

## The Colorado River Runs Dry

Dams, irrigation and now climate change have drastically reduced the once-mighty river. Is it a sign of things to come?

By Sarah Zielinski

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From its source high in the Rocky Mountains, the Colorado River channels water south nearly 1,500 miles, over falls, through deserts and canyons, to the lush wetlands of a vast delta in Mexico and into the Gulf of California.

That is, it did so for six million years. Then, beginning in the 1920s, Western states began divvying up the Colorado's water, building dams and diverting the flow hundreds of miles, to Los Angeles, San Diego, Phoenix and other fast-growing cities. The river now serves 30 million people in seven U.S. states and Mexico, with 70 percent or more of its water siphoned off to irrigate 3.5 million acres of cropland.

The damming and diverting of the Colorado, the nation's seventh-longest river, may be seen by some as a triumph of engineering and by others as a crime against nature, but there are ominous new twists. The river has been running especially low for the past decade, as drought has gripped the Southwest. It still tumbles through the Grand Canyon, much to the delight of rafters and other visitors. And boaters still roar across Nevada and Arizona's Lake Mead, 110 miles long and formed by the Hoover Dam. But at the lake's edge they can see lines in the rock walls, distinct as bathtub rings, showing the water level far lower than it once was—some 130 feet lower, as it happens, since 2000. Water resource officials say some of the reservoirs fed by the river will never be full again.

Climate change will likely decrease the river's flow by 5 to 20 percent in the next 40 years, says geoscientist Brad Udall, director of the University of Colorado Western Water Assessment. Less precipitation in the Rocky Mountains will yield less water to begin with. Droughts will last longer. Higher overall air temperatures will mean more water lost to evaporation. "You're going to see earlier runoff and lower flows later in the year," so water will be more scarce during the growing season, says Udall.

Other regions—the Mediterranean, southern Africa, parts of South America and Asia—also face fresh-water shortages, perhaps outright crises. In the Andes Mountains of South America, glaciers are melting so quickly that millions of people in Peru, Bolivia and Ecuador are expected to lose a major source of fresh water by 2020. In southwestern Australia, which is in the midst of its worst drought in 750 years, fresh water is so scarce the city of Perth is building plants to remove the salt from seawater. More than one billion people around the world now live in water-stressed regions, according to the World Health Organization, a number that is expected to double by 2050, when an estimated nine billion people will inhabit the planet.

"There's not enough fresh water to handle nine billion people at current consumption levels," says Patricia Mulroy, a board member of the Colorado-based Water Research Foundation, which promotes the development of safe, affordable drinking water worldwide. People need a "fundamental, cultural attitude change about water supply in the Southwest," she adds. "It's not abundant, it's not reliable, it's not going to always be there."

Mulroy is also general manager of the Southern Nevada Water Authority, which serves two million people in greater Las Vegas. The city is one of the largest in the Colorado River basin, but its share of the river is relatively small; when officials allocated the Colorado's water to different states in 1922, no one expected so many people to be living in the Nevada desert. So Nevadans have gotten used to coping with limitations. They can't water their yards or wash their cars whenever they like; communities follow strict watering schedules. The water authority pays homeowners to replace water-gulping lawns with rocks and drought-tolerant plants. Golf courses adhere to water restrictions. Almost all wastewater is reused or returned to the Colorado River.

In 1922, conservationist Aldo Leopold paddled a canoe through the great delta at the mouth of the Colorado River. He wrote about a "wealth of fowl and fish" and "still waters...of a deep emerald hue." In Leopold's time, the delta stretched over nearly 3,000 square miles; today, it covers fewer than 250, and the only water flowing through it, except after heavy rains, is the runoff from alfalfa, lettuce and melon fields and pecan orchards.

The river has become a perfect symbol of what happens when we ask too much of a limited resource: it disappears. In fact, the Colorado no longer regularly reaches the sea.

## **A Difficult Choice on Water**

**BY LESLIE MACMILLAN**

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Arizona's two senators, John McCain and Jon Kyl, traveled to the Navajo reservation this week to meet with Navajo and Hopi tribal leaders about a proposed water rights accord that would settle the two tribes' claims to the Little Colorado River system.

