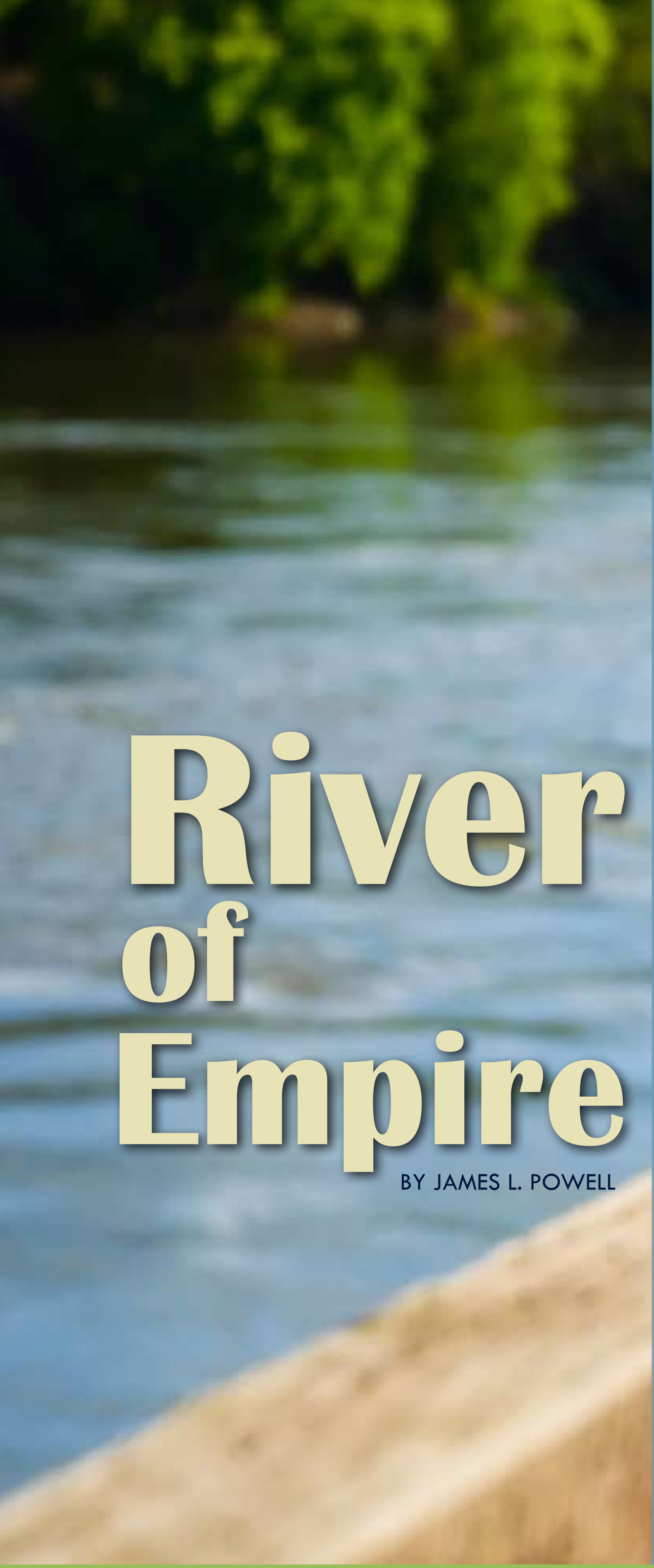

River of Empire

BY JAMES L. POWELL

> In the West, 80% of the water goes for agriculture, much of it to agribusinesses to grow alfalfa, cotton, and rice, thirsty crops that cannot survive in an arid land without heavy irrigation.

In the American Southwest, growth has become a way of life. Take a warm, dry, and scenic land, add water, and you have instant civilization and population growth. But what happens when a region has no more water to add?

