the basin’s farms and cities to make direct use of the water.

As Ingebretsen saw it, Glen Canyon Dam was and is a vehicle for holding back some of the river’s annual flow so it didn’t all go to Lake Mead where the Lower Basin states of Arizona, California and Nevada could get it.

“It’s so the Lower Basin doesn't get more than its required share of the water,” he said. “The Upper Basin was afraid that if the Lower Basin gets more than their share, the Upper Basin won’t get it back.”

The dam was put as close to the boundary between the two
basins, which is at Lee's Ferry, 16 miles west of Glen Canyon Dam, as it could be, he said.

"It’s a philosophical dam — a political dam," Ingebretsen said. "It’s stupid."

![The Glen Canyon Dam site as it looked in 1889 and then in 1992.

U.S. Geological Survey](#)

**Dam built to keep some water from California**

To that point, historians, books about the dam and congressional testimony offer two schools of thought.

The first backs up Ingebretsen’s argument — that the dam was built to keep all of the river’s water from flowing to the Lower Basin, particularly California, which was viewed by Upper Basin leaders as a voracious, water-sucking monster whose officials coveted the river for its own population growth.
The second viewpoint contradicts Ingebretsen, arguing that a real need existed for the dam to store enough water to insure there was enough to meet the 1922 Colorado River Compact’s requirement that the Upper Basin send 75 million acre-feet to the Lower Basin states every decade.

The idea was that the dam would store enough water to have plenty available in dry years when there otherwise wouldn’t be enough.

The dam’s construction was authorized by Congress in April 1956, as part of a much larger approval for the Colorado River Storage Project, which included 11 dams and other water projects total, spread across all four Upper Basin states. The Glen Canyon Dam was considered the cornerstone, its 26 million acre-foot capacity giving it about half the water storage space offered by the entire project.

In 2008, Utah State University historian Stephen Spurgeon chronicled the many arguments advanced for the project in an essay titled, “Just Add Water: Reclamation Projects and Development Fantasies in the Upper Basin of the Colorado River.” He painted the region as having an inflated sense of the Colorado River Storage Project’s value, far beyond the main reason linked to most reclamation projects in the past: promotion of irrigated agriculture.
The project’s earliest stated goals were to build dams to
generate enough electricity to be sold for cash to pay for additional irrigation projects, he wrote. But the Bureau of Reclamation and its boosters actually had a much larger agenda in mind: "to transform the Upper Basin of the Colorado River from a desert wasteland into a new industrial and recreational center for the United States," Sturgeon wrote.

The mining of what were believed to be vast, untapped resources topped the list of potential benefits.

Pamphlets featuring maps described the region as the "treasure chest of the nation."

Minerals reputed to exist there included lead, copper, iron, zinc, phosphates, gold, silver, oil, natural gas, gilsonite, gypsum, tungsten, molybdenum, and vanadium, Sturgeon wrote.

He continued, “Promoters were quick to emphasize that the Upper Basin was the chief domestic source for such strategic minerals as uranium, and contained the world’s largest reserves of oil shale. All that was needed to unleash these potential riches was power and water.”

But those and many other examples of boosterism aside, the overwhelming motivation driving the push for Glen Canyon Dam and the rest of the storage project was fear and
suspicion of California, Sturgeon told the Star.

Legally, both basins, Upper and Lower, have rights to the same amount of water under the 1922 Colorado River Compact — 7.5 million acre-feet per basin. But led by Hoover Dam, most water developments since 1922 had landed in the Lower Basin, largely due to California’s political power, he said.

Due to the Upper Basin’s low, rural population, water development there languished. The actual Upper Basin watershed consists mostly of rural areas and small cities and towns, with its bigger cities being Denver, Salt Lake City and Albuquerque.

“In water law there is a ‘use it or lose it’ provision when it comes to water rights. Over time the Upper Basin became nervous that if they did not do something to capture and retain their portion of the Colorado River, then California would eventually establish a de facto right to the water,” Sturgeon wrote in an email to the Star.

“Did politicians believe in all the booster literature that talked about visions of massive industrial development in the Upper Basin that would benefit from the water that the (river storage project) would capture? My guess is that they did believe it to at least some extent, but it would probably be more accurate to say that they couldn't envision a future for
the region without access to Colorado River water, that California represented a threat to that water, and therefore they needed to take steps to eliminate that threat.

“In other words, the first priority was controlling the water. Once that was done, then development could proceed,” wrote Sturgeon.

Construction 'inevitable'

Author and retired water manager Eric Kuhn has a different take.
In 2019, Kuhn and University of New Mexico water researcher John Fleck co-authored a book outlining how the river’s dams and other water projects had been developed despite century-old warnings from scientists that the river doesn’t contain nearly the amount of water allocated to the basins by the 1922 compact.

For their book, “Science Be Damned,” they extensively researched the history of how federal officials and Upper Basin water leaders developed a rationale for building Glen Canyon Dam and the rest of the storage project.

Through the 1930s and early 1940s, Reclamation prepared a detailed report, outlining the type of water developments that would be needed for the Upper Basin to have adequate water storage for its own use, and to be sure of satisfying the bureau's 1922 compact obligations for water deliveries.

“The bureau had many meetings with the states while they prepared this report. With the success of Hoover, there was a lot of support within the bureau, the Interior Department, and all of the states, with the possible exception of California, for another big dam and Glen Canyon was the obvious choice,” Kuhn told the Star.

“When the different state and bureau hydrologists did their studies, they came up with similar answers. The Upper Basin needed about 30 million acre-feet of storage upstream of
Lee Ferry to meet their compact commitments,” said Kuhn, former general manager of the Colorado River Water Conservation District in Glenwood Springs, Colo.

Besides the water storage, the Upper Basin needed electricity from the turbines of Glen Canyon Dam and the other project dams to subsidize farms that would benefit from the irrigation works generated by the Colorado River Storage Project, Kuhn and Fleck wrote in their book. “Glen Canyon Dam was the linchpin,” Kuhn and Fleck added. “Its storage capacity would provide most of the holdover storage, and its hydroelectric power would provide the subsidies.”

Kuhn acknowledged that the idea of “‘keeping California and Arizona from taking all our water’ made great politics in the Upper Basin, and today it still does.”

But while politics provided the emotional argument for the dam, “I believe that even without the politics, the 1922 Compact provision requiring the Upper Basin to not deplete flows below 75 million acre-feet every 10 years made the authorization and construction of Glen Canyon Dam inevitable,” Kuhn said.

**Broad congressional support**
Testimony from a 1955 Senate subcommittee hearing on the Colorado River Storage Project showed both sides of the case.

Upper Basin senators expressed deeply felt fears that if the dam and other Upper Basin projects weren’t built, all the river water, including their share, would keep flowing into the Lower Basin. Then, the water would be either sucked up by the much more rapid development in Lower Basin states, or be “wasted” — running unused through then-lush, now mostly parched Colorado River Delta into the Gulf of California.

At the same time, many California officials were concerned that if the Upper Basin projects were built, they eventually would use enough water that there wouldn’t be enough left for Lower Basin states to grab their entire share, or that California would lose access to extra water it was using beyond its legally guaranteed supply.

Because California had first crack on development of the river with completion of Hoover and Parker dams in the Lower Colorado River Basin, “they now have nearly three times as much of the Colorado waters as the Upper Basin,” testified Utah Sen. Wallace Bennett, a leading proponent of the dam and the entire river storage project.

Due to the river’s boom and bust flow cycles, Bureau of
Reclamation studies showed that without enough dam space to store surplus waters in wet years, “only about 60% of the water allocated to the Upper Basin could be used,” Reclamation Commissioner Wilbur Dexheimer testified.

Bureau officials also testified that the other project dams would be able to furnish water for urban growth, for farming, particularly feed crops for cattle, and for extraction of oil, copper, uranium, phosphate, coal and other minerals.

The river storage project ultimately passed both houses of Congress by wide margins.
Secretary of the Interior Stewart Udall, third from right, and Floyd Dominy, far left, commissioner of the U.S. Bureau of Reclamation, show plans for a Western power project to others on June 2, 1964. Dominy oversaw construction of Glen Canyon Dam, and wrote later that it "has tamed the wild river — made it a servant to man’s will."

Byron Rollins / Associated Press

**Environmentalists gave the dam a pass**

Environmentalists and other conservationists, who stopped two other dams proposed for the storage project in Dinosaur National Monument at the Utah–Colorado border, gave a free pass to Glen Canyon Dam.
That was partly because it didn’t lie in a national park or monument, and partly because they didn’t want to be seen as opponents of all water development.

That was an act of omission that the Sierra Club’s Brower would regret for the rest of his life.

He recalled decades later that he always felt he could have stopped it. But in 1956 the Sierra Club’s board of directors instructed him, as the club’s executive director, not to oppose Glen Canyon Dam because Congress had killed the other dams.

“Instead of flying home immediately and calling for a special meeting, I just sat in Washington and watched the mayhem proceed,” Brower wrote in Sierra Club magazine in 1997, three years before dying at age 88.

As the Glen Canyon Institute’s Ingebretsen walked down the Subway section of Glen Canyon in May, he recalled that back in 1996, he’d asked Brower why he didn’t fight the dam.

“Brower said to me he didn’t know why he didn’t, and that ‘I will wear sackcloth and ashes for the rest of my life for not stopping that project,’” said Ingebretsen. Brower used that Old Testament phrase several times in his writings and speeches — it symbolizes mourning and repentance.

Not long after the dam was finished, Brower elaborated on
his regrets in a lavishly illustrated, Sierra Club coffee table book about the canyon, titled, “The Place No One Knew.” It contained more than 70 photos of the canyon by renowned nature photographer Elliott Porter.

In the foreword, Brower wrote: "Glen Canyon died in 1963 and I was partly responsible for its needless death. So were you.

“Neither you nor I, nor anyone else, knew it well enough to insist that at all costs it should endure. When we began to find out it was too late.”

**Making the wild river 'a servant to man's will'**

A decade later, with a slowly filling Lake Powell drawing multitudes of houseboats, ski boats and fishers, Reclamation commissioner Dominy fought back, in a 36-page, federally financed pamphlet, “Lake Powell: Jewel of the Colorado.”

Dominy oversaw most of the dam's construction work. After leaving the bureau in 1969, he remained a vocal advocate for big dams in general and Glen Canyon in particular for the rest of his life, and died in 2010 at age 100.

“Man has flung down a giant barrier in the path of the turbulent Colorado in Arizona. It has tamed the wild river — made it a servant to man’s will,” said his pamphlet, published
in 1965, two years after the Sierra Club book.

Dominy repeated his humans-first theme at the booklet’s conclusion, in pitching to build two more dams within the Grand Canyon.

He wanted them to generate electricity that would raise cash to build more canals to import more water into the Southwest deserts, to augment the soon-to-be authorized Central Arizona Project. Proposals for those dams were eventually killed, after generating massive environmental protests.


“Man cannot improve upon Nature. But — as he has since before dawn of history — Man must continue to adapt Nature to his needs. Still, that process of adapting must preserve, in balance — the whole natural heritage that is his.”

The booklet was replete with full-color photos of water skiers, power boaters and fishers plying their skills on the lake. Other photos showed the formerly muddy red river’s often raging waters now still and clear-blue, reflecting sunlight’s glare and flanked by luscious red rock canyon walls.
“Once in a blue moon, we come upon almost unbelievable beauty. Such was my reaction at the first sight of Lake Powell and its setting of incomparable grandeur,” wrote then-Interior Secretary Stewart Udall in a forward to the pamphlet.

Udall voted to authorize the dam’s construction as an Arizona congressman and in 1963 spurned Brower’s 11th-hour request not to close the dam’s gates. He recanted that support after leaving office.

But in this pamphlet, he hailed President Lyndon B. Johnson and his wife Lady Bird for having “challenged us with an exciting new concept of conservation: creating new beauty to amplify the beauty which is our heritage, as well as creation of more places for outdoor recreation. In this magnificent lake, we have made such accomplishments.”

Dominy promised that once Powell and the other Colorado River Storage Project reservoirs were filled with “surplus waters” from wet years, “users of Colorado River water will be freed from disruptive cycles of drought. The reservoirs will hold sufficient water for four years of committed needs — regardless of inflow.

“When the system is complete, damaging floods — large or small — will be impossible,” Dominy added.
In a dig at critics upset at seeing Glen Canyon drowned, Dominy led his pamphlet with a poem, credited to a Gordon Michelle:

"Dear God, did you cast down

"Two hundred miles of canyon

"And mark 'For poets only?'

"Built of rock and cement and sweat and skill, Glen Canyon Dam stands as a monument to the talent of its builders — and to reaffirmation of the pioneering spirit that is America. The manmade rock of the dam has become one with the living rock of the canyon," he wrote.

“It will endure as long as time endures."

Recently, the Star asked bureau spokeswoman Becki Bryant how relevant the agency’s officials believe Dominy’s sentiments are today.

“No comment,” Bryant replied in an email.

Photos: The receding waters of Lake Powell, Glen Canyon National Recreation Area
Contact Tony Davis at 520-349-0350 or ttdavis@tucson.com. Follow Davis on Twitter@tonydavis987.

