

'Worse-case' CAP shortages threaten the Tucson aquifer's delicate balance



Employees with Nelson's Drilling sink a new water well near the Tortolita Mountains near Marana. A new federal study projects the possibility of significantly increased groundwater pumping in the future.

Rebecca Sasnett, Arizona Daily Star

Back in 1977, President Jimmy Carter wanted to put the Central Arizona Project on a hit list of 17 water projects he found too expensive and environmentally destructive. Sahuarita pecan grower Keith Walden told Time Magazine that if that came to pass, "Tucson will be covered up with sand and become a ghost town within a hundred years."

CAP and plenty of other water projects survived, and today, the Tucson area is a million-resident metropolis, not a ghost town.

But now, as CAP's first water shortages draw near, a more subtle, long-term threat to the Tucson area's water future is emerging because of climate change.

With increasing aridity and warmth on the horizon, a new federal study projects the possibility of significantly increased groundwater pumping in the future here, as warmer weather slashes stormwater flows needed to replenish the aquifer after it's pumped.

Exactly what happens will depend on whether we endure a "worse-case" or "best-case" scenario in the changing climate; the study did not analyze "worst-case" situations.

The \$2 million Lower Santa Cruz River Basin study, sponsored by the U.S. Bureau of Reclamation, made these projections to help the Tucson community develop strategies to adapt.

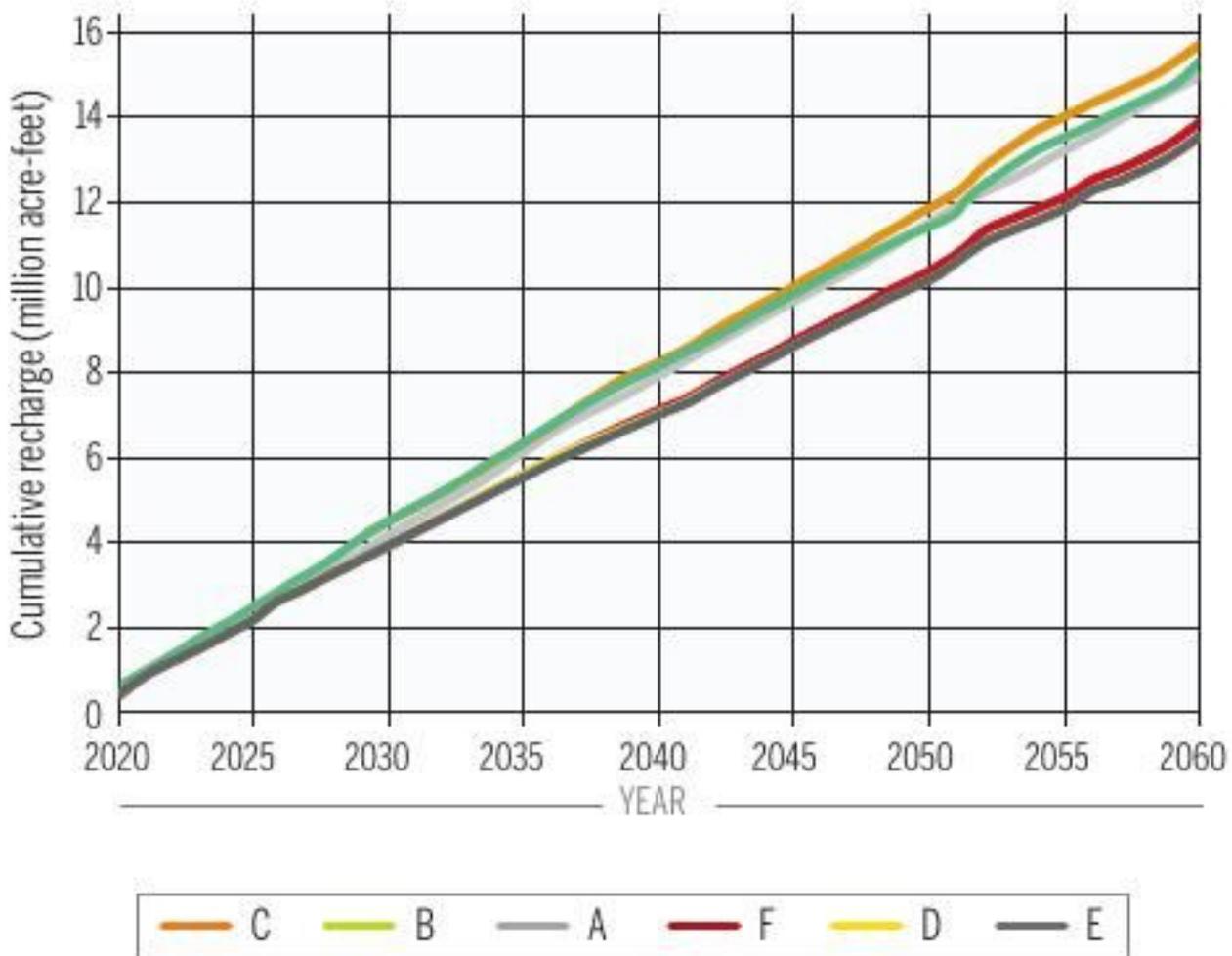
The study's worse-case climate scenario projects that nearly 70% of Arizona's total CAP supply would be cut for a short time in the mid-2050s, with lesser, still major cuts before and afterward.