In 2008, Utah was the fastest growing state, followed by Arizona, Texas, Colorado, North Carolina, Idaho, Wyoming, and Nevada. Yet Nevada is also the driest state, with only seven inches of precipitation per year on average. Utah is close behind, followed by Wyoming, Arizona, and New Mexico. Topping the list of fastest growing cities between 2000 and 2006 was St. George, Utah at 40%, or about 5% per year. Las Vegas was fifth at 29% and the Phoenix megalopolis tenth at 24%. Note that a rate of 5% per year doubles in less than 15 years. The economic recession that began in 2008 led to a real estate bust that slowed or eliminated those growth rates, but when economic times turn better, the demand for growth will resume. Is there a city or state in the West that does not plan to grow? Where will they get the extra water? In the Southwest, up to now the answer would have been: from the Colorado River. But no longer.

The Colorado is the lifeblood of the American Southwest (Figure 1), supplying 30 million people with water and power through its system of dams and reservoirs. Without the river, there could be no Las Vegas, Phoenix, and Los Angeles, as we know them.

Since Hoover Dam went up in the 1930s, creating Lake Mead, and Glen Canyon Dam rose in the early 1960s, creating Lake Powell, demand for Colorado River water has risen inexorably until today, not a drop is left. As I show in my book, Dead Pool, add up the flow of the Colorado and its tributaries and you get a total supply of about 15.8 million acre-feet (an acre-foot is 325,851 gallons). Add up all consumption, including evaporation from the vast surfaces of Lake Powell and Lake Mead, and you get a total demand of 15.9 MAF. The Colorado River is tapped out.

Here's a specific example of what this means. Were Las Vegas to continue to grow as it did from 2000-2007, the neon metropolis would climb from 1.8 million to 3.2 million by 2030. If those extra 1.4 million people consumed water at the same rate as today, they would need nearly another 200,000 acre-feet. Las Vegas has done an admirable job of cutting consumption, so that in spite of the increase in population, the total water use today is about the same as in 1999. But conservation measures can only go so far. Cash for grass only works as long is there is grass to cash. More people will need more water and in the Southwest, we have run out of places to get it. The Colorado River has no surplus water; desalination is a problem when you are 500 miles from salt water; groundwater is fossil water that we always extract faster than nature can replenish and eventually use up. In a dry land, water is the ultimate limiting factor and if we want more, the only real choice is to change the way we use the water that Nature provides, which brings us to the issue for rural communities.