Subscribe to stay connected to Tucson. A subscription helps you access more of the local stories that keep you connected to the community.

Be the first to know

Get local news delivered to your inbox!

Tony Davis

Reporter

Tony graduated from Northwestern University and started at the Star in 1997. He has mostly covered environmental stories since 2005, focusing on water supplies, climate change, the Rosemont Mine and the endangered jaguar.
Lake Powell's record low levels confound tourists, businesses, Park Service

Tony Davis 13 hrs ago

Editor's note: This is the third of six stories for "Colorado River reckoning: Not enough water," an investigative series by the Arizona Daily Star that observes, at length, the future of the Colorado River.

Bullfrog Marina is the getaway point for houseboaters, ski boaters, water skiers and fishing enthusiasts to tour some of Lake Powell's less visible but still beloved side canyons,
which stretch out like a series of finger lakes along the main lake body that encompasses the Colorado River.

The marina anchors Lake Powell's north end, lying nearly 100 miles and a four- to five-hour powerboat ride upstream of Glen Canyon Dam. It rents out houseboats and smaller power boats along with ski tubes, paddleboards and kayaks. Its environs play host to a restaurant, a convenience store, a gift shop and a post office.

But Bullfrog's boat ramp has been closed off and on over the last year and a half due to low water, leaving its usually bustling parking lot virtually empty at times. And all signs are that the ramp — and Lake Powell in general — are in for an extended period of hard times starting in December.

People are also reading...

Then, federal forecasters predict Powell's water level most likely will again fall below 3,525, at which the ramp stops short of reaching the water and can't be used at all, and will stay that way for at least another five months. The ramp was closed to houseboats and other large vessels in mid-November, when the lake dropped to 3,529 feet. The lake's lowest level ever was 3,522 this May, a drop of 178 feet, or more than 16 stories, since Powell was last full in the mid-1980s.
A more pessimistic forecast has Powell staying below 3,525 for all of the next 20 months starting in December. That same forecast, which federal officials say has a 10% chance of coming true, shows Powell falling below 3,490 feet — the lowest level at which Glen Canyon Dam can generate electricity for its 5 million customers in the West — starting in October 2023 and staying below there for 10 of the next 12 months.

Those are the realities confronting managers of the Colorado River and the millions of tourists who flock every year to Lake Powell, which straddles the Arizona-Utah border. Already, the lake has become a less enjoyable place for many tourists than it used to be, due to the shrinkage from drought and climate change. Some formerly key recreation sites are less accessible or virtually inaccessible, although some boaters say they still enjoy the lake as much as ever.

Without major curbs in water use across the Colorado River Basin, particularly in Lower Basin states including Arizona and California, the lake seems likely to keep falling, tightening the screws on a multi-billion-dollar recreation economy that had already shrunk due to the pandemic.
The continuing decline of Powell has raised an almost endless list of questions about how authorities should respond. The lake is so low that most of its boating ramps are closed. Several popular attractions are either inaccessible or difficult to reach by boat. A heavily used marina is closed due to the low water and no one can say when it will reopen. Millions of visitors still flock there every year, but attendance last year was well below pre-pandemic levels.

The crisis at Powell has environmentalists asking: When does it become a losing game to keep extending boat ramps, moving marinas and moving houseboats around as the lake shrinks?
It has also triggered calls by environmental activists for the federal government to modify Glen Canyon Dam — whose construction created the lake — so it can deliver water to the Grand Canyon and Lake Mead downstream even if and when Powell's levels are too low to pass water through the turbines to generate power.

Federal officials, however, seem determined to do whatever it takes to keep the lake above 3,490 feet, out of concern the dam's facilities could be damaged if water is run through it at excessively low levels.

Many boaters and other recreationists want the lake kept at higher elevations to insure usage of the few boat ramps still open. But many scientists say that won't be feasible if river flows stay as low as they are or continue declining.

'Might break my heart'

Near the Bullfrog ramp, when the Star visited in May to see the record-low water, lay a sea of dead salt cedar branches. The lake itself was about 50 feet wide at that point, and the canyon walls were colored a medium to deep chocolate. Whitish streaks indicated the lake's famed bathtub ring, areas recently exposed to air due to the lowering water. In areas along the lake, the canyon walls were interrupted by a line of rounded and rectangular red rock structures, known as hoodoo style, carved over the eons by the Colorado River
and by wind erosion.

Looking northeast from Wahweap Marina public boat ramp at Lake Powell in 1986, top, and 2022.

Benjie Sanders (top) Kelly Presnell / Arizona Daily Star
At the marina, already launched boats were parked and able to come in and out of the water. One was a power boat owned by Jennifer Matamoros of Paonia, Colorado, who had just returned from a trip to Lost Eden Canyon, lying a little less than a mile away. The canyon serves as a hideaway for many like herself, loaded with slot canyons, amphitheaters, 100-foot-high canyon walls and caves.

Matamoros was clearly displeased at the lower water but determined to carry on.

"Overall, it sucks, but we have to enjoy what we're seeing," said Matamoros, chief of staff for sales and operations for an accounting software firm, who had just celebrated her 45th birthday.

"The last time I was here was this same weekend, two years ago," when the lake was 70 feet higher, she said. "Before that, it was every five years I came here. When I was 10 to 14, it was every summer."

A birdwatcher, she said she visits the lake to enjoy nature, even though it's not completely natural, having been created in the 1960s by the damming of Glen Canyon on the Colorado River.
"You get lost in the canyon. In Eden Canyon, it seemed like we were in another planet. The moment we got back there, it was complete silence, like nothing else existed," she said. "I felt safe and protected in a corner of the world, surrounded by nothing but rocks and cliffs."

Matamoros showed ambivalence when hearing about the return to view of historic Glen Canyon attractions that were underwater for decades, such as Cathedral in the Desert, a
massive sandstone grotto with a long waterfall.

“It’s really a Catch-22. With all the BS going on in the world, it’s nice to have more nature. But it might break my heart to see the (lake) water draining," she said.

'Asking too much' of the river

Michael Winn, 45, an attorney from Torrey, Utah, who had parked his fishing boat at Bullfrog, has no ambivalence about his vision for Lake Powell's future. Winn spoke while standing on a walkway to the marina from the parking lot.

“I want it to go back to being wild," said Winn. "I don’t think the dam should have been built in the first place. It’s the Colorado. It’s not the Nile. It’s never been the Amazon. It’s never been meant to be sustain all this crop production. It’s just a river that runs through.”

Winn was at Powell to catch largemouth and smallmouth bass, northern pike and walleye. While many of his old fishing holes have dried up, it’s easier to catch fish than before, he said. Less water means “there’s less places for them to hide," Winn said.

“Once you get into the main canyon, you still have plenty of room, plenty of water," he said. “The side canyons are more dried up.”
Looking southeast from above the Wahweap Marina rental docks on Lake Powell in 1986, top, and 2022.

Benjie Sanders (top) Kelly Presnell / Arizona Daily Star

It was Winn’s first trip to Powell in at least five years, although he had been coming to the lake off and on since
growing up in the Salt Lake City area.

Winn’s grandfather saw and loved the original Glen Canyon before the dam went in, but he also liked Lake Powell and fishing there, his grandson said. He used to launch a 14-foot-long houseboat at the end of the Hite marina on the lake's far northeastern edge.

As for Winn, he’d like to see Glen Canyon through the eyes of explorer John Wesley Powell, who led two major expeditions through the Colorado River’s canyons in the 1860s-'70s, a century before the dam changed the landscape.

Today, the Colorado’s "only got a fraction of the flow it had, and we are asking so much of that. It’s unfair to the river," he said. "Do we really need Lake Powell to still satisfy the water needs for winter crop production?"

“You guys built those cities in the middle of the desert,” he said, referring to Lower Basin urban development. “I love you all, but seriously.”

'Our favorite vacation spot'

For Damian DiFeo of Golden, Colorado, the lake’s decline has been “devastating — I’ve never seen it this low.” But he hopes it can be salvaged through a strong water
Now 50, he’s visited Powell regularly since he was 18. When interviewed, he and his wife Lynette were sitting in their gray pontoon boat, preparing for a day of fishing. Then, they would park their houseboat, with the pontoon boat in tow, at a suitable beach and detach the pontoon boat to explore side canyons and fish.

"We love this place. It’s our favorite vacation spot of the year,” DiFeo said.

He's disconcerted that the low water keeps his boats from accessing tributaries and side canyons he once visited regularly: the Escalante River, Clear Creek and Lake, Lost and Iceberg canyons.

The DiFeos couldn’t get their power boat back as far as they used to.

As water in one of the nation's largest reservoirs recedes, geologic features hidden for nearly 50 years are revealed in Glen Canyon National Recreation Area in Northern Arizona. Video courtesy of Glen Canyon Institute, 2022

Glen Canyon Institute, 2022

“What this place is kind of known for are canyons off the main channel. You used to be able to go back miles in some of those canyons. Now you get one-half mile, three-quarters of a mile in, it’s sand,” he said.
“There’s a bay there — Hall’s Creek Bay, around the creek from Bullfrog. It’s a beautiful bay — tons of beaches and places to park houseboats.

“But it’s completely gone,” he said. "There may be water back there, but you can’t get back there. The entrance to get there is dried up."

Other than that, “the fishing has been good,” he said. “There’s still a lot of water in the lake. There’s a lot of good beach spots — the only good thing about low water.”

A pedestrian ramp draped across the landscape well above the water levels at Bullfrog Bay in Glen Canyon National Recreation Area in 2022.

Kelly Presnell / Arizona Daily Star

But now, to park a houseboat, you have to go farther south on the lake, towards Page, Arizona — 93 miles downstream of Hall’s Creek Bay, DiFeo said.
“If people would just conserve water west of here, and not put so much water on golf courses and lawns. You know it’s all the western states of California, Arizona and Las Vegas — look at how much water they’re using,” he said.

He added that during dry periods in the Denver area, where he lives, many cities limit outdoor watering to two or three days a week.

“You can’t just keep taking and taking and taking. At some point there has to be some give and take,” DiFeo said.

Rainbow Bridge access dramatically reduced

Only three years earlier, in 2019, Lake Powell was on a temporary roll. After heavy winter snows produced the river basin's highest spring runoff in eight years, water levels were so high that boaters were warned not to park too close to the shoreline, so vehicles wouldn't be surrounded by water and need towing.

That year, Glen Canyon National Recreation Area and the adjoining Rainbow Bridge National Monument drew 4.4 million visitors. It was the third straight year of 4 million-plus visitation, and more than double the number of total visitors in 2013. The visitors spent $427 million in communities near the park, led by neighboring Page, supporting 5,243 local jobs, the National Park Service said.
But in 2020, the pandemic dropped visitation to about 2.5 million. A very poor monsoon season in 2020 and two years of low spring runoff pushed Powell down around 50 feet in a single year to a then-record low level of 3,555 feet in July 2021. It kept falling, bottoming at 3,523 in May 2022, then rising to almost 3,540 feet before starting another decline in mid-July.
Aerial image of Rainbow Bridge in 1962–’64 before flooding of Forbidding Canyon and Lake Powell. Ironically, that flooding improved access to the natural wonder. But today —conversely — as the water recedes, getting to the bridge is much harder again.

Phil Pennington / Courtesy of Grand Canyon Institute

Despite a lifting of pandemic restrictions in 2021, visitation
barely rebounded to about 3.1 million, although that was still the 25th highest annual visitor total at any National Park Service unit.

One of the most prominent spots to which the low water has dramatically reduced access is Rainbow Bridge, the flaming reddish-sandstone arch structure lying more than halfway up the lake from Glen Canyon Dam.

At 297 feet tall with a 270-foot-wide span, it’s one of the world’s largest natural bridges. It also has enormous cultural significance to Indigenous people. It has inspired origin stories, pilgrimages and ceremonial rights for centuries if not millennia, says the Park Service, which designated it a Traditional Cultural Property five years ago.

Protecting Rainbow Bridge and the national monument in which it lies was a hot-button issue during the controversy over building the dam in the 1950s, with environmentalists fighting, ultimately unsuccessfully, to keep the lake’s waters from intruding past the Rainbow Bridge National Monument’s boundaries. Congress first approved, then rescinded legislation aimed at preventing that.

Easy boat access to the bridge was a prime selling point in a 1965 promotional pamphlet for the lake authored by then-Bureau of Reclamation Commissioner Floyd Dominy. Dominy, probably the dam's most vociferous promoter, noted that
before the dam, only “the rugged few who packed in” could reach Rainbow Bridge. They approached it by a 10-mile hiking trail from Navajo Mountain to the south.

“Now, all of you can see it — easily,” Dominy wrote in the pamphlet. “Your boat will moor to floating docks at the entrance to Rainbow Bridge Canyon. Then you can take a walk along a trail to the canyon’s side. You’ll find the bridge undamaged by Lake Powell’s waters. And you can marvel at its arched and graceful beauty of its natural setting.”