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Hotter weather will mean less water for the aquifer

We'll have less water recharging the aquifer, maybe a lot less, by 2060 if climate change and warmer weather significantly reduce the amount of precipitation and runoff in the Tucson area, a new study shows. The aquifer is recharged by a number of sources — streamflow, water flowing downhill in mountains, treated sewage effluent dumped into the Santa Cruz River and CAP water deposited onto farmland.

Cumulative total recharge, all scenarios



		DEMAND GROWTH		
		Slow, compact	Medium	Rapid, outward
CLIMATE	Worse case	D	E	F
	Best case	B		C
	Current climate		A	

The study also warns the Tucson area faces dramatic temperature increases by the 2050s and precipitation declines starting in the 2030s, under the worse-case scenario.

Austin Carey, a CAP planning analyst, and Kathy Jacobs, a University of Arizona climate scientist, agree that a combination of less CAP water, less recharge, more water demand due to growth, and more pumping would make achieving the long-held regional goal of "safe yield" of the aquifer more challenging.

"Obviously, it is much easier to control the demand side of this equation than the supply side. That said, if we are able to move quickly into a lower (greenhouse gas) emissions scenario globally, the worse-case scenario may overstate the impacts. If we don't, there will be even more serious consequences," said Jacobs, director of UA's Center for Climate Adaptation Science and Solutions and former director of the Arizona Department of Water Resources' Tucson office.

The less Colorado River water available in the future for the CAP, "the more the Tucson region will need to rely on fossil groundwater pumping. You can't really get around that," said

Kathryn Sorensen, a research fellow at Arizona State University's Kyl Center for Water Policy, referring to ancient groundwater.

While Phoenix faces more acute, short-term water problems if CAP supplies are cut drastically, Tucson faces bigger long-term problems, she said. That's because the Tucson region has only groundwater and the Colorado River, while the Phoenix area can also tap water from the Salt and Verde rivers.

"The health of Tucson's aquifers is nearly entirely dependent on flows from the Colorado River. As these flows diminish in a hotter and drier future, Tucson's aquifers will likely suffer, as well," Sorensen said.



Reeds and algae cover what little standing water there is above the dam on Cienega Creek at the Pantano Wash southeast of Tucson. Water in Cienega Creek and other streams serves as a major source of groundwater recharge in the Tucson area. But a federal study predicts that future hotter and drier weather will reduce the amount of streamflow available

to replenish the aquifer.

Kelly Presnell, Arizona Daily Star

Safe yield, in which the region pumps no more groundwater than is recharged into the aquifer in a given year, is prescribed by the landmark 1980 Arizona Groundwater Management Act. It set 2025 as a non-enforceable deadline for reaching it.

Today, the Tucson area's total annual recharge barely exceeds pumping. Safe yield is promoted because many scientists, officials and environmentalists say that unbridled groundwater pumping can lead to subsidence, or collapsing of the ground surface, sharply higher water costs and lower water quality.