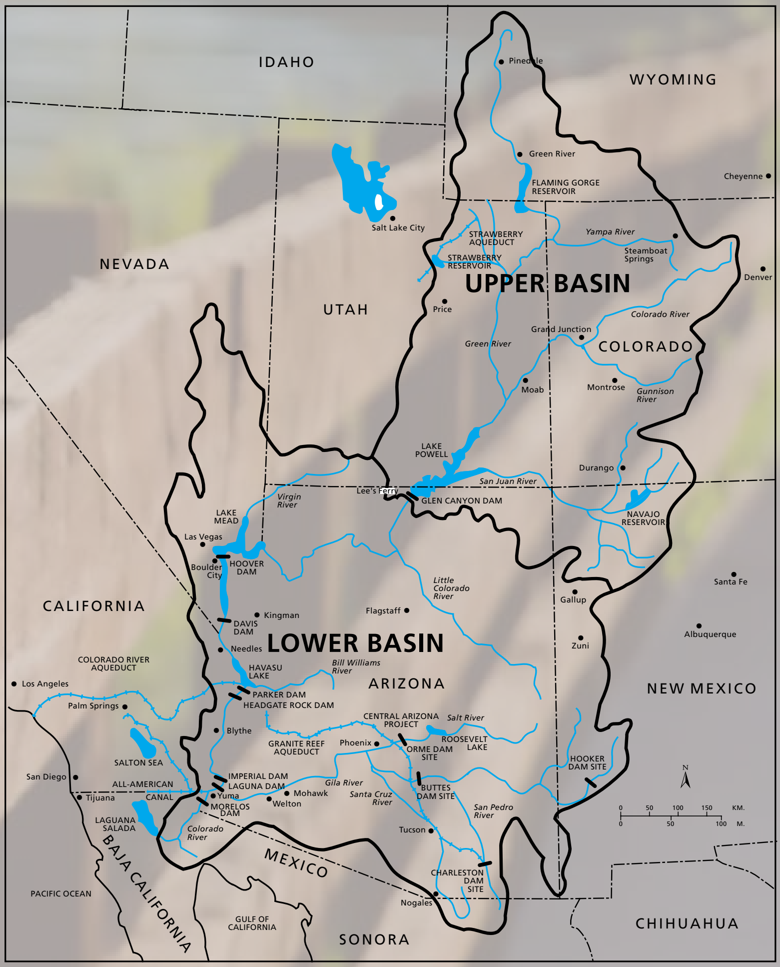

Figure 1. Colorado River Map. Pacific Institute.

In the West, 80% of the water goes for agriculture, much of it to agribusinesses to grow alfalfa, cotton, and rice, thirsty crops that cannot survive in an arid land without heavy irrigation. It seems inevitable to this writer that politically powerful western cities will demand that governments reduce the share of water going to agriculture and send the difference to them and their residents. Government may not have to demand it: some water districts already sell part of their allocations to Los Angeles and San Diego.

Suppose the percentage going to agriculture fell to, say, 60%. Could farmers and irrigators make up the difference? Many experts believe they could if they implemented stringent conservation measures such as drip irrigation, micro-sprinkler systems, laser-leveled fields, and soil-moisture monitors. The Pacific Institute estimates that in California, these measures could conserve five million acre-feet per year, allowing the state to double its population. A fundamental problem, however, is that if California were to implement those measures and the state's population did double, California would be right back where it started, with twice as many people but out of water again, fearing the next hard drought.

Conserving water will not be optional: the West is going to have to conserve, for rising demand for water is no longer the only problem: the supply is going to fall and may have already started doing so.

Although a river is always changing on a scale of months and years, until now it has been safe to assume that on a scale of decades, a river will continue to deliver the same amount of water that it has in the past. Without that assumption, there would have been no case for building megadams to impound a river and smooth out the annual fluctuations. But this assumption no longer holds, for the Earth is warming, affecting precipitation, evaporation, and therefore, river runoff.

Over the twentieth century, the flow of the mainstem Colorado River averaged 15.1 MAF (the figure above included the tributaries), but the higher flows came in the first two decades. The Commissioners who divided up the river's water among the seven basin states met in 1922, just after several years of what would turn out to be well-above average rainfall, leading them to allocate about 1.5 MAF more water than the river carries on average. Moreover, studies of tree-rings show that the centuries-long average is about 14.6 MAF: in other words, the twentieth century was unusually wet.

The twenty-first century so far gives even more cause for alarm. In 1999, just before Figure 2 begins, Lake Powell was brim full. The last thing any expert or government agency expected was that the first five years of the decade, 2000-2004, would see flows on average less than 50% of the historic ones. By the spring of 2005, Lake Powell was two-thirds empty. Fortunately, as shown in Figure 2, 2005 was a relatively wet year, though still only 5% above the long term average. At the time I am writing, Lake Powell and Lake Mead combined stand at 55% of their long term average. (The bar for 2010 in Figure 2 is the Bureau of Reclamation's projection for the "water year," which ends October 31.) To refill both reservoirs would take about 27 MAF, the equivalent of a second Lake Mead. Since the Southwest now consumes all the water that the mainstem Colorado River has reliably carried, how long might it take to regain that missing 27 MAF and refill the reservoirs? Suppose we aim to refill them by, say, 2025, 15 years from now. To refill reservoirs requires surplus water. The annual flow of the river would have to average 27/15 or 1.8 MAF above its long-term flow. That is virtually impossible in any century. Moreover, to refill the reservoirs would require that all parties agree to hold the surplus water back in the reservoirs, rather than let it flow downstream to irrigators and new subdivisions. That might be impossible politically. Thus I for one believe that at least one of the two giant reservoirs will never refill.

The West has had droughts before, though none in living memory that lasted a decade. The trouble is, there is scientific evidence that what we are witnessing in the Southwest is not just a drought, but also a change in the climate. The reason? Global warming.