Mr. Kyl and Mr. McCain have introduced a bill known as the Navajo-Hopi Little Colorado River Water Rights Settlement, which would require the tribes to waive their water rights for "time immemorial" in exchange for groundwater delivery projects to three remote communities.

The tribes must sign off on the settlement, along with 30 other entities including Congress and the president, before the bill becomes law.

Mr. Kyl said the bill was on a "fast track" and he would like to see it pushed through Congress before this session ends. But the outcome is uncertain, as there is a disagreement within the Navajo and Hopi governments over whether or not to endorse the bill, as well as disapproval within the communities, which are pushing for more public hearings.

The settlement would benefit the two tribes by providing clean drinking water piped directly into their homes, Mr. Kyl said. There is very little surface water on the two reservations, he said, adding that most of the water that does exist is in aquifers and the tribes can't afford to build the infrastructure necessary to gain access to it.

What the tribes would lose by settling is a crucial bargaining chip. Other parties, including Peabody Coal and two other corporations, want the water for ranching, farming and coal mining operations. Coal mining in particular uses copious amounts of water for its slurries.

The tiny Hopi reservation is completely surrounded by the much larger Navajo reservation, which covers 27,000 square miles of land over sections of Arizona, New Mexico and Utah. Many homes lack indoor plumbing, and one out of three families on the Navajo reservation does not have access to a public drinking water system, according to the Environmental Protection Agency. Some wells and springs are still contaminated with uranium and other toxic heavy metals, a legacy of 40 years of mining.

In an arid region where water is scarce, some tribal leaders are in favor of settling their claims in exchange for running water. But the bill has also stirred some controversy among environmental groups and tribe members, who say that their leaders didn't inform them about the details.

"Water is life, and when you take away our water, you take away our lives," said Ed Becenti, a Navajo grass-roots organizer. He said that after the meeting, which took place behind closed doors, a crowd of about 200 milling outside followed the senators to their cars chanting "Kill bill 2109" and "Leave our water alone."

He said that Senator Kyl should "meet with the Navajo and Hopi grass-roots representation on the settlement agreement and go over it in detail." He added, "Our tribal leaders have evidently dropped the ball on this one."

Several environmental groups also oppose the bill. The Grand Canyon Trust, which was recently successful in halting new mining claims on federal land around the Grand Canyon, characterized the bill on its Web site as containing “several dangerous provisions that require a permanent waiver” of water rights.

Mr. Kyl acknowledges that the bill has aroused some deep-seated emotions but says that it has been widely misunderstood. “There are a lot of very smart people of good will who are trying to get these people wet water,” he said. The water the tribes have now, he said, exists mainly on paper in the form of rights to water that they cannot use.

Mr. Kyl and Mr. McCain, both Republicans, met privately with leaders of the two tribes in Tuba City on Thursday. Navajo leaders said they were working on scheduling a public meeting with the senators in Window Rock, Ariz., the capital of their reservation.

## Perilous new Vegas water pipeline claims a life

BOULDER CITY, Nev. – Just six miles from where the Hoover Dam holds back the largest reservoir in the nation, workers are struggling against solid rock, geologic faults and seeping water to construct an intake tunnel to keep drinking water flowing from shrinking Lake Mead to thirsty Las Vegas.

Their work in a hot, humid cavern some 600 feet below ground goes largely unnoticed by local residents and tourists enjoying icy drinks in glittery Sin City casinos and nightspots.

But the perils of tunneling beneath the lake bed were cast in stark terms this week, when a veteran tunnel worker died on the daunting \$817 million, five-year project that officials compare with building the dam itself. They cast the so-called "Third Straw" project as the most complex current effort of its kind in the U.S.

"It has factors that are very unique to this project and make it very complicated," said Heidi Dexheimer, a Las Vegas civil engineer and regional representative of the American Society of Civil Engineers. Dexheimer once worked at the Southern Nevada Water Authority and is familiar with the project, but isn't involved with it.

She compared the 3-mile tunnel project to work on the 1.5-mile Lincoln Tunnel that connected New York City and New Jersey beneath the Hudson River in 1937 and the nearly 1.7-mile Eisenhower Tunnel through the Continental Divide on Interstate 70 west of Denver that opened in the 1970s.