Yet officials of some suburban municipal water providers such as Metro Water and Oro Valley say they believe their communities can still provide adequate water without major groundwater pumping increases, even with big CAP cuts.

Tucson Water officials say the same thing: that they can withstand cuts of even 75% without returning to the massive pumping that dropped the aquifer 200 feet from 1940 to 2000. The new study agrees, saying that only in the last few years of the 2050s is the utility projected to increase pumping.

But the study found that increased demand and reduced

CAP deliveries will trigger major declines in groundwater levels in suburbs south of Tucson, in southeast-side suburbs near Vail and in incorporated and unincorporated suburbs such as Oro Valley, Catalina and SaddleBrooke.

The calculations

Under the worse-case climate scenario studied, CAP would lose up to 1.1 million acre-feet of its total annual 1.59 million acre foot supply — a 69% cut — in a handful of years during the 2050s. During the 2030s, cuts in CAP supplies could reach about 56% of the annual supply.

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The 69% cut would translate into a 60% cut in supplies to municipal and industrial users, including cities and towns such as Tucson and Oro Valley, and mining companies such as Freeport McMoran, CAP found.

In a better climate scenario, CAP would lose a little less — close to 900,000 to 1.1 million acre-feet in some years. If the current climate persists, however, the study projected the water project would lose no more than 600,000 acre-feet annually during the next 40 years.

Those lesser cuts would not affect city and industrial water users much, only Central Arizona farmers, some Phoenix-area cities and some tribes including possibly the Tohono O'Odham.

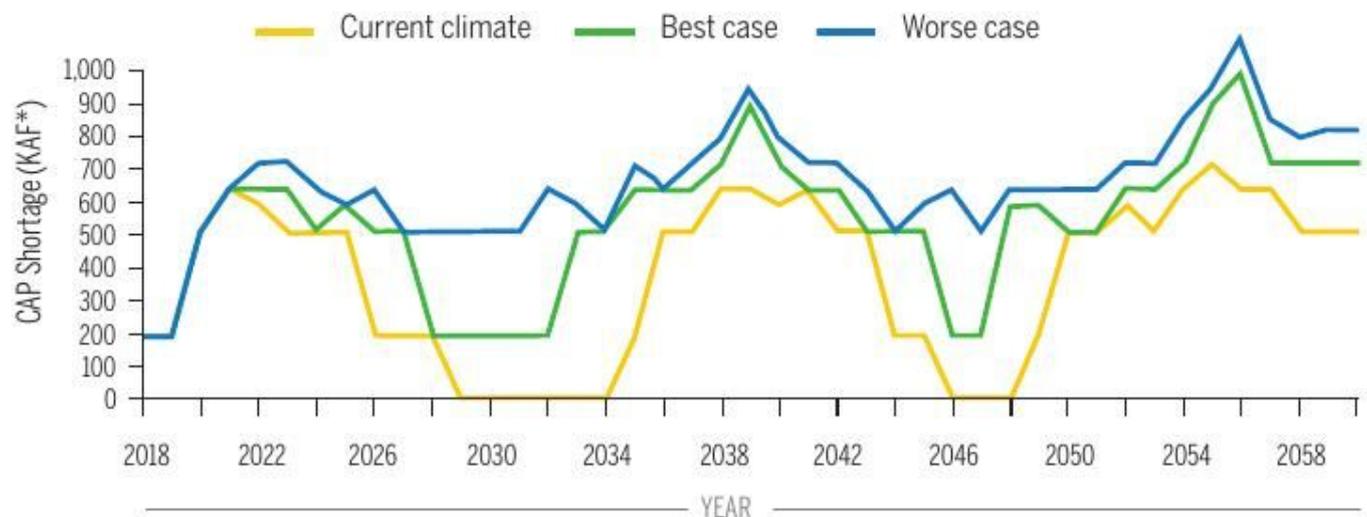
For context, Tucson Water customers use about 100,000 acre-feet a year of drinkable water. One acre foot is enough to cover a football field one foot deep with water.

The worse-case climate scenario could happen if greenhouse gas emissions rise until 2100 at the same pace of recent years with little mitigation, said Patti Aaron, a Bureau of Reclamation spokeswoman.