Figure 3 shows that beginning around the year 1800, carbon emissions from fossil fuel burning and land use changes, atmospheric carbon dioxide, and global temperature all began to rise together and have kept on rising, the farther the faster. There are two possible explanations: one, the triple rise is a coincidence; two, it represents cause and effect. Appealing to coincidence is always a last resort. It is a fact of physics that carbon dioxide in the atmosphere traps heat and warms the surface. Without the greenhouse effect, the planet would be 57°F colder on average and none of us would be living on it. Thus by far the most logical explanation of Figure 3 is that as humans began to burn coal with the Industrial Revolution and then, in the twentieth century, oil and gas, the carbon dioxide emitted to the atmosphere caused global temperatures to rise. If you assume that the carbon emission curve can continue to rise but the temperature curve will turn down of its own accord, a Las Vegas casino has a spot reserved for you.

If this were merely an academic argument, we could let the scientists sort it out, as they always do. But it is not merely academic.

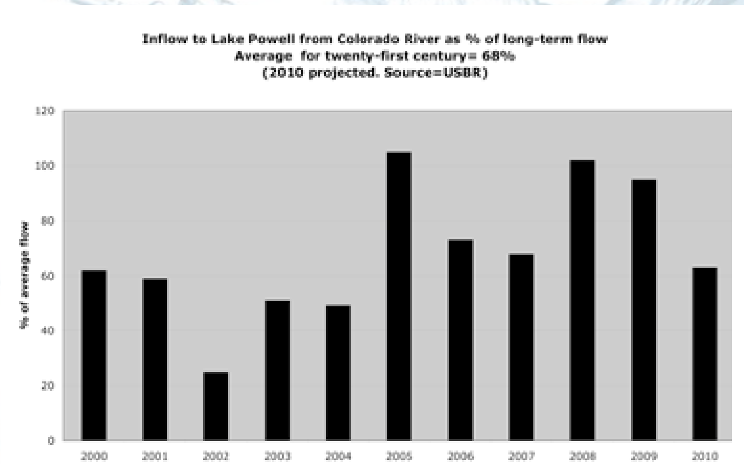

Figure 2. Inflow to Lake Powell from Colorado River.

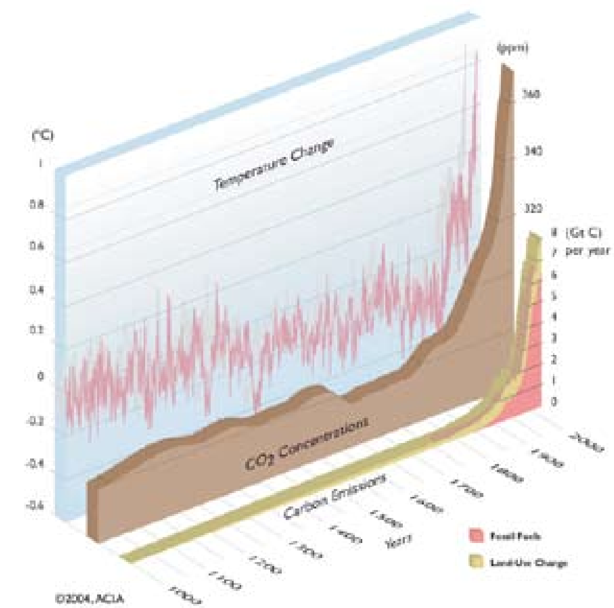

Figure 3. Changes in carbon emissions, CO2 concentrations, and temperature since AD 1000.

Almost all the water in the Colorado River comes from melting snow on the western slopes of the Rocky Mountains. (As early evidence that global warming has already begun, mountain snowfields in the west are melting earlier in the spring.) Higher temperatures cause more evaporation, which lowers river runoff. In a desert, evaporation is high: nearly 90% of the precipitation in the Colorado River basin evaporates, which means that small changes in evaporation can have a disproportionate effect on runoff. Calculations show that if evaporation increases by just 2%, runoff declines by 14%. How much water is 14% of the Colorado River? About 2 million acre feet, roughly half of California's allotment; or about seven times Las Vegas' allotment; or more water than Arizona receives from the river.

