

# Population growth, warming, and water supply

**Water for the ongoing influx of people in the Southwest will come at a cost**

BY MELANIE LENART

Expanding cities and warming climate merge dramatically in the Southwest to boost water demand. The combined effect of rising population, temperature and water use, meanwhile, threatens to take a toll on quality of life.

“We have put ourselves on a trajectory to make this a hotter, drier place,” keynote speaker Grady Gammage cautioned during a June workshop in Phoenix, called “Providing water to Arizona’s growing population: How will we meet the obligation?” A lawyer, Gammage helped secure regional water supplies by serving on the Central Arizona Project (CAP) board of directors for 12 years before taking his current post at the Arizona State University’s (ASU) Morrison Institute.

While many workshop speakers expressed confidence that Arizona could find water to support the ongoing influx of people, their words supported Gammage’s premise that residents would pay a price for continued population growth.

Higher water bills clearly will be coming down the pipeline in many cities, with current as well as future residents anteing up. Declining water quality could represent another cost as water managers consider saltier sources.

Shrinking rivers also follow rising water demand, as acknowledged by speakers at the June workshop, organized by The University of Arizona’s Water Resources Research Center, and at an August event in Tucson. Another cost of the growing population and the water policy it will inspire will be measured in degrees.

Temperatures had already reached 110 degrees on the morning of the first day of the workshop, as the sun was reaching its annual peak in intensity on the summer solstice. Unrestrained

population growth will make Arizona cities hotter for several reasons, Gammage suggested, naming more xeriscaping, agricultural water buy-outs, and city infill.

Xeriscaping—using desert vegetation in landscaping—uses less water, but it also does less to cool residential areas than lush grass and trees. Shifting agricultural allotments permanently to cities will reduce the region’s ability to weather drought years by temporarily turning off the supply to agriculture. This increases the chances for urban water use restrictions. Promoting the infill of population within city centers saves on pipelines and other infrastructure, but makes cities even hotter as heat-trapping concrete replaces cooler open spaces.

The “urban heat island effect”—a result of concrete, buildings, and asphalt covering open land—worsens as cities become more densely populated. For instance, temperatures in Tempe (near Phoenix) increased by about 10 degrees Fahrenheit over the last century, ASU researchers have found, with about two-thirds of the difference related to the urban heat island effect and the remainder linked to global warming. The population of metropolitan Phoenix roughly doubled in three decades to top 1.4 million in 2005.

Residents who bought homes in 2005 in Arizona’s central area—Maricopa, Pinal and Pima counties—can expect the surrounding population to nearly double again by the time they pay off a conventional mortgage in 2035. Their roughly 9.6 million neighbors in the merging three-county urban sprawl will contribute to a projected near doubling of water demand during that same time frame, as described in a discussion paper drafted for the workshop.

The central Arizona region can support only about 8.5 million people with the

water considered “currently secured,” according to the paper’s preliminary analysis led by ASU researcher Jim Holway, a former assistant director with the Arizona Department of Water Resources. Beyond that population level, projected for about 2020, the supply would depend on securing additional sources such as agricultural water and wastewater effluent (Figure 1).

Additional water sources are “likely” to become available, including from the Colorado River allocations to agriculture, but are not secured at this point. Water managers are pursuing the prospect of treating wastewater effluent, among other sources, to keep up with the growing demand for potable water (For more information: <http://sustainability.asu.edu/gios/waterworkshop.htm>).

Projections for global warming, meanwhile, indicate regional temperatures could continue to rise throughout the century by perhaps a degree Fahrenheit a decade. That’s the rate already registering in Arizona since about the mid-1970s, based on data from the Western Regional Climate Center. It’s several times faster than the average rate for the world as a whole.

Higher temperatures boost water demand, especially in summer when residents run evaporative swamp coolers and water wilting plants. An average household in Tucson, for example, uses a third more water during the warm months of May through October than in cooler months.

Global warming causes other regional climate changes as well. Along with temperatures, it increases evaporation rates, rainfall variability and the risk of heat waves and drought.