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CAP shortage scenarios

To understand how the water delivery system in Tucson could handle the stress of severe Central Arizona Project shortages, CAP officials who worked on the Lower Santa Cruz River Basin study projected an overall CAP shortage of up to 1.1 million acre-feet a year — nearly 70% of the project's annual supply — under a severe climate change scenario. But if our current climate patterns continue unchanged, CAP officials project that there will still be wetter periods in the 2030s and 2040s in which the project still delivers its full supply of nearly 1.6 million acre-feet.



*1,000 acre-feet

The best-case climate scenario assumes that some measures are taken to rein in greenhouse gas emissions but not enough to avoid moderate temperature increases.

Metro Water

Officials of Metro Water on the Tucson area's northwest side insist they could manage a CAP cut of 40% to 50%. A 60% cut, which Metro General Manager Joe Olsen calls "very theoretical," would make things a little trickier, but Olsen says it could be weathered unless it happened every year.

The district, serving unincorporated Pima County, has rights to nearly twice as much CAP water as its customers use every year. The district currently pumps groundwater but plans to start delivering CAP in 2023 via a new, \$43 million pipeline, built in cooperation with Marana and Oro Valley.

Even then, it will deliver less than one-third of its CAP bounty to customers. The rest will be recharged into basins along the Santa Cruz River, or delivered to nearby farmers to replace groundwater — as the district does today.



Colorado River water brought to Tucson by canal is recharged at the Lower Santa Cruz Recharge Project by CAP customers to replenish the aquifer while they pump groundwater elsewhere. The less Colorado River water available for the CAP in the future due to climate change, the more the Tucson area will need to rely on pumping out ancient groundwater supplies, researchers say.

Central Arizona Project

So a 40% cut in CAP deliveries could be handled without the district having to pump additional groundwater, Olsen said. A 50% cut would require the district to use long-term “credits” it has from CAP water it has stored underground, but the amount needed would be nominal.

With a 60% cut, the district would need to pump up to 2,500 acre-feet a year, using the credits. It only has enough CAP water stored underground to last 20 years using credits at that pace, meaning the district would someday have to go

deeper into the aquifer.

But in reality, Olsen points out, the study forecasts such cuts only in periodic "spikes." So the district could in many years get by without having to pump more groundwater.

Oro Valley

For Oro Valley, the study projects its current water use will more than double and its pumping will increase significantly by the 2050s. It will lose some CAP water and will keep growing rapidly as it has done until now, the study projects.

On that point, Oro Valley Water Director Peter Abraham disagrees, although he doesn't dispute that some additional pumping will be needed in the worse-case scenario.

Oro Valley has rights to more CAP water, about 33%, than the 7,500 acre-feet that town residents and businesses currently use. When the CAP pipeline arrives, Abraham says the town will take up to 4,000 acre-feet of CAP on top of 2,600 it's currently importing through Tucson Water's pipelines. So it will still have some water to store underground after that.



A new study predicts that Oro Valley's current water use will more than double and its pumping will increase significantly by the 2050s.

Rick Wiley, Arizona Daily Star 2020

With a 50% cut in CAP supplies, Abraham said his computerized forecasts show the town could supply customers for up to 40 more years without more pumping. With a 60% cut, "it's just simple math. At that point I would have to go to increased pumping sooner," Abraham said.

But he disagrees with the study's projections of pumping and growth because development within current town limits will be "built out" by 2030. While future annexations would add population, he said he believes town leaders will only support annexations allowing "sustainable" growth.

"As a water professional, that means to me not having to

resort to additional groundwater pumping," Abraham said.

Other areas

Many other growing suburban areas such as Marana, Vail and Green Valley don't have much of a CAP supply cushion.

Those are areas where the new study forecasts the deepest water level declines in the event of CAP cuts. Also on that list are SaddleBrooke, Quail Creek and Rancho Sahuarita, whose private water companies have no CAP.