Several peer-reviewed studies have examined the possible effect of global warming on the runoff of the Colorado River and the status of its reservoir and water deliveries. One study from 2009 found that if global warming reduces inflow to Lake Powell 20%, by 2050 an annual shortfall of 2.2 MAF would result. Each study has found that the Colorado River reservoir system is vulnerable even to a 10% reduction in flow, the low end of the projected decreases due to global warming.

Figure 2 shows that inflow to Lake Powell is already down by almost one-third so far in the twenty-first century. None of the published studies assumed that the average flow going forward would be that low. We should hope that global warming has begun, for if we have yet to feel its effects, we start from unusually low flows and half-full reservoirs.

One reason runoff and river flow are down in the Colorado River basin may be because western temperatures have been rising steadily since the early 1970s (Figure 4). This is ominous, because previous droughts in the basin, like the one in the early 1950s, occurred at much lower temperatures.

The Rocky Mountain Climate Organization and the National Resources Defense Council report that "During the 2003 through 2007 period, the 11 western states averaged 1.7 degree Fahrenheit warmer than the region's 20th century average

The science of global warming is clear and strengthening. There is not a shred of evidence that scientists have fudged the data. Climategate, glaciergate, and all the "gates" have turned out to be tempests in teapots, changing not a single observational fact of global warming. Global warming is true, caused by humans, and dangerous. Long before rising temperatures lift sea level to dangerous levels, they will drop the Colorado River reservoirs to dangerous lows, or drain at least one of them. If we ignore the inevitable western water shortfall and fail to act, we and our grandchildren will have no one to blame but us. ■

About the Author

James L. Powell is the executive director of the National Physical Science Consortium. He holds a PhD in Geochemistry from the Massachusetts Institute of Technology and several honorary degrees, including Doctor of Science degrees from Berea College and from Oberlin College.

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He served as acting president of Oberlin, president of Franklin and Marshall College, president of Reed College, president of the Franklin Institute Science Museum in Philadelphia, and president and director of the Los Angeles County Museum of Natural History.

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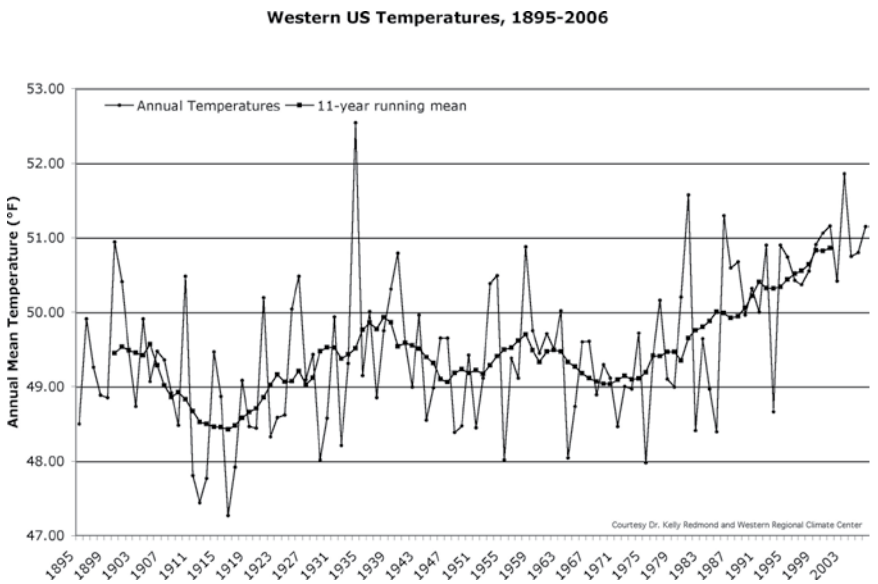

Figure 4. Western U.S. Temperatures 1895-2006.