More than 100,000 visitors saw the bridge annually from 2017 through 2019. You could park your boat at a dock right at the shore and walk a mile or so to the bridge. During very high water years in 1983 and 1984, boats could travel directly underneath it. It lies a two-hour boat ride upstream from Wahweap Marina near the dam.

But the pandemic and the low water sent annual visitation tumbling to a little less than 3,600 and 3,300 in 2020 and 2021, respectively. Visitation was particularly hurt by the cancellation of scheduled tours to Rainbow Bridge by private operators.
A stranded buoy sits on the cracking silt on the bottom of Lake Powell near Bullfrog Bay Marina in Glen Canyon National Recreation Area. Bullfrog's boat ramp has been closed off and on over the last 18 months as the lake shrinks.

Kelly Presnell / Arizona Daily Star

Since October 2021, visiting the bridge has become even more difficult, due to low water and mud and debris from big storms. The dock at the bridge where boaters traditionally parked hasn’t been connected to the monument’s shoreline since then. The dock system and its restroom, still accessible to boats, are being moved further out to prevent the restroom from getting stuck, said Park Service spokeswoman Mary Plumb.

“Boats and small vessels may beach at their own risk” at the shore, Plumb said.
Aramark Management Services, which runs the lake's Wahweap, Bullfrog and Hall's Crossing marinas under contract with the Park Service, has for some time offered "truly one of a kind excursions" by boat to Rainbow Bridge National Monument. But its website now says, “The Rainbow Bridge Tour will not run until further notice.”

**Used to be '10,000 people here for spring break'**

The low water also has cut access to other popular areas.

The Castle Rock Cut, for instance, was a popular shortcut, dug by the Park Service, that created a mile-long, two houseboat-wide channel between swaths of desert, said Bob Wilkes, a longtime boat rental business owner. Lying just east of Wahweap Marina, it saved about an hour of travel time, connecting that area to the main Lake Powell channel. But the cut is dried up, forcing boaters to detour for a long distance.

It has been deepened four times since it was first dug in the 1970s, but even with that it runs dry when Powell falls below 3,580 feet. That's been the case since January 2021.

A similar fate has befallen Lone Rock, a huge, rectangular stone monolith jutting close to 150 feet high from the desert in Utah, about 12 miles north of Page.
It was for years a popular site for circling by boat and the hub of a public beach and campground. But when the Star visited Lone Rock on a sunny May afternoon, it sat in an open field, at least a half-mile from the main Lake Powell as it wrapped around a bend. The rock itself, adorned by alternating light and dark brown bands, stuck out starkly in the desert.

Lone Rock, jutting out of the now dry Lake Powell, would usually be surrounded by water.
Kelly Presnell / Arizona Daily Star

In October 2021, when veteran Lake Powell fishing guide Mike McNabb took a Star reporter to Lone Rock, water was still close to the lake but the area was virtually deserted, with a handful of people on the beach. He recalled that decades ago, “there’d be 10,000 people here for spring break.”
"For me, it hurts to see it like this. There's nothing we can do. It's Mother Nature," McNabb said.

'A real conundrum'

More troubling for boaters and boat rental companies has been the indefinite closure of Dangling Rope Marina. It was the only refueling stop for the 100-mile distance between the Wahweap and Bullfrog marinas. It lies about 40 miles up the lake from Wahweap.

For years, it had a fueling dock, minor boat repair services, a supply store and snack bar, a ranger station and restrooms. But the park service closed it in May 2021 after it was severely damaged by a windstorm.

Since then, reopening has been put on indefinite hold.

The main lake channel there is expected to narrow to 100 feet wide as the lake drops, and the Dangling Rope Marina complex is much wider than that, Glen Canyon National Recreation Area Superintendent Billy Shott told local media outlet Lake Powell Life in fall 2021. That means officials have to look at possibly moving it farther out into the main lake channel, "and that's a big undertaking as well."

"You have to power these facilities. And even if it's just a fuel dock, have to power the fuel pumps and power the fire
suppression system that goes along with it,” he said. “All of that power comes from the shore.”

The problem is that the generator that would power the marina’s facilities is served with fuel that is normally delivered by a fuel truck that uses a ramp to access the generator — and that ramp “is high and dry, just like our other ramps in the water,” Shott said.

“We have right now a real conundrum,” Shott said.

A veteran Lake Powell boater called the Dangling Rope Marina closure “a huge deal,” one that can severely limit how far up the lake boaters can travel.

“We don’t go as far as we used to,” said John Ryder, a project manager for the Yavapai County Probation Office in Prescott who has been boating on the lake for 30 years. “I really like the Escalante River (tributary of the Colorado River). “It’s beautiful. Very shiny.

“But unless I haul gas (separately) up there, I can’t get back. I probably won’t do that. It can’t be done safely,” he said at the Wahweap Marina. “We talked to a guy on the way up here who said he burns 28 gallons an hour. This guy had six five-gallon jugs of fuel. You can’t put enough gas in the boat’s fuel system, and hauling gas is dangerous.”

The problem is this lake is so huge, if someone wants to go
to Rainbow Bridge, the majority of boats cannot make the trip there and back, roughly 100 miles, without a fuel stop, said Page Mayor Bill Diak. “The marina was placed there to have a fuel stop between Wahweap and Bullfrog.” Losing it has “eliminated the middle portion of the lake” as a place to go.

Dangling Rope’s closure forced Bob Reed, owner of Uplake Adventures boat rentals, to cancel all his overnight boat trips last year. "I lost 50% of my business," he said.

In his Lake Powell Life interview, Superintendent Shott said there’s a fear in the community that the Park Service has decided to abandon Dangling Rope, “and I can assure you that’s not the case. Having that facility midlake is in our general plan. It is a high priority for the park. The idea of abandoning that service forever is not in the cards.

“With that said, we don’t have a solution yet for how we get this online."
Robert Wilkes, owner of Skylite Rentals in Big Water, Utah, says closure of boat ramps at nearby Lake Powell is a drain on the economy. “Last year I was down $230,000 in cancellations,” he says.

Kelly Presnell / Arizona Daily Star

'I was down $230,000 in cancellations'

As of now, 9 of 12 boat ramps into the lake are closed because they stop above the water. A 10th ramp at Antelope Point Marina is open only to smaller boats. A tenth ramp, at Bullfrog, is now partially closed.

The closures hit particularly hard in July 2021, when the National Park Service shuttered the main boat ramp at Wahweap Marina to houseboats after the lake plunged, leaving all ramps into the lake closed at least a few weeks.
Full access was restored in early fall that year when the Park Service finished a three-month project that extended, rehabilitated and reopened the Legacy Stateline Auxiliary Ramp — built in the 1960s — near the shuttered Wahweap ramp.

Work continued on extending the ramp farther this year by adding more concrete. The Park Service’s goal is to keep the ramp usable until the lake drops below 3,490 feet.

At the neighboring Antelope Point Marina, the main public boat launch ramp was closed most of 2021 because the low water made it end at a point where it hit a cliff that dropped straight into the water. A second ramp at Antelope Point was available last year for boaters willing to pay a $40 fee just to put their boat in the water. It was closed by the start of 2022 although it’s now open for boats no longer than 22 feet.

Because of the ramp closures, “last year I was down $230,000 in cancellations,” said Wilkes, owner of Skylite Boat Rentals, located in Big Water, Utah, about 12 miles north of the lake. “In the last eight years I never laid any of my staff off in winter. Last year, we shut down for the winter. We had to cancel insurance on everything. We couldn’t pay it.”

While Wilkes’ smaller boats could still enter the water, negative publicity about ramp closures scared off
customers, he said.

“People didn’t want to chance it. They didn’t trust it would work out,” he said. “They are putting their huge vacation with all their family in the hands of the Park Service. They didn’t want to.”

Five other boat rental business owners said the ramp closures dramatically hurt their businesses. Overall, sales tax revenue to Page from tourism fell about 32% in summer and early fall 2021 compared to pre-pandemic totals, said Diak, the town's mayor.

One of Wilkes’ cancellations was by Dr. Randall Metsch, a San Diego dentist who was in the process of renting jet skis from Wilkes as part of a trip planned with several other families for the end of July 2021.

“I was concerned with the water levels, wondering could we get boats in the water and once we got in the water would we be restricted by crowds and the shallow water? We all got together and decided it was not worth the risk and we cancelled.”

Then, Metsch and his friends got into the lake through an unexpected backup plan. After cancelling their first trip, they received an invitation from a college roommate to spend five nights at his houseboat that was already docked in the water
Metsch was glad afterward that he did it, but the trip had its glitches. He had trouble getting his ski boat in and out of the low water. Twice the boat’s propeller got bent.

“MY roommate was showing us these cool areas, and all of a sudden we hit a sandbar. In places, the water was 30-40-50 feet deep. We made it, but it was hard getting it out of the water,” Metsch said.

Still, Metsch finds Powell “one of the most beautiful places on earth.”

“It’s like being in the Grand Canyon on water. The water is beautiful. You are out isolated, away from civilization. You’re living off what you brought on your houseboat. You’re cooking, barbecuing and you have all the fun with ski boats and jet skis.”

Download PDF
A shrinking lake reveals its secrets

Stretching 386 miles upstream of Glen Canyon Dam, Lake Powell draws more than 3 million boaters, fishers, and other recreators annually. But low water has made access to the lake increasingly tough. Ten of 12 ramps leading from marinas now are at least partially closed. Some visitors lament they’ve lost access to certain side canyons where the water is too low for boats. Environmentalists, however, are cheering the return to public view of treasured Glen Canyon sites exposed by the receding water such as Cathedral in the Desert. Other sites flooded by Lake Powell, such as Music Temple and Hidden Passage, remain underwater.

Chiara Bautista

Still more water than 'most can even fathom'

Last year, the Park Service and Shott, the Glen Canyon
National Recreation Area superintendent, took huge criticism from recreators and Mayor Diak for failing to start sooner in creating a low-water boat ramp and for what they felt was failing to provide enough advance notice that the main Wahweap Marina ramp would close.

"The Park Service used an excuse that they got bad information from the Bureau of Reclamation. They've been here as long as everyone else and saw the pattern that was going on that indicated they should have moved quicker," Diak said.

In an interview with Lake Powell Life, Shott replied that the park service was up against "a really unique situation," in which the lake fell far faster than any federal forecasters had predicted. Climate change "is occurring at a rate beyond our comprehension."

"To say my confidence has been shook based on the projections that we've gotten would be grossly underestimating my reaction," said Shott, who left that job over the summer of 2022 to take a higher-ranking post overseeing Park Service operations in eight states.

This year, with two boat ramps at Powell still operating and lake levels less volatile, the business climate appears to have stabilized or improved. Business for many boat rental companies has rebounded, as have sales tax revenues,
although not to pre-COVID levels, said Diak.

A longtime Powell boater, Thor Odinsun, maintains the lake’s negative image is due mainly to media “fearmongering.” He sees the lake’s future as bright.

“We will always have a ramp to launch and retrieve at. We have to have one. I have also had online friends inform me that they cancelled their trip to Lake Powell because they seriously believe that there is not enough water in Lake Powell, which is insane,” Odinsun said. "The amount of water out here is more than most can even fathom," said Odinsun, who runs a cruiser boat on the lake dozens of hours a week.

By contrast, longtime Lake Powell fishing guide McNabb said that while his business is surviving, “The bottom line is if this (drought) weather pattern doesn’t change, we’re done.”
Moving marina and other expensive options

There's no question more change lies ahead for Lake Powell — the question is how much.

Mary Plumb, the Park Service spokeswoman, noted in a statement to the Star, “All conventional methods of maintaining access have been exhausted, necessitating new locations and design for current unprecedented lake levels.”

“Over the past two years, we have been extremely busy responding to low water levels by moving marinas, docks, slips and walkways, and utility line chaseways (fuel, electricity, wastewater, water), the Park Service added in a recent newsletter.

The Park Service has hired a contractor, Jacobs Government Solutions, to explore long-term, low-water solutions and options for “sustainable access,” including at four public launch ramps across the lake.

The huge array of upgrades needed to make the ramps accessible will require difficult decisions, Shott said before leaving his post there.
“If I want to replace every ramp we have, move every marina, every utility, to keep same level of service we have now at 3,450 feet, that would be in the cost of hundreds of millions of dollars,” Shott told the Star. “That’s not money I expect to get next year or any other year.”

For one, Bullfrog Marina “is running out of water,” sitting in a shallow basin off the main lake channel, and “will essentially become unusable when the lake gets to 3,515 or 3,520 feet,” he said. The Park Service’s contractor is looking at what it would take to move the marina to an adjacent location lying in much deeper water.

“It’s not that big a deal to move the marina. A bigger deal is how we provide it with electricity and drinking water, and how we remove wastewater, the sewage; gasoline. We need to figure out what this will cost,” Shott said.

But, “if we keep Bullfrog the way it is right now, and we fail to do anything, it will be sitting on mud flats, potentially, in two years.”

At Antelope Point Marina, extending the closed public boat ramp to operate at 3,450 feet is estimated to cost $14 million to $15 million, he said. That’s because the ramp “is built on the side of the canyon, and is literally on the edge of a cliff now.”
Shift to land-based recreation

Eric Balken, director of the environmentalist Glen Canyon Institute, said if he could talk directly to the National Park Service, he’d ask first, at what elevation does it become impossible to operate the reservoir as a lake-based recreation destination?