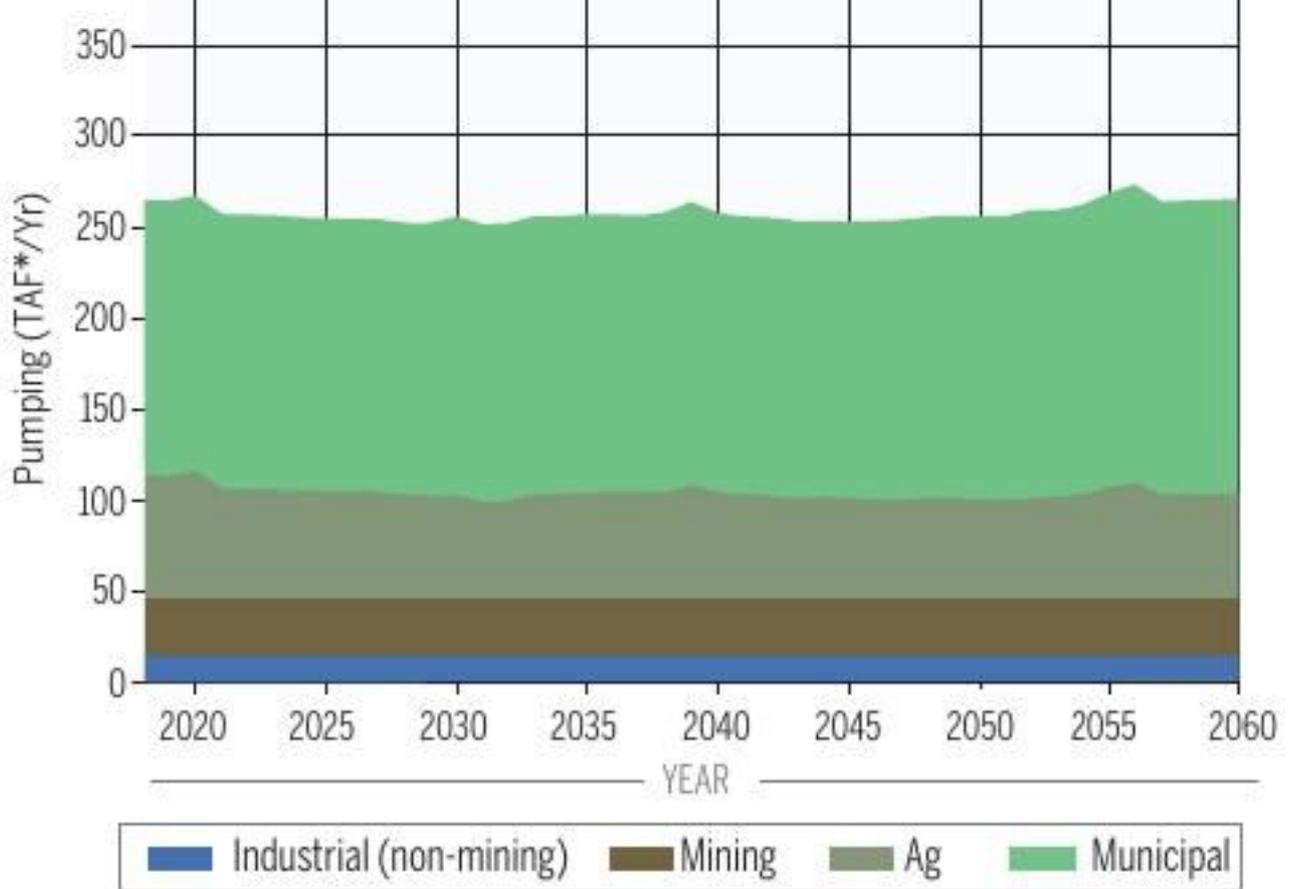
For Community Water Company of Green Valley, if CAP suffers major cuts, "We are not sustainable as long as the water table continues to decrease. (But) the true impact (of continued pumping) on our aquifer looks like it will happen beyond our lifetime," its president Arturo Gabaldon said.