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“We’re going to have to prepare for more intense droughts than we’ve had in the past,” acknowledged Steve Olson, executive director of the Arizona Municipal Water Users Association that covers metropolitan Phoenix. By one climate change assessment that models a slight drop in Colorado Basin precipitation along with an ongoing temperature rise, the river could run short about a quarter of the time in the coming century (*Climatic Change*, March 2004).

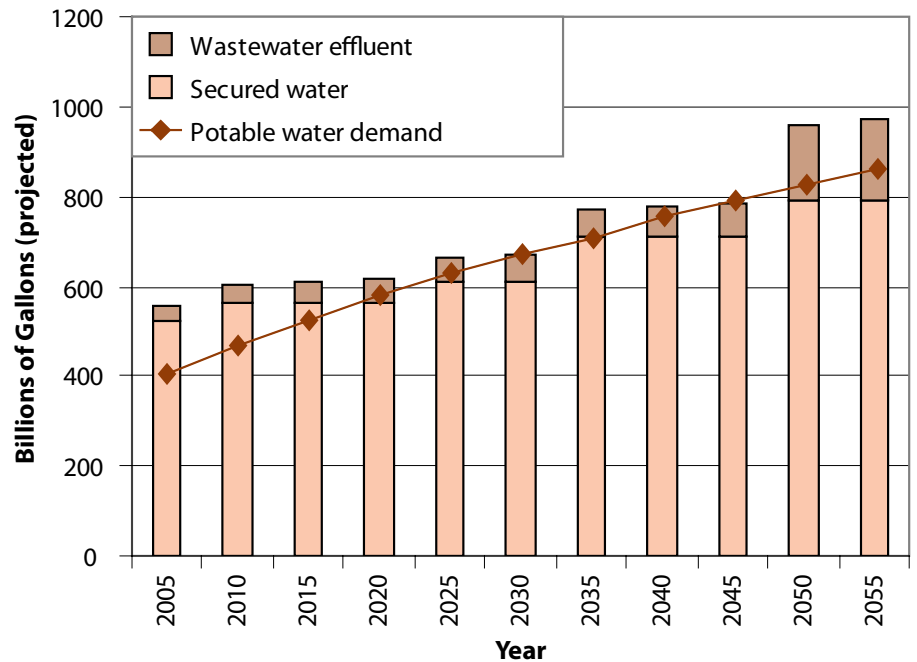
“I think the climate is going to change. We need to be able to react to what that change might be.” Tucson Water Director David Modeer said.

Modeer and other water managers for Tucson have been alerting residents to the potential need to start converting wastewater effluent into drinking water within the next decade. Pima County residents must decide in the next few years whether to accept what some critics characterize as a “toilet to tap” plan.

It may be a tough sell. Tucson residents twice voted against even allowing Colorado River water directly into their drinking water, citing water quality issues. Residents finally agreed in 2000 to accept a blend of CAP water with groundwater. The Tucson Water Plan indicates they’ll soon be asked to consider a saltier blend, with a greater share of Colorado water.

Tucson renewable groundwater could sustainably support a population of roughly 375,000—less than half the current population of the city’s metropolitan area. In theory, Tucson’s allotment of Colorado water could supply another 1 million people at current use rates. That would assume that drought doesn’t limit the supply, and the city retains its entire share for residential use.

Currently, about 70 percent of Arizona’s water, and 80 percent of its Colorado River allocations, goes to support agriculture on private and tribal lands.



**Figure 1.** The population of central Arizona is projected to exceed the “secured supply” of renewable water by about 2020 given current population growth. Water managers are pursuing the prospect of treating wastewater effluent, among other sources, to keep up with the growing demand for potable water.

“Ultimately, urban and rural Arizona are competing for the same water supplies,” Gammage told the group, some of who needed no reminding.

“We’re a target and we know it,” said Roger Gingrich, Yuma’s water resources coordinator. He noted that Yuma lettuce growers supply the country, helping Arizona’s third largest metropolitan area earn \$1 billion a year from crops. The resources, including water, supporting this industry would not be given away lightly, he indicated.