“At what point do you tell everyone to get their houseboats off the water before they become beached?” Balken asked. “What plans are in the works for modifying the canyon for its river recreation potential? Will new boat ramps be built for rafting groups at Bullfrog? If sediment or waterfall hazards appear on the main river channel, will the park service dredge and clear those so that people can run the river?

“The writing is on the wall. The likelihood of this reservoir filling again is very low. The likelihood of it dropping more is high,” Balken said.

If any of the scenarios Balken discusses comes to pass, Plumb responded, “the park and subject matter experts will assess the situation and address possible solutions in accordance with law and policy and in consultation with our partners."

For now, the Park Service's efforts to maintain existing services at Powell show no signs of retrenching. Using $26
million in federal disaster funds, it’s designing a new ramp for Bullfrog that’s aimed at lasting down to 3,450 feet at the lake, the service wrote in a newsletter in August.

It will work with a contractor to design new ramps at Antelope Point, Halls Crossing, a now-closed ferry terminal lying directly across the lake from Bullfrog, and at Hite Marina at the lake’s north end. It’s also seeking federal funds to explore ways to provide fuel and other services to replace what was provided by Dangling Rope Marina, along with a long-term access method for Rainbow Bridge.

A possible vehicle for financing these fixes is a proposed federal disaster relief program for National Park Service sites that includes $320 million for the Glen Canyon and Lake Mead National Recreation areas — of which the Glen Canyon would get about $200 million. The proposal is pending before the Senate Appropriations Committee.

“It gives our team at the National Park Service in Glen Canyon a reason to stay positive, because we see a bright future,” Shott said.

At the same time, Shott has said the majority of the recreation area’s 80% increase in visitation since he arrived there in 2015 has been in land-based activities such as hiking, backpacking and off-road vehicle use.
"In many ways, it’s even better right now because it looks different. There are places you can see that haven’t been seen since you could raft the river. And those are all documented," Shott told the Lake Powell Chronicle a year ago. “There are some phenomenal beaches now that are opened up that weren’t open before. You have to be careful, but there are some great hikes now too because you can hike in these slot canyons.”

In 2016, Glen Canyon’s Strategic Plan identified land-based recreation as a high-priority activity “that was already seeing exponential growth,” Plumb said.

The worst-case scenario would be if officials ever remove the dam, making the boat ramps useless, Shott told the Chronicle.

“But you know what? We’ll have more people coming here to raft than they have in the Grand Canyon. It’ll be a different place, but people will still enjoy it. It’s just change. We just have to adapt to it.”

Operators of Aramark-owned Lake Powell Resorts and Marinas, which run the Wahweap and Bullfrog marinas, seem to get Shott’s point. In the past year, the resorts have used full-color photos of newly visible slickrock in Glen Canyon in glossy ads to lure visitors.

“Access spectacular new sights including the breathtaking Cathedral in the Desert and the dazzling landscape of the Anasazi Canyon. It's truly an extraordinary other world.”

Photos: The receding waters of Lake Powell, Glen Canyon National Recreation Area

Tom Wright hikes past the beached marker for Willow Canyon where it joins with the Escalante River, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star
Tony Davis

Reporter

Tony graduated from Northwestern University and started at the Star in 1997. He has mostly covered environmental stories since 2005, focusing on water supplies, climate change, the Rosemont Mine and the endangered jaguar.
Plunging water levels flip activists' goal for Glen Canyon Dam

Tony Davis   21 hrs ago

Editor's note: This is the fourth of six stories for "Colorado River reckoning: Not enough water," an investigative series by the Arizona Daily Star that observes, at length, the future of the Colorado River.

The debate over how to manage Lake Powell has been almost radioactive since the 1990s.

Environmentalists have pushed hard to drain the lake and "Fill Mead First," to let Powell's waters run downhill into Lake Mead so Glen Canyon will reappear in its natural state.
Water officials have denounced this proposal as unfeasible, saying Powell is still too important because it stores water in wet years to be called upon during droughts.

And today, all the water stored in both reservoirs would barely fill Mead halfway.

So now, the environmentalist Glen Canyon Institute is taking a different tack.

**People are also reading…**

It’s asking the U.S. Bureau of Reclamation and the National Park Service not to decommission the dam, but to prepare for what the group sees as inevitable: that Lake Powell will keep dropping, and much more of the natural Glen Canyon will reappear, absent a sudden change in the climate, said Eric Balken, the institute’s director.

If Balken were at the bureau, he would commission a full-scale study, to start now, on reengineering the dam as a backup facility, where water would flow through or around the dam down to its original river bed elevation, he said. “Things are happening too fast to use a ‘wait and see’ approach.”

Recently, his group and two other environmental groups issued a report asking the bureau to study such a possibility,
not for deliberately restoring Glen Canyon, but to prepare for when Lake Powell drops too low to keep delivering water.

Construction of the Colorado River diversion tunnels around the base of Glen Canyon Dam in 1959. Environmental activists long pushed to decommission the dam because it flooded out a particularly scenic canyon, but the effects of drought and climate change have shifted that debate.

U.S. Bureau of Reclamation, University of Utah J. Willard Marriott Library

Surprising historical echo

More than 25 years ago, Glen Canyon Institute founder Rich Ingebretsen got a similar recommendation from none other
than Floyd Dominy, a retired Bureau of Reclamation commissioner who was the dam’s driving force.

In February 1997, Ingebretsen and Glen Canyon Institute activist Eleanor Inskip were having dinner with Dominy near his home in Boyce, Virginia when Dominy first mentioned, then eviscerated a plan by environmentalist David Brower to drill through the dam’s bypass tunnels in the dam's main structure to drain Lake Powell.

“Well, you can’t do that. It is 300 feet of reinforced concrete,” Ingebretsen recalled the former commissioner saying, whereupon Dominy lowered his glasses and added, “There is a better way. All you have to do is drill new bypass tunnels around the old ones in the sandstone, on the sides of the dam. Then you can put waterproof valves at the bottom of the lake. They can be raised and lowered as you need, to let water out.”

With that he pulled over a cocktail napkin and drew a sketch of Glen Canyon Dam, the old bypass tunnels, the lake, the river, and the new tunnels with the waterproof valves that would be used to drain the reservoir, Ingebretsen said. His hands worked busily as he explained what he was sketching. Dominy concluded, Ingebretsen said, “This has never been done before, but I have been thinking about it, and it will work,” Ingebretsen recalled.
After more than a decade of construction, Glen Canyon Dam was officially dedicated by First Lady Ladybird Johnson on Sept. 22, 1966.

Jesse Tellez

Recounting the story in a written presentation for the Returning Rapids Project, Ingebretsen wrote, “I must admit I was a little stunned. First, I was fascinated at how draining such a large reservoir could be accomplished, because it seemed so simple. But to think that it was Floyd Dominy who had just sketched the plan was beyond belief. The man who built the dam, the man who called Lake Powell his own, had actually sketched for Eleanor and me the method to drain his reservoir.

“I said, ‘Mr. Dominy, no one will believe me when I tell them that you drew this. Would you sign and date it?’

“He answered, ‘Sure I will,’ and signed the napkin, which I keep in a safe and special place,” wrote Ingebretsen, who included with his writeup a scanned version of the napkin containing Dominy’s signature.

Dominy has been dead since 2010. David Wegner, a retired bureau official who later worked for the Glen Canyon Institute, was also a friend of Dominy’s and held a 100th birthday party for the ex-commissioner shortly before his death in 2010. Wegner says Ingebretsen's story is true and that he and Dominy had discussed this plan when they debated the dam at Colorado College in Colorado Springs.
“Floyd’s point was that it was easier to drill through sandstone than concrete,” said Wegner. “He was not advocating that, just bringing it up as a possibility.”

Nothing has come of that idea since Dominy signed the napkin.
Officials to evaluate modifications

But at a news conference in mid-August this year, officials of Reclamation and the Interior Department said they’ll evaluate whether physical modifications are feasible to both Glen Canyon and Hoover dams to allow them to keep sending water downstream if those reservoirs fall to critically low levels.

Those include water levels below the point at which the dams can generate power and below “dead pool.” That’s the point where normally no more water can be physically extracted from their reservoirs.

They made no reference to Dominy's idea. But that scheme would allow water to keep flowing in large quantities from Glen Canyon downstream into the Grand Canyon and the Lower Basin, and lowering Lake Powell, while keeping the dam intact.

Download PDF
Such modifications could follow Dominy's 1997 blueprint. But at their news conference, Interior Department officials
didn't respond to reporters' questions about whether they'd decommission the dam or even whether they'd rule that out.

“We will continue to rely on our expert technical staff to help us evaluate what additional measures we should be taking to protect the infrastructure. That could include a wide range of options,” said Tanya Trujillo, Interior’s assistant secretary for water and science.

“We’re focused on maintaining the integrity of existing structures. The existing system. That’s our highest priority,” Trujillo said. “We need to be sure we have the infrastructure intact, to protect water supplies for everyone who relies” on them.

That Trujillo didn’t outright deny interest in decommissioning Glen Canyon Dam “speaks volumes,” said former bureau scientist Wegner.

“They didn’t absolutely come out and say we are not going to even consider” decommissioning the dam, Wegner said. “It could be she didn’t want to consider the question; it could be they don’t want to take anything off the table," Wegner said.

“Often, what is not said is more significant than what is said. The lack of a direct response to your question, which should have been a softball for her, ended up with a nonspecific
answer. It was just a non-answer when historically it was an adamant ‘no,’” Wegner said.

The bureau hasn’t responded directly to questions from the Star about Balken’s comments.

A small fishing boat ties up on the breakwaters at the security perimeter behind Glen Canyon Dam. The drop in water level has revealed the trash racks, steel bars that trap large debris, covering eight huge intakes that feed water to the power turbines deep inside the dam. Federal officials say they’ll study whether modifications are feasible to allow the dam to keep sending water downstream if Lake Powell falls to a critically low level.

Kelly Presnell, Arizona Daily Star

**Focus now is keeping Powell high enough**

The bureau has, however, made it very clear that, for now, it will take all measures that are feasible and practical measures to keep Powell from falling below 3,490 feet, the elevation at which Glen Canyon Dam could no longer generate power.
Twice this year, for instance, it has held back water in the lake that it had planned to release to Lake Mead. Both in 2021 and 2022, it’s released additional water into Powell from its Flaming Gorge Reservoir, lying on the Green River at the Utah-Wyoming border.

Then in June, the bureau told the seven Colorado River Basin states to cut their total water use by 14% to 28%, to prop up Lakes Mead and Powell. It has since given the states more time to come up with a plan, rather than impose its own solution as it had threatened to do.

Wegner, a now-retired Bureau of Reclamation engineer for 22 years, said he talks to someone from the bureau virtually every day and believes its number one goal is to keep Powell above 3,490 feet if possible.

“That being said, if we go into another bad year in the basin, a fourth bad year in a row, they don’t have a choice” but to let the lake decline below 3,490, said Wegner, who was the bureau’s program manager for environmental studies of Glen Canyon Dam’s downstream impacts in the 1980s and ‘90s — studies that led to changes in how the dam was managed.

“There’s not enough water in the system to move to prop up Powell further. If we were to have another year of low snowpack, there’s going to be little room for flexibility,” said Wegner. He is a founding trustee and former science director
of the Glen Canyon Institute but doesn’t support deliberately draining the lake — he wants the canyon restored by other means.

Twice in the past year, federal officials released additional water into Lake Powell from Flaming Gorge Reservoir on the Green River, shown here, at the Utah-Wyoming border. But Flaming Gorge is also beginning to feel the effects of the two-decade megadrought gripping the southwestern U.S.

Rick Bowmer, Associated Press

“You may be able to get one more year of releases out of Flaming Gorge, but then there will be no refill. You are living on borrowed time in these La Niñas now," he said, referring to the weather phenomenon that often brings warm, dry weather to the Southwest and the Southern Rockies. "You just won’t have enough snowpack to fill the upstream reservoirs if the climate pattern holds.”
Contact Tony Davis at 520-349-0350 or tdavis@tucson.com. Follow Davis on Twitter@tonydavis987.

Subscribe to stay connected to Tucson. A subscription helps you access more of the local stories that keep you connected to the community.

Be the first to know

Get local news delivered to your inbox!

Tony Davis

Tony Davis

Reporter

Tony graduated from Northwestern University and started at the Star in 1997. He has mostly covered environmental stories since 2005, focusing on water supplies, climate change, the Rosemont Mine and the endangered jaguar.
The Colorado River we rely on is likely to get even drier

Tony Davis  14 hrs ago

Reporter

Tony graduated from Northwestern University and started at the Star in 1997. He has mostly covered environmental stories since 2005, focusing on water supplies, climate change, the Rosemont Mine and the endangered jaguar.
Flows on the Colorado River, already crippled by warm, dry weather since the turn of the century, seem likely to get lower still in the coming decades.