"There's a lot of risk and a very small margin for error," Dexheimer said Friday. "It takes a really highly trained team of experts to do it."

The Lake Mead Intake No. 3 project has already had several setbacks. The tunnel flooded in July 2010 when a drilling machine hit a geologic fault. It flooded again in December 2010, forcing contractor Vegas Tunnel Constructors to abandon the tunnel and start a new one in a different direction. The completion date was pushed back several months, to summer 2014.

Ninety percent of Las Vegas water currently comes from Lake Mead, which has shrunk in recent years due to ongoing drought and increasing demand from seven states and more than 25 million people sharing Colorado River water rights under agreements dating to 1922.

The water authority is aggressively working on other ways to ensure a future water supply for Las Vegas' nearly 2 million residents and more than 40 million annual visitors. One is a controversial plan to build a \$3.5 billion, 300-mile surface pipeline to pump billions of gallons of water south to Las Vegas from rural areas along the Nevada-Utah border.

In a city that averages just over four inches of rain per year, officials say they have no choice but to press on with the Lake Mead project. It promises to ensure the ability to fetch water no matter how low the reservoir gets.

Even the Occupational Safety and Health Administration administrator in the region said he expects drilling will resume after an investigation.

"A human life was lost," said Stephen Coffield, chief of the Nevada OSHA office in Henderson. "We need to know what happened and get it corrected so it doesn't happen again."

But, "the lake is dropping," Coffield added. "The first straw is going to be sucking air."

Two initial Lake Mead water intakes were built along with Hoover Dam, an engineering marvel that authorities estimate cost the lives of about 100 workers during five years of construction. It was completed in 1936.

The lake behind the dam is fed by Rocky Mountains snowmelt and managed by the U.S. Bureau of Reclamation in tandem with the Lake Powell reservoir upstream and lakes Mojave and Havasu downstream.

The Lake Mead surface level has dropped about 100 feet in elevation since the lake was full in 2000, bureau spokeswoman Rose Davis said. It is about half-full today — displaying a distinctive white mineral "bathtub ring" between the low and high water lines.

The lake surface elevation was just beneath 1,118 feet on Friday, about 68 feet above the first intake elevation of 1,050 feet. A second intake draws water from an elevation of 1,000 feet.

"It's really hard to say when we're going to get there, but if the drought continues as it has over the last 12 years, we have to expect that first intake is in danger," said Scott Huntley, a Southern Nevada Water Authority spokesman.

The current lake level also is only 43 feet above a mark that would trigger a mandatory reduction in water deliveries to Nevada and Arizona. In November 2010, the reservoir water level dropped to 1,081 feet — just six feet above the mark — before a heavy winter snowfall pushed the lake level back up.

At the bottom of a shaft 600 feet beneath Lake Mead's Saddle Island, 125 workers face more immediate dangers — in conditions that Huntley described as loud, wet, humid and busy.

"It's a huge cavern down there, with large machines, welders, everyone doing a job," he said.

The death of Thomas Albert Turner, 44, was the first directly associated with the project.

On Monday, Turner — a married father of two from Henderson whose brother also works on the pipeline — died when he was hit in the head by a pressurized stream of a grout mixture containing fist-sized rocks, pebbles, sand, fly ash, water and cement.

Huntley said it appeared the pressurized slurry hit Turner after a segment of curved concrete wedged loose before it could be cemented in place, creating a 4-inch-by-2-foot gap. The slurry mix was being injected into a void between the pipeline wall and the tunnel wall at 200 pounds per square inch of pressure — about twice the flow from a fire hose.

A nearby co-worker was hurt but is recovering, Huntley said. A third co-worker on the team escaped injury.

OSHA has inspected the work site eight times since August 2008, and 14 safety violations were found during two of the visits, according to U.S. Department of Labor data. Coffield said the contractor corrected the violations and paid \$800 in fines.

Officials with Vegas Tunnel Constructors, based in Boulder City, and corporate parent SA Healey Co. of Lombard, Ill., didn't immediately respond to messages. The company is a subsidiary of Gruppo Impreglio S.p.A. of Milan, Italy.

This week's accident happened some 55 stories underground, where a \$25 million machine has, so far, slowly bored through 1,000 feet of solid rock. It has about 13,000 feet to go.