“It’s more, what are you willing to pay? When it comes to water, you’ll be paying a lot,” he said. Noting that bottled water sells in stores for more than \$1 a gallon, he tallied the price for an acre-foot of water at about \$365,000. Gingrich was speaking mostly with tongue in cheek, but he said he was serious in conveying that farmers would not sell water at the going rate. Currently, Tucson residents pay about \$15 for their first 11,200 gallons of water a month. At this rate, water costs about \$450 an acre-foot.

Arizona residents would pay an estimated \$3,000 an acre-foot for desalinated water in a plan proposed by CAP Deputy General Manager Larry Dozier. The desalination approach he outlined would boost an average water bill to \$150 to \$200 a month, he said.

It would involve erecting a desalination plant and an electrical plant to power it on the Gulf of California in Mexico, given the approval of Mexico’s burgeoning tourism industry on the gulf. The desalinated ocean water could help cover the million acre-feet of Colorado River water promised to Mexico, Dozier said, freeing up more of the river’s share for Arizona.

Arizona’s share of the Colorado could then support future development. Under current law, developments can go up in Arizona even where water supplies are deemed “inadequate” to supply homes for the century or more they may exist. Also, landowners currently can withdraw unlimited quantities of

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groundwater from below their land, with some caveats, even if doing so dries up nearby rivers and neighbors' wells.

In a day of interactive sessions during the June workshop, people suggested policy makers should consider the property rights of existing residents before permitting new developments. Participants also stressed the need to protect rivers when evaluating the potential impacts of new developments.

Southwestern rivers that once flowed year-round have been reduced to intermittent streams in areas where growing populations increasingly tap into groundwater or surface flows, such as Tucson's Santa Cruz River.

Even the San Pedro River has been faltering in recent years, with population growth in Sierra Vista and Benson as well as drought reducing stream flow. About seven miles northeast of Sierra Vista, the San Pedro dried up for 12 days in the summer of 2005—for the first time at least since continuous monitoring began there in 1930. It almost repeated its disappearing act in late June, but reaped the benefits of an early start to the monsoon season.

The impact on the San Pedro from water withdrawals depends in part on where wells go, explained hydrologist John Hoffman of the U.S. Geological Survey. To illustrate, Hoffman showed a map of the San Pedro River where it flowed through Arizona northeast of the Huachuca Mountains and explained the modeled impacts of 50 years of pumping 33 millions of groundwater—an amount that would support less than a thousand people a year at current use rates.

Wells located around the river near Fort Huachuca's eastern edge would draw about 95 percent of their supply from water that would otherwise feed the San Pedro River, Hoffman's preliminary map indicated. In contrast, wells located west

of the river near the Huachuca's southern boundary would draw only about 30 percent of their supply from water that would otherwise go to the stream.

The area's newest spate of wells are going in exactly where Hoffman's analysis shows they would do the most damage, pointed out Patrick Graham of The Nature Conservancy, alluding to some of the development occurring in the budding towns of Hereford and Palomina right along the river.

"Groundwater supports those rivers. While there's not a legal recognition, it's a fact," Graham said. Many states, including Arizona, fail to consider the impact groundwater withdrawals have on nearby rivers, as Robert Glennon describes at length in his book *Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters*.

Graham compared groundwater basins to bathtubs, noting that rivers flow only when the basins are full enough to overflow into channels. Yet surface waters serve millions of birds as "nature's highways, hospitals, hotels, and restaurants," he said. Conservationists consider the San Pedro especially crucial as an oasis for migratory birds, as it encompasses the northern limits for some tropical species and the southern edge for some species traveling from cooler climates.

Tourism and recreation also thrive due to surface water, such as the inner tubing industry on Phoenix's Salt River.

Concern for rivers and their functions drew a crowd of about 250 people to an August talk in Tucson by Jackie King. A researcher from South Africa, King assesses ecological, social, and economic values of river systems around the world and how they change with development.

Noting that Arizona policy encourages population growth, she outlined how

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## A natural source of water

By MELANIE LENART


Homeowners can turn their yards into oases by capturing rainwater and recycling household water, explained Brad Lancaster, author of *Rainwater Harvesting for Drylands*.


He describes harvesting principles that allow plants to thrive and thus cool the area around homes, a form of climate control that becomes more crucial with temperatures rising and populations growing.