Warming weather will continue to bring more evaporation and early melting of snowpack. It will keep drying out the river basin's soils, so they'll keep soaking up melted snow that otherwise would flow into the river and its tributaries.

And while it's not clear if the river basin will get more or less rain and snow over the coming decades than is falling now, even the extra precipitation won't be enough to counteract the impacts of continued warming weather.

People are also reading...
These are among the concerns raised by results of five recent studies. They suggest that continued declines in river flows could or will occur for as long as another 80 years, on top of a nearly 20% decline the river has suffered since 2000. A sixth study projects flows staying roughly at their post-2000 average from 2023 through 2060.

Such warm weather and diminished flows would make it more difficult than it already is for the federal government to keep Lakes Mead and Powell from falling so low that their accompanying dams can no longer generate electricity, or
that they hit "dead pool," at which no water can be pulled from them.

One new study specifically warns that "considerable periods" lay ahead in which Powell could fall below its minimum power-generating level of 3,490 feet.

The seven Colorado River Basin states, including Arizona, are now enmeshed in tense negotiations to try to meet a U.S. Bureau of Reclamation directive to cut their take from the river by up to 28% by next year. Cuts of that scale likely will be enough to stabilize the reservoirs at or near their current elevations, if river flows stay at currently depressed levels, says a seventh recent study, this one from Utah State University's Center for Colorado Studies.

But if flows keep declining, states will have to curb their take from the river even more, said Kevin Wheeler, one of the Utah State study's co-authors and a University of Oxford senior research fellow.

That study, published in Science magazine, assumed an equal probability of the number of dry years occurring on the river with the number that occurred from 2000 to 2018, Wheeler said.

The problem is, the last few years on the river have been significantly drier than the average flows over the 23-year
period of drought that began in 2000.

Since 2000, the river has averaged about 12.1 million acre-feet a year of flows at the federal gauging station at Lee's Ferry, just downstream of Glen Canyon Dam. That compares to a 20th century average annual flow of about 15 million acre-feet.

After more than a decade of construction, Glen Canyon Dam was officially dedicated by First Lady Ladybird Johnson on Sept. 22, 1966.

Jesse Tellez

Since 2018, however, average annual flows have plunged to about 10.41 million acre-feet a year, or nearly 50% lower than in the 20th century. the second worst period for the river on record since Lake Powell started filling in the 1960s.

The worst-case scenarios for future flows identified in two of the recent studies would give the basin 7.4 million to 9 million acre-feet a year — numbers that Colorado climate scientist Brad Udall calls totally unsustainable.

"At 12 million since 2000, it’s not sustainable. At 9 million acre-feet, we'll need a complete rethink of who gets what water," said Udall, a native Tucsonan and a senior water and climate scientist at Colorado State University's Colorado Water Center.

"In my mind a permanent 9.4 million acre-foot flow is not
going to happen for awhile, but what do I know? In the near term, you could easily see 9.4 million acre-feet for an extended period of time, a five- to seven-year period.

"This is a dangerous game of predicting what Mother Nature is going to throw at us."

Wheeler acknowledged that conditions could certainly become worse than those assumed by researchers on the paper he worked, if already warming temperatures keep increasing. A series of five or 10 years like the last three years, in particular, "would require larger reductions than we had simulated," he said.

Imagine Rockies with SW weather

Of the recent studies, one from Los Alamos National Laboratory offers some of the most sweeping conclusions.
Published in April 2022, it predicted that by the end of the 21st century, continued warming will cause much of the wetter Upper Colorado River Basin to have less water and to more closely resemble the already arid Southwest's Lower Colorado River Basin. The study was published in the journal Earth and Space Science.

The authors found areas of Colorado, Utah and Wyoming — which today contribute most of the runoff to the Upper Colorado River feeding Lake Powell — could have much less water than today. Those states and New Mexico comprise the Upper Basin, while the Lower Basin includes Arizona, California and Nevada.

Using a form of artificial intelligence to analyze climate data, the study predicts spring snowmelt will disappear entirely in some sub-watersheds in the Upper Basin. Large snowpack losses will occur in others, particularly in higher elevation areas such as the Rocky Mountains, the study found.

More specifically, the study projects more arid conditions in the Green River Valley, near the borders of Utah, Colorado and Wyoming. That area includes the Flaming Gorge Reservoir, which has been a crucial recent source of river water to send downstream to prop up Lake Powell. Some mountainous areas in Arizona will also receive significantly less soil moisture, the study concluded.
Hotter temperatures will mean a lot more evapo-transpiration of snow into the air will occur, producing snowpack losses of up to 50% to 60% by 2099, said Katrina Bennett, a research scientist for the laboratory and one of the study's co-authors.

"That obviously translates to lower streamflow," Bennett said. "We saw lower soil moisture, especially in areas already dry, and that is indicative of this longer drought."

The study examined results of six computer models that estimated Colorado River Basin temperatures will rise by a range of 7.3 to 12.6 degrees Fahrenheit by the period 2079 to 2099, compared to 1970 to 1999. Of those six models, three showed increases in precipitation and three showed decreases.

The study also looked at other indicators of extreme drought, such as numbers of dry days, minimum soil moisture, maximum temperatures and evapo-transpiration figures and minimum runoff totals.

But whether the models predicted more or less precipitation, the ultimate outcome is, "we still see increased aridity, due to the increases in temperatures," said Bennett, a hydrologist.

Aridity is a term many scientists use as an alternative to
drought. Drought typically implies a temporary lack of water, whereas aridity describes a long-term if not permanent change to a drier climate.

"As water cycles move through the system, if you have drier soils and increased evapotranspiration, that water, even if it’s falling in the form of precipitation, it simply runs off the landscape," Bennett said. "It falls in the summer as opposed to arriving in the system in winter as snowpack that can be released as snowmelt and is able to be absorbed into the groundwater system."

These future conditions are similar in some ways to conditions on the Colorado River today. For the past few years, average or near-average winter snowpack in the Upper Basin has translated to runoff well below normal, because the basin's increasingly arid soils soak up a lot of the snowpack, keeping it from reaching the river.

"But it's going to be more severe than now," Bennett said.

The study's computer modeling doesn't represent a crystal ball, laboratory officials noted.

"We observed significant uncertainty in drought behavior among the several climate models used," Bennett said.
A view north from the Wahweap Marian Overlook show the shrunken waters around the marina in Glen Canyon National Recreation Area, Page, Ariz.
Kelly Presnell Arizona Daily Star

2nd century drought worse than ours

Two other recent studies looked at long-ago Colorado River droughts, using tree ring and other data, and found they were worse or much worse than today's drought.

The most dramatic finding came from a study that examined 2,000 years of Upper Basin tree ring records and other data. It found the lowest flows in that period came during the 2nd century, from 130 to 150. Besides tree ring data, the researchers used lake and cave sediments and sediments from bogs.

Historical river flow records have shown the current drought,
measured from 2000 to 2021 but continuing today, is the worst on the Colorado since such records started being kept in 1906. Also, existing tree ring records show this period has had the lowest flows of any 22-year period dating back to 762, the study said.

Flows coming downriver from Lake Powell to Lake Mead since 2000 have averaged 84% of the river's average annual flow of 14.7 million acre-feet from 1906 to 2021.

Satellite imagery from Google Earth shows Lake Mead from 1984 to 2020. To see how the water body has changed over time, press the play button at the bottom of the image.

But from 129 to 150, the river only carried 68% of the 1906-2021 flows, or 10 million acre-feet a year, the study found.

This study's finding of worse conditions in the distant past is "alarming," Oxford researcher Wheeler said.

"This does suggest that the same conditions could reoccur anytime in the future, and with elevated CO2 and global temperatures than (there were) two millennia ago, this could occur with a greater frequency or magnitude," Wheeler said. "At the same time, we are in a new era of climate in which there is much we do not know, so periods of wetter years ahead certainly cannot be ruled out either."
Sightseers twenty or thirty feet above get photos of the low water levels of Lake Powell from the public boat ramp at Antelope Point Marina, Ariz.

Kelly Presnell Arizona Daily Star

In the 21st century, "it's probably fair to say we could have a lower 22-year period of stream flows" than the 2nd century period, in part because of our warming temperatures, said Connie Woodhouse, a University of Arizona tree ring specialist and one of five co-authors of this study. She is also a professor of geography and development and of dendrochronology.

The other authors work for UA, the U.S. Bureau of Reclamation, the U.S. Geological Survey and Northern Arizona University. The study was published in June in the journal Geophysical Research Letters.
"The tree-ring data support that this is within the realm of possibility," said Woodhouse of a longer future drought than in the 2nd century.

The gap between the second century's low flows and those since 2000 is "not a huge difference," she said.

But at the same time, the 2nd century's climate suggests we won't see an exact replica of those conditions today, Woodhouse said. Most important, climate records dating back thousands of years show a very slow wetting period over the last 2,000 or even 5,000 years, meaning the 2nd century had less precipitation than now, she said.

But also, today's climate is warmer than that of the 2nd century, she said.

"When we have a drought, it can be because there’s not much rain. But that can be exacerbated by warm temperatures and now we have decreases in flow not because we are not getting as much rain and snow," Woodhouse said. "It's because it's warmer."

**Looking back to look ahead**

A study published in September by Utah State researchers took a similar tack, looking at tree-ring records of river flows over the past 600 years. The researchers then went a step
farther, using those records to make future, drier flow projections.

"Guided by the idea that if it has happened in the past, it might happen again in the future, they found that future drought conditions could produce even lower flow conditions than the present drought," said a Utah State news release about the study. "This suggests the need for alternative management strategies for the Colorado River Basin."

Future scenarios indicate there could be "considerable periods" in which Lake Powell falls below the level at which its turbines can generate power, the study said.

That's "a critically low level for operation of the reservoir and supply of water" to the Lower Basin states.

The study looked specifically at three dry periods, ranging from 19 to 25 years long, dating from the 15th to the 20th centuries.

One lasted from 1576 to 1600, a second ran from 1953 to 1977, and a third covered most of the current drought period from 2000 through 2018. By far the worst period was the earliest, during which the river carried 11.76 million acre-feet a year from 1576 to 1600. That's almost 20% less water than the depressed flows recorded in the basin since 2000. The
most recent dry period before now came from the 1950s to the 1970s, averaging 12.89 million a year.

The 11.76 million figure is "dire," said Professor David Tarboton, a study co-author and director of Utah State University's Water Research Laboratory. Looking at shorter periods in that time span, "you could get down maybe as low as 9 to 10 million acre-feet a year over 10 years," he said.

The co-authors included three Utah State researchers, one from Colorado State University and one from the University of Oxford. It was published by the Journal of the American Water Resources Association.

The researchers used climate computer models to project future river flows, based on records randomly selected from each drought period. They created 100 sets of low-flow scenarios for the river based on individual droughts. The scenarios are "extreme but plausible," Tarboton said.

Looking to 2060, the river could see average annual flows a little bit less or a little bit more than the 11.76 million figure, he said.

"While it is tempting to suppose that the current drought is an extraordinarily rare occurrence that should not evoke any permanent change, this research pushes back against that notion. Results suggest that the (water-saving) measures we
Study: Possible flow decline of up to 41%

One of the few recent studies to make specific projections for how much water the river will lose due to climate change came out of the U.S. Geological Survey in early 2020.

It warned that just considering rising temperatures' impacts, river flows could drop 14% to 31% from 2036 through 2065 from an annual average flow of 14.8 million acre-feet from 1913 through 2017.

If precipitation is also considered, the range of impacts grows much wider, from a 3% increase to a 41% decrease over the same period. The range of possible flows is wider when precipitation is considered, because some computer models predict climate change will increase precipitation while others predict decreases. If the 41% decrease occurred over a long period, that could produce annual flows as low as 9 million acre-feet.

Looking strictly at the projections that consider precipitation and "given the drought you've been experiencing, one might tend to believe the more pessimistic climate models ... making the 41% decrease more credible than the 3% increase," said study co-author Christopher Milly, a just-
Milly called the prospect of a 9 million acre-foot river plausible although not the most likely outcome. Probably the most likely scenario lies between the extremes, he said.

But he said he would strongly recommend that public officials and water managers consider the possibility of annual flows as low as 9 million within the next 30 years.

"In this scenario, the new normal would be 9 million acre-feet, and things would be even drier in drought years," Milly said. "Furthermore, what's 'normal' would likely continue to decrease over subsequent decades."

"Those flows below 12 million acre-feet are going to continue to put this system in a really bad place. If it goes much lower than that, to 9-10-11 million-acre feet, it just speeds up the crash of the system," said researcher Udall, who wasn't part of this study.

**ASU study is less pessimistic**

A still unpublished although publicly discussed study from Arizona State University, among other parties, offers a bit more hope.

That study used computer models to project the river's annual average flow from 2023 through 2060 will be 12.39
million acre-feet. That's very slightly more than the river's average flow since 2000, while still representing a significant decline from the historic flow of 14.76 million acre-feet, from 1906 through 2019.

The study was financed by a $1.1 million grant from NASA, and the Central Arizona Project participated in the research with ASU.