When finished, the 23-foot-high tunnel will reach almost three miles, connecting an existing water treatment plant to a funnel-like structure already cemented in place on the lakebed.

The pipeline itself, measuring 20 feet in diameter, is being constructed of some 2,500 concrete rings weighing 17 tons each, cemented into place like kitchen tile by the slurry mixture.

Water authority officials called the accident tragic — a private family memorial service for Turner was to be held Friday — and vowed to prevent it from happening again. But they left little doubt that drilling will resume.

"The third intake is the most demanding and difficult project the SNWA has undertaken," agency chief Pat Mulroy said in a statement.

"It is quite possibly also the most important. As the drought on the Colorado River continues, and even intensifies this year, the critical importance of this project to the security of our community's water supply is heightened."

## Devastating Drought Seems Inevitable in American West

The southwestern U.S. looks a lot like Australia before its nine-year dry spell

By Peter H. Gleick, Matthew Heberger on January 1, 2012

Australia experienced the worst and most consistent dry period in its recorded history over much of the past decade. The Murray River failed to reach the sea for the first time ever in 2002. Fires swept much of the country, and dust storms blanketed major cities for days. Australia's sheep population dropped by 50 percent, and rice and cotton production collapsed in some years. Tens of thousands of farm families gave up their livelihoods. The drought ended in 2010 with torrential rains and flooding.

Australia's Millennium Drought is a wake-up call for residents of the drought-plagued southwestern U.S. and for all of us. What happened in Australia could happen in the U.S., with devastating consequences to the region and to the nation. We can avert the worst, however, if we pay attention to Australia's experience and learn the right lessons.

The southwestern U.S. bears some resemblance to parts of Australia before the drought. Both include arid regions where thirsty cities and irrigated agriculture are straining water supplies and damaging ecosystems. The Colorado River no longer flows to the sea in most years. Water levels in major reservoirs have steadily declined over the past decade; some analysts project that the largest may never refill. The U.S. and Australia also share a changing global climate that is increasing the risk of drought.

Evidence is mounting that climate change is playing a role in Australia's water woes. Since 1950 average rainfall has decreased 15 percent, and researchers found average temperatures over southeastern Australia from 1995 to 2006 were 0.3 to 0.6 degree Celsius higher than the long-term average. The combination of higher evaporation and lower precipitation depletes soil moisture and reduces runoff, making droughts more intense and more frequent. Australian scientists forecast a 35 to 50 percent decline in water availability in the Murray-Darling river basin and a drop in flows near the mouth of the Murray by up to 70 percent by 2030.

The Millennium Drought did have one benefit: it got people's attention. Australians responded to these extremes with a wide range of technical, economic, regulatory and educational policies. Urban water managers in Australia have been forced to put in place aggressive strategies to curb water use and to expand sources of new and unconventional supplies. They have subsidized efficient appliances and fixtures such as dual-flush toilets, launched public educational campaigns to save water, and more. Between 2002 and 2008 per capita urban water use—already low compared with the western U.S.—declined by 37 percent.

Other efforts focus on tapping unconventional supplies, such as systems that reuse gray water, cisterns to harvest rooftop runoff, and sewage treatment and reuse. The country's five largest cities are spending \$13.2 billion to double the capacity of desalination, enough to meet 30 percent of current urban water needs.

Even in the midst of the drought, Australia moved forward with plans to restore water to severely degraded aquatic ecosystems. The government has continued with plans to restore rivers and wetlands by cutting withdrawals from the Murray-Darling river basin by 22 to 29 percent. It has committed \$3 billion to purchase water from irrigators to restore ecosystems. Regulators introduced water markets in the hope of making farms more water-efficient and

reducing waste. Despite efforts to phase out subsidies, the government announced more than \$6 billion in aid to improve irrigation infrastructure and make it more productive.

The southwestern U.S. states would do well to push for these kinds of reforms before a similar disaster strikes. They need to tackle difficult policy issues, such as development of water markets and pricing, expansion of water efficiency and productivity programs, elimination of government subsidies that encourage inefficient or unproductive water use by cities and farms, and agricultural reform. As the climate continues to change, smart water planning may help ease the impacts of unexpected and severe shocks that now appear inevitable.