"We're truly desertifying our so-called desert," Lancaster said during a talk this year at The University of Arizona's Water Resources Research Center. "Here's where the rivers are today," he added, showing a slide of a Tucson street flooded by monsoon rains.

Paved streets, concretized river banks, and hard bare soil all channel water away before it can soak into the ground—sometimes whisking it out of town even before it can recharge groundwater aquifers, he noted.

A permaculturist based in Tucson, Lancaster learned some of his techniques in Zimbabwe, which has a semi-arid climate similar to that in the Southwest. There, a man he calls Mr. Phiri taught him how to "plant water before planting trees" and other lessons. These include:

 Start by observing your landscape during rains, noticing how water moves and collects. Then revise after noticing what does and doesn't work.

 Start at the top of your "watershed," which on a residential lot may be a roof. Capture and/or

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researchers could assess some of the benefits and costs of proposed water withdrawals to encourage more informed policy decisions (*River Research and Applications*, Fall 2003).

Using extensive data on historical, present-day, and future river flow patterns and location of riparian plants, researchers could project how proposed withdrawals might impact water quality, wildlife, and tourism, for example.

“If you take half your diet away, you will change. If you take half the river water away, it will change,” King told the crowd gathered at The University of Arizona. Later she reminded, “Good quality of life doesn’t just mean a nice house and food in the fridge.”

King noted that her approach includes working with various interest groups and individuals. With her recommended approach, scientists restrict their role to evaluating and presenting data, leaving policy decisions to the governments and stakeholders involved.

In the concluding remarks at the June conference, Kathy Jacobs encouraged water managers and the research community to explain the impact of decisions so policy makers could avoid working “in a vacuum.” A onetime water manager, Jacobs now directs the tri-university Arizona Water Institute.

Water managers need to create a better link between water availability and population growth management, Gammage suggested, adding, “I don’t think water managers can continue the attitude of ‘We’re the plumbers. You tell us what we need to do and we’ll do it.’”

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## Natural source, continued

direct gutter water toward plants or into a storage tank.

- 💧 Start small. Use simple strategies that slow and spread the flow of water across the land, giving it time to seep down into soil.
- 💧 Maximize ground cover, especially living ground cover. Plants and mulch help soils quickly soak up water, so it won’t be available for mosquito breeding.

“If nothing else, raise your pathways and patios and sink your planting areas,” Lancaster suggested. That way plants will receive some of the water running off the impermeable surfaces.

During an early September tour of his yard, he pointed out a 1,200 gallon cistern—now full—that stores water channeled from his roof (Figure 2). A spigot on the side yields some of its contents with a turn of the faucet. A driveway and a strategically sliced curb pull in some of the street’s flow during monsoon rains, where native plants benefit from the spillover. Corrugated zinc on the roof of his workshop drains water in rivulets into an area sprouting orange and fig trees.

The thriving saplings also receive water every time Lancaster washes a load of clothes. Recycled water draining from showers, washing machines, and other household pipes is known as greywater.

Arizona has begun encouraging residents to use greywater for landscaping, as long as they avoid draining from kitchen sinks or, of course, toilets. In 2007, the state will start providing up to \$1,000 in tax credits per household to help reimburse residents who set up greywater-harvesting systems.

When employing greywater, Lancaster recommends using liquid detergents rather than powders, which use salt as filler. Also, unlike rainwater, greywater should not be stored in a tank. Lancaster encourages people to deposit it directly into mulched and vegetated soil.

Water harvesting can make a crucial difference when living in any desert. Lancaster’s mentor, Mr. Phiri, became a role model for his village in Zimbabwe after turning a barren wasteland into a productive farm over the years.

“There are other people in his village literally dying of thirst in drought years, and he is raising fish,” Lancaster said. “And they could be doing the same.”

*More information about the tax credit program, suitable detergents for greywater systems, and Lancaster’s book can be found at his website: <http://www.harvestingrainwater.com>.*



**Figure 2.** Brad Lancaster in front of the cistern that stores rainwater in his yard. Photo credit: Melanie Lenart