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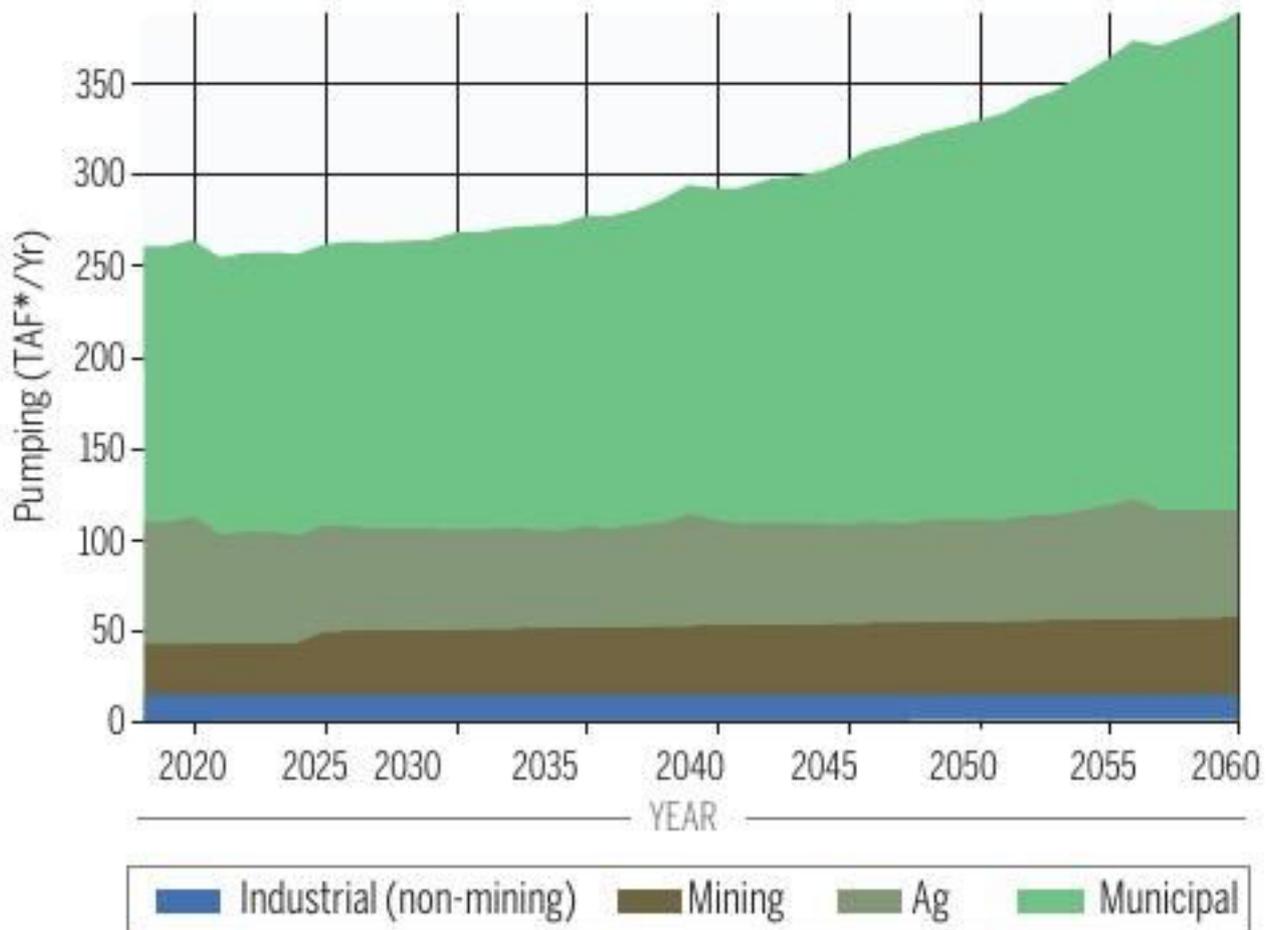
More heat, more pumping

Groundwater pumping in the Tucson area will increase significantly by 2060, by up to 150,000 acre-feet a year, if the climate heats up dramatically and our growth spreads farther out. The hotter weather is likely to reduce our deliveries of renewable Central Arizona Project water. Continued outward growth — or sprawl— will likely lead to the creation of more private water companies that have no CAP supplies and must pump groundwater to serve their new customers and recharge renewable supplies far from the point of pumping.