"It’s clear that the amount of snow and soil water will decrease. The precipitation future is very variable. Some years it's high, some years low," one of the study's co-authors, Arizona State University Professor Enrique Vivoni told a September CAP board meeting in Phoenix.

"The key message is no matter what we're having of years of high rainfall, it cannot offset the warming effect. The warming effect is here to stay. The Colorado River will have less water in the 21st century," said Vivoni, of ASU's School of Sustainable Engineering and the Built Environment.
Jake Quilter walks down the newly cut banks of Clear Creek just outside Cathedral in the Desert, Glen Canyon National Recreation Area Utah. The sand is silt left behind by the receding waters of Lake Powell.

Kelly Presnell Arizona Daily Star

Plus, he pointed to the study's finding of a 10% chance that the annual river flow could average as little as 7.4 million acre-feet throughout the study period — less than half the river's historic average flow of the 20th century.

This forecast offers the river's "best case" scenario, noted Eric Kuhn, an independent water researcher and author.

"There's no doubt we are currently within a dry cycle within a dry period. There's no doubt we are going to get some big winters, because climate change, it juices the atmosphere," said Kuhn, former general manager for the Colorado River
District in Glenwood Springs, Colo.

"There's also probably going to be some periods like we going through now, that are really dry for an extended period. In my view, if that study is right, if that happens, it would would be a good thing. It just means we have to cut a lot of water to survive at the river level we are at today."

Utah State's Tarboton said the 12.39 acre-foot forecast by the ASU-CAP study is entirely consistent with his study's scenarios.

But he wouldn't be surprised if annual flows fall below 12.4 million acre-feet even as soon as the next 20 years, he said.

"We are in a period of warming and the climate is going places where we don't have past experience," he said. "We're doing an uncontrolled experiment on the Earth."

By the numbers

One million acre-feet of water will:

- Cover a million football fields a foot deep in water.

- Serve all of Tucson Water's customers for about 10 years and all of the city of Phoenix's water customers for about 5.3 years.

- Grow all the lettuce, cauliflower, alfalfa and other crops in
the Yuma area for one year, with a little water left over.

-Serve all of the customers of the 336-mile-long Central Arizona Project canal system for one year.

-Supply about 35% of Arizona's total annual Colorado River allocation and 23% of California's total annual Colorado River allocation.

-Serve about 41,000 average U.S. subdivisions of 24 acres each.

**Photos: The receding waters of Lake Powell, Glen Canyon National Recreation Area**

Tom Wright hikes past the beached marker for Willow Canyon where it joins with the Escalante River, Glen Canyon National Recreation Area, Utah.

Kelly Presnell Arizona Daily Star
Contact Tony Davis at 520-349-0350 or tdavis@tucson.com. Follow Davis on Twitter@tonydavis987.

Subscribe to stay connected to Tucson. A subscription helps you access more of the local stories that keep you connected to the community.
Our water future: We'll pay more and use much less. Here's how

Tony Davis 21 hrs ago

Editor's note: This is the last of six stories for "Colorado River reckoning: Not enough water," an investigative series by the Arizona Daily Star that observes, at length, the future of the Colorado River.

As Colorado River water grows increasingly scarce over the next 30 years, we in the Southwest could be using as little
water every day as drought-stricken Sydney, Australia, uses today.

Even in 5 to 10 years, we're likely to pay 60% more than now to bring Central Arizona Project water from the river to Tucson.

Food prices are likely to be higher and crop production lower in the Southwest.

City residents will keep installing more efficient toilets, faucets, shower heads and other indoor plumbing fixtures, while lawns will be increasingly scarce across the region.

**People are also reading...**
The practice often disparaged as "toilet to tap" — treating wastewater to drink — is likely to become commonplace as cities hunt for new water sources.

Cisterns that have increasingly popped up in Tucson yards to catch rainwater will become a common sight across the West.

And we will have to be very careful about not replacing lost river water with pumped groundwater, which would trigger the drying of more wells, ground collapse from land subsidence, and earth fissuring.
These and other forecasts and cautionary notes about the long-term impacts of Colorado River water cutbacks come from experts who have been active in planning, managing and fighting to conserve water supplies for decades.

These changes will be needed because many scientists warn the river is very likely in the next 20 years to be carrying 9 million to 11 million acre-feet annually — down from 15 million during the 20th century and around 12 million since 2000. Compounding that problem, residents of the seven river basin states and Mexico have used at least 14 million acre-feet annually for most of this century. Those states are the Lower Basin's Arizona, California and Nevada and the Upper Basin's Colorado, New Mexico, Utah and Wyoming.

Our water future on many fronts:
Mark Wilmer Pumping Station on Lake Havasu. The six 66,000 horsepower pumps lift Colorado River water more than 800 vertical feet into Buckskin Mountain Tunnel and the Central Arizona Project canal.

Central Arizona Project

**CAP water prices to go up**

As reduced water supplies must be spread among the same number of customers, the price per gallon must rise.

CAP rates could go 62% higher by 2028, based on current plans for water delivery cutbacks from the river. Tucson residents won't see that steep of an increase in their water bills, however. The cost of buying the water is one of many factors contributing to the cost of water sold at the tap.

But rates charged by CAP will likely soar even higher once the U.S. Bureau of Reclamation follows through with its plan to cut 2 million to 4 million acre-feet of river water supplies across the seven-state Colorado River Basin. Then, CAP will have to spread its fixed operating costs for the project over an even smaller water supply. The $4 billion project delivers river water to the Tucson and Phoenix areas via a 336-mile-long canal system.

At some point, it's not unthinkable that rates will go so high that low-income and lower middle-class families won't be able to afford them, said CAP board member Mark Taylor, chair of CAP's Power and Finance Subcommittee.
"I personally believe water is way too cheap for its value that we get from it," said Taylor, who sat on Tucson's Citizens Water Advisory Committee for 12 years until earlier this year. "We're replacing a very scarce resource. It’s only priced as to what it costs to distribute and transport — not the cost to replace it with new sources.

"We all know new sources will be much more expensive. We all know costs will go up. They will have to go up a lot more in the coming years," Taylor said.

Many families in low-income areas such as South Tucson already can't afford to pay water bills, said Roxanna Valenzuela, a current Citizens Water Advisory Committee member and a just-elected South Tucson city councilwoman.

"The majority of their income is already going to rent and utilities. It’s going to impact them dramatically. You know that’s going to determine if they can afford groceries or not. People are living day to day here. They are just like one paycheck away from disaster," said Valenzuela, director of a community land trust and a community organizer for the Casa Maria Soup Kitchen in South Tucson.
The Whitsett Intake Pumping Plant is the first of five pumping stations that carry Colorado River water over mountains and through the desert and to Southern California faucets. Irfan Khan / Los Angeles Times

She noted that South Tucson's median household income is very low. The median of $28,700 is barely half the median household income for the entire Tucson metro area, 2020 census data shows.

CAP's total water charge to cities like Tucson and Phoenix in 2022 was $240 an acre-foot. By 2028, the rate could approach $400 an acre-foot. By then, CAP will likely be taking a 50% cut in its total supply, compared to around 30% in 2022, even before possible cuts ordered by the bureau are considered.
Tucson Water utility customers face proposed rate increases of 5.5% a year annually from fiscal years 2023-24 through 2026-27. In part, those proposals were triggered by higher CAP charges. As part of that increase, Tucson Water proposes to raise a longstanding charge it imposes to cover CAP delivery costs from 70 cents to a dollar for every 748 gallons a homeowner or business consumes.

The Tucson City Council will hold a hearing on the proposed increases Jan. 10.

Tucson Water already has good programs for helping low-income residents meet their water bills, CAP's Taylor said. One program provides monthly water bill discounts to low-income customers, with the utility's budget making up the difference between what low-income customers pay and what they would have paid without the discount.

About 4,800 utility customers got the discounts in fiscal year 2021-22 at a cost of about $1.7 million. That's more than twice the number of customers and more than three times the cost of nine years ago.

"More likely, the utility will have to do more in the future," Taylor said.
Paul "Paco" Ollerton and his dog, Aggie, look toward the canal system that delivers Colorado River water to his farm near Casa Grande, Ariz., on Tuesday, July 20, 2021. Climate change, drought and high demand are expected to force the first-ever mandatory cuts from the Colorado River water supply, and Arizona farmers will be hit hardest.

Felicia Fonseca / Associated Press

Farm production will shrink

Farms in the seven Colorado River basin states use an estimated 70% to 80% of the Colorado River's water, so they will be the biggest target. While improved irrigation efficiency will bring some water savings, crop production must also shrink, experts said.

"Perhaps as high as 25% of land currently in production would be removed. To be smart about it, we should target
the least productive land and/or the land that generates the highest salinity runoff," said Jeff Kightlinger, retired general manager for Southern California's six-county Metropolitan Water District.

To reduce farms' water use by a million acre-feet, for instance, "I think it will result in most of these scenarios in a reduction in agricultural production by 10 or 20%," said Bruce Babbitt, a former U.S. Interior secretary and former Arizona governor.

A bleak outlook for some sectors of Arizona farming operations is offered by Kathleen Merrigan, a former deputy U.S. agriculture secretary who now works at Arizona State University.

"In terms of the large-scale vegetable production that goes on in parts of our state, alfalfa production, which is a very, very thirsty crop, and cotton, also thirsty — these operations are at risk," said Merrigan, executive director of ASU's Swette Center for Sustainable Food Systems.

Alfalfa and cotton, both big water users, are grown on more acreage than any other Arizona crop, and alfalfa is grown on more than double the number of acres devoted to any other crop, ASU said in a recent news release.

But a recent survey found that nearly 75% of 650 farmers in
15 Western states had reduced their harvests due to water supply issues, ASU reported. Among Arizona respondents, 40% removed orchard trees or other multi-year crops because of water restrictions, said the American Farm Bureau Federation's survey.

Farmhands wrap a bale of cotton in a tarp while harvesting at the Pacheco Farm in Marana, on Oct. 28, 2020. Roughly 1,150 acres of cotton were harvested in Pacheco's fields that year.

An environmentalist who has fought to protect river flows is dubious about the potential for increased efficiency to keep agriculture afloat.

"Some farmers will be going into bankruptcy. Everybody's doing efficiency, and that works for now. It doesn't work to
"At the end of the century," said John Weisheit, director of the Moab, Utah-based group Living Rivers. "There's going to be more people, more demand, more evaporation, more heat and less snow. They can conserve water and save Lake Powell and Lake Mead. They are still going to end up short."

"In the 1970s, farmers were using 90% of the water, now they are using 80. They already have reduced their consumption. Now we are asking them to reduce it even more, while the cities are welcoming people to live in their communities," Weisheit said.

But we're also going to have to deal with the fact that farmers generally have the most senior rights to river water, said Babbitt and Kathy Jacobs, a longtime University of Arizona climate scientist and former top state water official. In Arizona, the rights are in the hands of farmers from Yuma north to the Colorado River Indian Reservation in Parker, and beyond.

That means farmers must be compensated for giving up water. The Bureau of Reclamation is offering up to $400 an acre-foot of federal dollars to compensate users for giving up river water. Yuma-area farmers want $1,500 an acre-foot.

"It's going to be politically impossible for agriculture to sit on (their water rights), and say the cuts will have to come mainly out of municipal supplies, and that the Central
Arizona Project will have to shut down and the Metropolitan Water District will have to shut down," Babbitt said. "Either agriculture voluntarily comes to the table and joins this discussion on where the cuts will be made, or it will be done for them."

Clearly, cuts in agricultural water use will have to be proportional to future river flows, said Jacobs, director of UA's Center for Climate Adaptation Science and Solutions.

"But due to the farms' senior rights, it's not just a question of who should restrict their water use. The question is 'what is the legal potential to cause that to happen?' Those folks have very strong legal rights and they will try to protect them."
Higher food prices, more political pressure

As farm production decreases, the prices people pay for a variety of food products will also rise and some crops may be harder to find, experts said.

While federal dietary guidelines say we should eat a half-plate of fruits and vegetables a day, “Where in the world are those fruits and vegetables going to come from? They're going to be imported,” ASU's Merrigan said. "They may not be produced as safely. They may be produced using
pesticides that we don't allow here in the United States for toxicology reasons."

The U.S. will need to look at food security issues — "how much of our food is going to be exported," said Kightlinger, now interim general manager of the Pasadena Department of Water and Power. "We've allowed markets to dictate what's more efficient to grow. We export alfalfa and almonds. Some of that may have to be rethought for food security if we have a shrinking portion of agriculture."

Babbitt and Jacobs also agreed tighter water supplies will increase pressure on farms to sell some of their water rights to cities. That's almost certainly going to cause controversy, as has happened in Arizona over a couple of proposals by the CAP and the town of Queen Creek to buy such rights from riverfront farmers.

"If CAP deliveries get cropped down below 500,000 acre-feet (compared to 1 million acre-feet scheduled next year), there's going to be enormous pressure. That's the big issue all over the West these days," Babbitt said. "That is going to be a difficult political fight. There hasn't been much discussion about that. Everybody wants to avoid the issue."