Pumping by sector, scenario B: best climate, slow compact growth



Pumping by sector, scenario F: worse climate, rapid outward growth



*Thousands of acre-feet

“If it’s cut 50%, something is better than nothing. Right now we don’t have anything,” said Gabaldon, whose company is building a pipeline to bring 2,800 acre-feet of CAP water a year to its 13,000 Green Valley-Sahuarita-area customers.

The company’s four drinking water wells all go 1,000 feet deep, and water levels are 200 to 300 feet deep. At current water level declines of 2 feet a year, “straight math tells you it’s 400 years” before the pumps hit bottom, Gabaldon said.

Still, the reclamation agency’s study forecasting declines in precipitation and recharge concerns him, since the district has no alternative water supplies.

“I look to the Arizona Department of Water Resources to work with the region and develop the best strategies to mitigate the impact of changing weather and increased populations,” Gabaldon said.

Vail

In unincorporated Vail southeast of Tucson, CAP is the only supply used. Since the middle 2010s, Tucson Water has sent Vail Water Company about 75% of its total CAP supply of 1,857 acre-feet.

The company isn’t pumping groundwater, and it stores CAP

it doesn't use in recharge basins in the Avra Valley west of Tucson. It expects to be using its entire CAP supply in five to eight years as its customer base grows, said Kip Volpe, a vice president of the Vail Water Co.'s parent the Estes Company.

Volpe said he is not concerned that much about the prospect of major CAP cuts, because he believes those cuts will fall first on supplies such as Tucson Water's that are not being fully used. No matter what, Vail isn't going to lose all its CAP supplies, he said.

"I'm not fearful of subsidence, and the cut is not going to be enough to risk subsidence, because we will still have some water coming down the pipeline from the CAP," he said.

Finally, many unincorporated suburban areas surrounding Tucson have been able to grow on groundwater because their developers enrolled them in a water district that is legally required to replenish aquifers, generally lying elsewhere, with renewable CAP supplies. Those CAP supplies will also be cut back when shortages hit — even sooner than shortages will reduce CAP deliveries to city and industrial water users.

But the Central Arizona Groundwater Replenishment District, which handles these recharge efforts, says it will still be able to meet its legal obligations to replenish with renewable

supplies through 2050. It will do that both with “wet” renewable supplies it owns and with “long-term credits,” allowing it to pump groundwater, credits the district earned by replenishing CAP water to begin with.

Water project officials “have been preparing for many years for shortage conditions and have developed a portfolio of replenishment supplies sufficient to meet obligations into the 2050s — even during prolonged shortages,” said CAP spokeswoman DeEtte Person.

Commenting on the water providers’ statements, UA scientist Jacobs agreed that most of those with CAP water rights are in good shape at least until the 2050s. Beyond that, she’s hesitant to make predictions, adding, “Hopefully we will reduce greenhouse gas emissions very soon.”

But if they do have to resume significant pumping, Jacobs said suburban water districts are more vulnerable to the loss of groundwater recharge than is Tucson Water. She made an exception for Marana, which lies next to where the Santa Cruz River carries treated sewage effluent that recharges aquifers.

“Tucson Water has a huge service area, very large recharge facilities, the largest CAP allocation in the state, access to effluent, and multiple well fields from which to recover water,” Jacobs said.

Utilities in the best situation are recharging CAP water or collaborating with other utilities to do it, said Thomas Meixner, UA's hydrology department head. Utilities not doing that ultimately will have problems, "although the most severe issues will take decades to arrive."

One thing local utilities shouldn't expect is new water sources, Meixner added. "We need to live within the water budget we have."

**Photos: Central Arizona Project canal construction
Central Arizona Project Aqueduct**



Construction of the Central Arizona Project Aqueduct in Western Arizona in June, 1979. The canal supplies the Phoenix and Tucson metro areas with Colorado River water.

Joan Rennick / Tucson Citizen

Central Arizona Project Aqueduct



6/9/1979 Central Arizona Project construction. Photo by Joan Rennick / CitizenConstruction of the Central Arizona Project Aqueduct in Western Arizona in June, 1979. The canal supplies the Phoenix and Tucson metro areas with Colorado River water.

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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.