Jacobs said she hopes water rights transfers can be seen as a partnership "rather than some sort of predatory relationship."
"It’s possible to negotiate conditions that are very positive for agriculture as well as for cities. There are plenty of examples. We’ve seen the Metropolitan Water District pay for the lining of irrigation canals of various (agricultural) districts in California in order to harvest water for the cities in the L.A. area. That was a negotiated agreement. It benefited everybody."

Dirt roads outline a planned subdivision in the desert southwest west of Mission Road in Tucson in 1953.

Sedley-Hopkins / Tucson Citizen

Using less on lawns, toilets, appliances
As water supplies shrink for cities as well, the average resident's daily water use will very likely shrink to as low as 50 to 60 gallons daily, Kightlinger said. That matches Sydney's 55 gallons per day use but tops Melbourne's 43 gallons. Those Australian cities' uses started dropping more than a decade ago due to a drought even more severe than the U.S. Southwest's has been.

Reaching those levels in the Southwest will require substantial, although not unthinkable, water use changes inside and outside the home, experts say.

In recent years, Tucson's daily per-person use has ranged from 76 to 82 gallons, less than half of that in the 1970s and early '80s. The average Arizona resident uses about 146 gallons daily, says the Arizona Department of Water Resources. Phoenix, Las Vegas, Los Angeles and Albuquerque residents use 99, 110, 110 and 125 gallons per person daily, respectively.

Water use has been reduced in Las Vegas by cracking down on lawns. Las Vegas-area local governments banned new front lawns in the early 2000s and all new grass planting, except for schools, parks and cemeteries, during the past year. On summer 2022, county commissioners there agreed to limit residential pool sizes to 600 square feet.

Scottsdale recently approved grass removal rebates up to
$5,000 per property and a rebate for in-ground pool or spa removal of $400 plus $1 per square foot of water surface area.

Tucson is considering banning the planting of ornamental grass in new businesses and at some apartment buildings. Many other Southwestern cities are signing on to a regional letter committing to future passage of additional bans on ornamental turf.

Jacobs doesn't foresee grass bans being very controversial here, unless we "absolutely outlaw lawns in peoples' backyards," because Tucsonans have already reduced turf a lot. But they might be very controversial in areas of Phoenix where water is served by the Salt River Project utility. Its lands have existing water rights for the purpose of planting grass, she said.

All experts interviewed expect we'll also be getting more and more efficient toilets, faucets, shower heads and other plumbing fixtures, keeping indoor water use on an even steeper downward path. Toilets, for instance, needed 5 gallons per flush in the 1970s, but you can easily find toilets today that only need a gallon or so.
In Tucson, the City Council has approved a requirement that all new development install fixtures that meet Environmental Protection Agency standards. Existing homeowners continue to get rebates from $100 to $200, covering much of the cost of toilets and washing machines.

But many low-income owners of older Tucson homes can't afford to buy high-efficiency washing machines even with rebates, said Gary Woodard, a private water consultant and researcher. Low-income families can get free toilets from the city rebate program if their old toilet uses at least 1.6 gallons per flush. But when other fixtures are considered, in general,
older homes owned by lower-income families are a challenge for water-saving because they usually have higher water using appliances, he said.

The time for homeowners to pay back the cost of their new appliances through lower water bills is no more than 18 to 30 months, but "often low-income households can't afford to spend $100 now if it's even if it's going to save them $3 a month forever," Woodard said.

Covering pools

As for private swimming pools, their numbers have grown steadily in Pima County since 2015, with up to 1,450 pool
construction permits issued annually by local governments. The numbers of annual permits issued from 2009 through 2014 were in the 400s and low 500s.

Jacobs, Kightlinger and former Arizona Department of Water Resources Director Kathleen Ferris see little or no chance of pools being banned anywhere in the Southwest. But Ferris and Kightlinger see some possibility authorities could require pool owners to cover them, to limit evaporation.

If you are buying a place without a pool, it's a lot easier to stop the new owner from putting in a pool than to force someone to take out an existing pool, said Kathy Ferris, whose Phoenix-area home has had a pool for 35 years.

Having pools is "how we lived in the desert," Ferris said. "It's what people do in the desert with their kids in the summer. Also, the cost of taking out a pool is very steep. Would people get rebates for doing it?"

If you're buying a place that doesn't have a pool, it's easier to say on the front end that pools are no longer to be allowed than it is to say take out a pool, she said.

Whether people keep adding and maintaining pools will likely become personal issues of high cost and peer pressure rather than targets of bans, said Jacobs.

As conservation grows more necessary, increasing water
costs and covering pools "are obvious options that preserve opportunities for personal choices," said Jacobs, director of ADWR's Tucson office from 1988 to 2003.

Researcher Woodard found in an October 2018 study that 21% of a sample of Tucson households had pool covers, with 97% of them claiming to use them at least sometimes.

But in general, covers were used most heavily from November through April and much less in summers, when evaporation peaks, he said. Only 6% of the pool owners covered them in July and August, he said.

The covers' water savings are limited if they're used in spring and fall to keep the water warmer, Woodard said. If the pools are used at all then, "that increases evaporation substantially over what it otherwise would be," he said.

"I'm not anti-pool cover, but they clearly are not a panacea for pool-related water use," Woodard said.

The Central Arizona Project is a 336-mile canal in Arizona that supplies Colorado River water for the Phoenix and Tucson area, agriculture and several Native-American tribes. Construction began in 1973 and was substantially complete by 1994. This portion is located near Sandario Road and Mile Wide Road west of Tucson on March 17, 2021. Video by: Mamta Popat / Arizona Daily Star

Mamta Popat
One way Arizonans can keep the loss of Colorado River water from crimping their lifestyles would be to revert to the rampant groundwater pumping that dominated the state before CAP came online in Phoenix in 1985 and in Tucson in 1992.

Just the possibility that would happen keeps Ferris up at night. More than four decades ago, she chaired a State Groundwater Study Commission that drafted the pioneering 1980 Arizona Groundwater Management Act. One of its goals was to limit pumping in favor of renewable CAP water from the Colorado.

Despite widespread predictions that Colorado River cutbacks will slice peoples' water use, Ferris said she’s not sure things are going to be that much different in the next 20 years because of readily available, fossil groundwater supplies. That water has sat underground for millions of years and can't be replaced once withdrawn.

If large-scale pumping resumes, she fears a resurgence of the land subsidence and earth fissuring that were common before the 1980 law passed and that still strikes rural areas where groundwater remains unregulated.

“How we address this problem in the next few years will determine how inhabitable this place will be in 20 or 30 years. We don’t have 20 or 30 years to figure this out. We
have to start taking action now. (But) all we do is talk talk talk talk talk talk," Ferris said.

"We will see a lot of heartache. I think we will see a lot of ground fissures and subsidence that will affect homes and the value of property. It will be a signal to the rest of the country that this state is in decline."

Tucson may have to resume some pumping of ancient groundwater over the coming years. It's done little of that since the early 2010s when it started putting virtually all its residential and business customers on CAP water. It now recharges about 30% of its CAP supply every year for long-term storage in various aquifers, and serves the rest to customers after recharging it, then pumping it out of the ground.
A small sail boat traverses the water at Golder Lake which captured runoff from the Cañada del Oro River northwest of Tucson in July, 1972. The lake, developed by
Lloyd Golder III, was a 260-acre recreational lake that cost more than $1 million. When it was completed it was expected to stretch one-and-a-half miles across and be 120-feet deep at its lowest point. The dam deemed unsafe by the state and breached in 1980.

As of now, the city has stored about five years worth of CAP supplies underground, -- more than 560,000 acre feet. The state-run Arizona Water bank has stored almost that much additional CAP water underground in the greater Tucson area. But that water could be used by any Tucson-area entity with CAP rights. Tucson Water and ADWR officials can't say how much of that water could be used by Tucson compared to other cities and private water companies in this area with CAP water rights.

But if the bureau orders a large enough cut in Colorado River deliveries to Arizona, Tucson Water Director John Kmiec has said the city may have to start pumping out some of that stored CAP water to supplement its diminished annual CAP deliveries. When and if that stored supply is gone, the utility would then likely have to revert to pumping native groundwater.

In 1980, the state estimated that farms and cities in the three most populous counties — Maricopa, Pima and Pinal — were pumping around 2.5 million acre-feet more groundwater every year than rainfall was putting back in. Thanks to the groundwater law and the arrival of CAP, the overdraft plunged to 180,000 by 2010. But by 2019, the last year for
which statistics are available, it had rebounded to about 480,000, state records show.

Groundwater levels across the Colorado River Basin have, over the past 20 years, declined faster than water levels at Lakes Powell and Mead, a study has found. The study is led by Jay Famiglietti, a longtime water researcher who will soon join ASU as a professor.

"Most of the groundwater losses in the basin are happening in the Lower Basin, and mostly Arizona," said Famiglietti, now executive director of the University of Saskatchewan's Global Institute for Water Security. "The groundwater supply is so critical to the future of the region that it is not an exaggeration to call it an existential crisis."

Ferris said she's concerned there will be efforts in the Arizona Legislature to loosen the existing state groundwater law, to make it easier, for instance, to prove that a new development meets state requirements for having an assured, 100-year water supply.

"We've got to stop thinking this groundwater is inexhaustible. We have to start planning for a future that relies on less groundwater."
A home with a swimming pool abuts the desert on the edge of the Las Vegas valley July 20, 2022, in Henderson, Nev.

John Locher / Associated Press

**Toilet to tap foreseen**

That's been the catch phrase for years for people uncomfortable with treating wastewater to make it safe to drink. But now with Colorado River water slowly disappearing, many experts say that idea's time has arrived.

A key reason is that while treating wastewater that heavily is expensive, it stretches existing supplies rather than requiring governments to invest even more money developing more expensive supplies such as seawater desalination, or
building a pipeline to import water from less arid regions of the U.S.

"The best source of near term augmentation is water recycling and reuse," Babbitt said. "It should be near the top of the augmentation list."

While in the past many citizens have recoiled at this water solution, Ferris said she believes people will now accept it if it's handled correctly. In selling projects like these to the public, officials must also demonstrate that recycled wastewater will be used to supplement existing supplies—not to support new growth, she said.

Scottsdale has run a major water recycling plant for 20 years that creates 7 billion gallons a year of drinkable, reused wastewater. The city's Advanced Water Treatment Plant puts wastewater from a conventional sewage plant through a series of processes, including reverse osmosis, filtration and the use of ozone, to produce water that exceeds the quality of bottled water, Scottsdale Water officials say. Then, they inject the water into either the city's drinking water aquifer or into a reclaimed water distribution system serving golf courses and other turf uses.

Scottsdale has had a state permit since 2019 authorizing "direct potable reuse," in which the recycled water goes directly into the drinking water system. But the permit is only
valid for demonstration purposes. The city provides about 2,000 samples of the water annually to people who tour the plant, and has twice held events where people pay to drink locally brewed beer made from recycled water.

The Arizona Department of Environmental Quality can't allow recycled water directly into drinking water systems until it develops more detailed rules. That work started this year, after the Legislature required the rules by the end of 2024.

Once the rules are in place, Scottsdale Water officials intend to seek their City Council's permission to apply for a state permit to run the plant for drinking water.

"It's almost like we're the test dummies for it," said Scottsdale Water spokeswoman Valerie Schneirder.

As for Tucson Water, the city has no plans to pursue even indirect reuse of wastewater for drinking in the foreseeable future, utility spokeswoman Natalie DeRoock said in November.

A much bigger plant for treating wastewater to drink is being studied by Southern California's Metropolitan Water District. The $3.4 billion project would create 150 million gallons of clean drinking water daily — nearly eight times more than the Scottsdale plant.

That would be enough to serve more than 500,000 homes
every day, and produce around 50% more water than Tucson Water customers consume in a year. For now, however, MWD officials say this project would be only for indirect reuse, just like Scottsdale's. The reason is the same: California also is developing regulations allowing direct reuse of wastewater for drinking.

Officials hope to start construction on the project by 2025, have a preliminary phase online in 2028 and a second phase operating by 2032.

**Catching the rain**

Rainwater harvesting barely existed here 40 years ago, but it's now big business in Tucson. And it's likely to get a lot bigger here, and across the Southwest, as other water supplies disappear.

Today, about 30 Tucson businesses install cisterns and other kinds of equipment to help homeowners and businesses capture rainfall for their outdoor landscaping. A few people have even installed harvesting systems to capture rainwater for their pools.

In 30 years, Brad Lancaster, a Tucson author and advocate of rainwater reuse, said he wouldn't be surprised if water harvesting here matches that of Australia, where cisterns and other rainwater harvesting tools are now common.
As long ago as 2014, 45% of all homes in Adelaide, Australia, had rainwater harvesting systems, and in Sydney, you can't build, renovate or make a change without installing a cistern as part of your water supply.

Students at Mission View Elementary School in Tucson stand in line in 1960 for a drink of water in the late Summer heat.

Dan Tortorell / Tucson Citizen

Lancaster drinks rainfall coming off the roof of his Dunbar Spring home. That Tucson neighborhood now captures 1 million gallons a year along its streets and in public right of ways, Lancaster said, adding, "We're not done at all. We can
and have to do at least 30 times more of that; I did a simple calculation that we have over 50 million gallons of rain falling on our neighborhood in a year and I’m only talking about public right-of-way stuff."

Less consensus exists on the feasibility of capturing rainwater on a larger scale, through building small dams along washes or large water storage ponds such as one that Pima County uses to furnish water for the Kino Sports Complex.

Los Angeles County voters in 2018 approved property tax increase in part to build projects like grassy swales and dry wells to capture nearly 100 million gallons of storm water runoff a year that otherwise would speed into the Pacific Ocean. But county officials estimate it could take 30 years to build all the projects.

Ferris and Kightlinger question the feasibility of the very idea of storm water capture, because of its costs and potential legal difficulties because the rights to water flowing down a wash are often owned by landowners downstream.

Researchers at all three major Arizona universities are about to embark on a three-year, $3.7 million project to investigate a different kind of storm-water capture. It will involve finding the best locations across the state to corral and ultimately recharge rainfall into various aquifers, for future use. The
goal is to store runoff so it's not lost to evaporation, which accounts for 75% to 90% of all precipitation in Arizona, said Jacobs, co-lead investigator for the project along with Neha Gupta of UA's Institute for Resilience.

The Arizona Board of Regents signed off Nov. 18 on the project. While the Arizona Department of Water Resources hasn't specified how the captured runoff would be used, clearly it could later be pumped for human use, serve to upgrade the state's riparian habitats or help stabilize or restore flows in nearby rivers, Jacobs said.

A couple of sightseers take in the view from Hite Overlook, where the Colorado River enters what was once the upper reaches of Lake Powell. Now dry, the National Park Service closed Hite Marina.

Kelly Presnell Arizona Daily Star

Managing the crisis
In the worst case scenario projected by researchers — a 60% decline by 2060 in Colorado River flows from 20th century levels — many water experts and political leaders say the resulting cutbacks will cause serious economic dislocation, but will be manageable.

Among them is Babbitt, who said he believes that while water cutbacks on farms will cause some job losses and boost some food prices as land goes out of production, agriculture will still largely survive.

"Bear in mind that of the existing water uses of agriculture, more than half of it is for growing alfalfa and grass, more than half the water use is for cattle feed," he said. "That's true in both basins. There will be some reduction in the growing of alfalfa, winter wheat, sorghum and other feed, but those kind of crops can in fact be grown elsewhere."

Because so much of the river water goes to agriculture, the cities' water problems are more manageable, too, Babbitt said.

For instance, with 40% of urban water use in the West going outdoors (Tucson Water customers use 30% of their water outdoors), that leaves plenty of room for water savings there. As for indoor use, even if 40% isn't eliminated by conservation, the water used simply goes into sewage treatment plants and can be recycled, giving cities a large
new water supply, he said.

Weisheit, of Living Rivers, who has been warning for decades that the river is in trouble, is much more pessimistic. While conservation may reduce individuals' water use for a time, he said that by 2100, climate change will require the use of more water, not less.

As it gets hotter, "plants are thirstier. The air is thirstier. Soils are thirstier," said Weisheit.

"By the end of 21st century, more people will override the conservation that we do. Not only is the water needed for daily living, you have to grow food for these people."

**Can our population keep growing?**

Even with Colorado River cutbacks, Kightlinger and Jacobs say they believe the Southwest will still have enough water from groundwater, recycled water and other surface water sources to allow growth to continue without major reductions in its pace. But both conditioned their optimism with caveats.

"I don’t think that reductions in water availability necessarily have to lead to a reduction in growth. There’s a lot of perception associated with this that might affect things as much as actual shortages," Jacobs said. "(The water
problems) could discourage investors or people who read newspapers about water shortages and that may encourage them to move elsewhere.

"I don’t think with the amount of water we have available in the state there’s any reduction required. It’s not required that we limit growth; I do think that conservation needs to be a much larger part of the equation," she said. "If we have farsighted leadership and the resources required to carry it out, this transition (away from Colorado River water) could go relatively well. If we refuse to take farsighted actions now, we are going to pay for that."

Kightlinger added, "I think we can manage the population levels and growth with the resources we have. It will have to be as highly efficient growth as possible. We are going to have to make sure the water footprint we have with that growth is as small as possible."

Ferris said she doesn't know if it's politically feasible to limit where people can live or move to. But it may be necessary to restrict new home building to ensure growth doesn't occur in areas that depend mainly on nonrenewable groundwater due to the risks of land subsidence, fissuring and diminishing water quality as wells go deeper, she said. She noted, however, that based on how groundwater has been managed here in recent decades, "the political will for doing that is not good."
The problem is nobody in government is thinking about the truly long term, said Living Rivers' Weisheit.

While Arizona does require proof of a 100-year water supply for allow new home building in urban areas, "Why isn't that a 1,000-year supply?" he asked.

"Everybody’s thinking till the end of their employment and retirement. They're concerned about the here and now. They're putting this burden on future generations and I don't see them stepping up to the plate to solve this problem for future generations."
The entrance to the pedestrian access ramp of the Antelope Point Marina is taped off after being cutoff from the docks due to receding waters of Lake Powell.

Kelly Presnell Arizona Daily Star

Contact Tony Davis at 520-349-0350 or tndavis@tucson.com. Follow Davis on Twitter@tonydavis987.

Subscribe to stay connected to Tucson. A subscription helps you access more of the local stories that keep you connected to the community.
Tony Davis

Reporter

Tony graduated from Northwestern University and started at the Star in 1997. He has mostly covered environmental stories since 2005, focusing on water supplies, climate change, the Rosemont Mine and the endangered jaguar.
Feds announce plan for massive cuts in Colorado River deliveries

The Bureau of Reclamation is for the first time legally signaling its intent to make major cutbacks in water deliveries from Lake Powell to Lake Mead and the Lower River Basin to protect the reservoirs that are on the edge of collapse.

In online presentations last week, the bureau said it’s working through a formal process that could lead to cutting deliveries from Powell by 2 million to 3 million acre-feet annually and possibly more. That could happen if states in
the Lower River Basin — Arizona, California and Nevada — can’t reach agreement by Jan. 31 on how to slice their take from the river, the agency said. The bureau didn’t specify when cuts would begin or how they would be divided among states, saying those questions will be answered later.

But “it means that we’re looking at unprecedented reductions in supplies. There’s just no way you can slice and dice this any other way than that, especially if you’re using water from the CAP (Central Arizona Project),” said Cynthia Campbell, Phoenix’s water resources management advisor.

People are also reading...

The CAP, which serves drinking water to Tucson and Phoenix, sits at the bottom of the list of who in the Lower Basin has priorities for river water when cutbacks happen. But if “they don’t go strictly by priority and zero us out, it’s still going to be a big cut,” Campbell said.

As they have said before, bureau officials said last week cuts of this scale are needed to prevent Mead and Powell from falling to catastrophically low levels that would jeopardize their ability to deliver water to cities and farms and to generate electricity from their respective dams. They serve power to 8.5 million people in the Lower Basin states and 5 million in the Upper Basin states. Colorado, New Mexico, Utah and Wyoming comprise the Upper Basin.
Forecasts getting worse

This time, however, the bureau warned the reservoirs could reach such low levels sooner than it said before — if no cuts are made and the weather stays dry and hot.

It’s possible Lake Powell could fall below 3,490 feet, at which Glen Canyon Dam can’t deliver electricity, by next June or July, officials said. Under several bleak scenarios analyzed by the agency, Powell would stay below 3,490 through the end of 2026.

After more than a decade of construction, Glen Canyon Dam was officially dedicated by First Lady Ladybird Johnson on Sept. 22, 1966. 

Jesse Tellez

Under the new forecasts, Mead could hit “dead pool” at 985 feet — at which no water could be extracted — by early 2025, and stay there for much of the rest of that year. It could fall below 950 feet, at which Hoover Dam can’t generate electricity, by mid-2024.

The reason the scenarios turn dire so quickly now is that for the first time, the bureau analyzed impacts to river flows and reservoir levels if we repeat the very dry period of the early 2000s. By 2005, Powell dropped 100 feet in elevation, and lost half its total stored water from 2000 levels.

Scientists have long warned that a rerun of those years
could be disastrous, because Powell is far lower now than it was in the early 2000s. On Friday, a bureau official raised the possibility the next few years could be even drier.

The latest projections still don’t reflect the full range of possible low hydrologic conditions, said Dan Bunk, operations chief for Reclamation’s Boulder City, Nevada office. Because of that, “a drier future than what happened historically is possible,” Bunk said.

Cuts of the scale envisioned by Reclamation would shave 28% to 42% off deliveries from Powell to Mead compared to this year’s 7 million acre-feet. It would represent a smaller share — from 22% to 33% — of the 8.9 million that the Lower Basin states and Mexico actually took from the river last year. By comparison, CAP is scheduled to deliver about 1 million acre-feet this year to cities, farms and tribes in Central and Southern Arizona.

That the states and Mexico are taking more out of Mead than what’s sent there each year is at the root of the Colorado’s problems. The river has been running a supply-demand deficit for many years.

‘Right to the edge of the cliff’

“Reclamation is significantly advancing the discussion by showing with real numbers and real modeling how bad it can
get," if the basin states don’t significantly reduce water use, said Jack Schmidt, a Utah State University scientist who has overseen major studies of the river.

“We’re going right to the edge of the cliff ... We don’t have anything comparable to what we need in proposed cuts. If we don’t make the cuts, we go off the cliff. Reclamation showed what does it mean to go off the cliff,” said Schmidt, who is director of the university’s Center for Colorado River Studies.

Bureau officials aren’t saying they expect a particular kind of climate impact — “They are saying a particularly bad hydrology is clearly possible, and we need to have a plan for what we will do if that hydrology happens,” said John Fleck, an author and University of New Mexico water researcher.

“One of the things they are saying is that under climate change, we don’t know what the most probable future is. We know that with climate change, the future will be different from the past,” Fleck said.

Reclamation officials have said since June that cuts on the scale they talked about in detail last week are necessary.

Now, however, bureau officials plan to make cuts, if necessary, through formal procedures governed by the National Environmental Policy Act. Agency officials say
they’ll propose a range of alternatives for managing the reservoirs by next spring, and make final decisions by late summer 2023. In draft and final environmental statements, the bureau will analyze three alternatives.

One would be to take no action to cut water deliveries. A second would be for the states and the federal government to reach consensus on a plan for reductions. A third alternative would be for the bureau to act unilaterally if consensus proves unattainable.

“What Reclamation did was challenge everyone to come up with a way we don’t go off the cliff,” Utah State’s Schmidt said.

The bureau declined to respond to questions from the Star about how these cuts would play out among the states and Mexico, and who would decide that. Reclamation is in the early stages of environmental reviews and is accepting public comments until Dec, 20 on what subjects the environmental impact statement should cover, said Michelle Helms, a bureau spokeswoman.

“That’s the kind of stuff Reclamation desperately doesn’t want to have to make decisions on,” Schmidt said. “We are in such completely uncharted territory, I do think people are desperately trying to come up with something. In some ways, the most thoughtful innovative stuff is still talked
about behind closed doors."

‘It will hurt everyone’

One reason the bureau was reluctant to take steps this dramatic in the past is that its officials feared a lawsuit, said environmentalist John Weisheit. If such a court action went as high as the U.S. Supreme Court, it could drag on more than a decade as did the dispute between Arizona and California in the 1950s and ‘60s, said Weisheit, director of the Utah-based Living Rivers.

“But I think at this point the federal government doesn’t have any other choice but to save the system and leave the states in the dust because they haven’t been helpful,” Weisheit said.

Bureau officials know that whatever they do, they’ll be challenged, because the results of what they have to do will be so big it’s going to hurt, said Phoenix’s Campbell.

“It’s not going to hurt a small group of people. It’s not going to hurt just CAP. It will hurt everyone. They could take us out in Arizona and they’re not halfway there in reaching their goal,” Campbell said.

Arizona Department of Water Resources Director Tom Buschatzke was out of town on business and unavailable for
comment. Southern Nevada Water Authority officials didn’t respond to a request for comment.

California officials have offered in a letter to federal officials to cut 400,000 acre-feet a year, or just under 10% of the states’ total supplies. Arizona officials say that offer is inadequate. But “there’s multiple proposals submitted to the feds” to save additional water that haven’t been made public, said Bill Hasencamp of Southern California’s Metropolitan Water District.

“I anticipate it will be more than 400,000 between the two states that’s offered, maybe significantly more,” he said. Adding those cuts to those already approved under earlier drought plans, “I think we have a potential for a pretty good sized conservation plan,” he said.

But “if it’s really dry, record dry, our conservation is not going to be enough. There will be have to be mandatory cuts in 2024. If we get years like 2002 through 2005 stacked up, voluntary actions are probably not going to be enough. That’s just the reality.”

Contact Tony Davis at 520-349-0350 or tdaois@tucson.com. Follow Davis on Twitter@tonydavis987.
Tony Davis

Report

Tony graduated from Northwestern University and started at the Star in 1997. He has mostly covered environmental stories since 2005, focusing on water supplies, climate change, the Rosemont Mine and the endangered jaguar.