FAIR

Running Dry:

LOOMING WATER SHORTAGES IN THE UNITED STATES

A REPORT BY ERIC A. RUARK DIRECTOR OF RESEARCH

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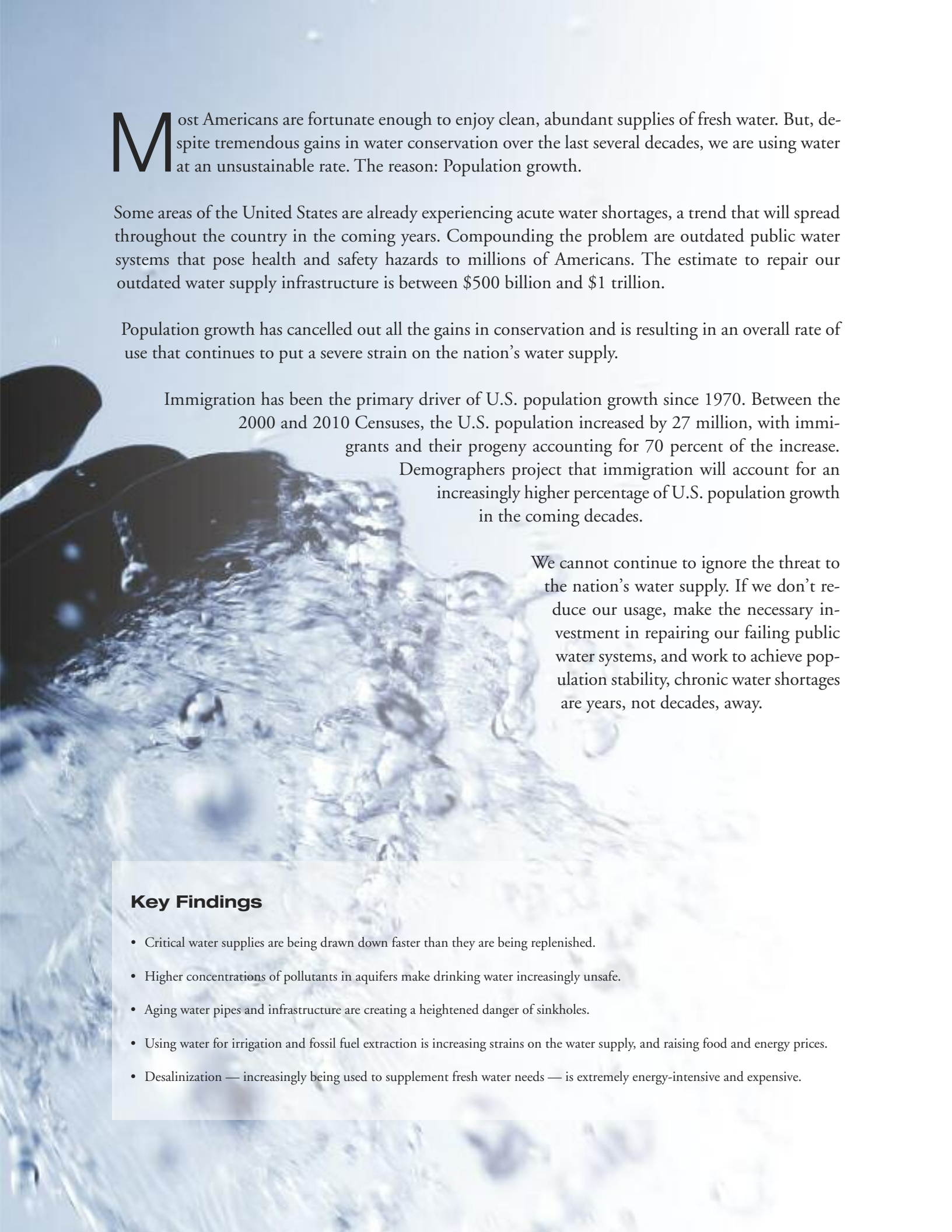


Most Americans are fortunate enough to enjoy clean, abundant supplies of fresh water. But, despite tremendous gains in water conservation over the last several decades, we are using water at an unsustainable rate. The reason: Population growth.

Some areas of the United States are already experiencing acute water shortages, a trend that will spread throughout the country in the coming years. Compounding the problem are outdated public water systems that pose health and safety hazards to millions of Americans. The estimate to repair our outdated water supply infrastructure is between $500 billion and $1 trillion.

Population growth has cancelled out all the gains in conservation and is resulting in an overall rate of use that continues to put a severe strain on the nation's water supply.

Immigration has been the primary driver of U.S. population growth since 1970. Between the 2000 and 2010 Censuses, the U.S. population increased by 27 million, with immigrants and their progeny accounting for 70 percent of the increase. Demographers project that immigration will account for an increasingly higher percentage of U.S. population growth in the coming decades.

We cannot continue to ignore the threat to the nation's water supply. If we don't reduce our usage, make the necessary investment in repairing our failing public water systems, and work to achieve population stability, chronic water shortages are years, not decades, away.

Key Findings

- Critical water supplies are being drawn down faster than they are being replenished.
- Higher concentrations of pollutants in aquifers make drinking water increasingly unsafe.
- Aging water pipes and infrastructure are creating a heightened danger of sinkholes.
- Using water for irrigation and fossil fuel extraction is increasing strains on the water supply, and raising food and energy prices.
- Desalinization — increasingly being used to supplement fresh water needs — is extremely energy-intensive and expensive.

Population Growth: Driving Unsustainable Water Use

One of the most pressing dangers caused by U.S. population growth is looming water shortages. That is a reality most Americans are likely unaware of, and many probably don't understand how or why the United States could be facing such a serious problem. It's not surprising, given the fact that water is readily available to almost every American home. When we turn on a faucet, water comes out, as simple as that. Water is everywhere. It even falls from the sky, free of charge. So why all the concern about a water shortage?

The problem is not a lack of water but the availability of a safe water supply needed for a rapidly growing population. Water is a renewable resource, but that does not mean that it's in infinite supply. The water cycle is a closed system, meaning that we cannot add more steps to it. When we talk about wasting water what we mean to say is that we are interfering in the cycle in a way that causes it to take longer for useable water to complete the cycle.

About 70 percent of the Earth is covered by water but only three percent of that is fresh water, and of that, only another tiny fraction, less than 1 percent, is available for human use.[1] Desalination is an option, but it is extremely costly and energy intensive and thus not a preferable solution.

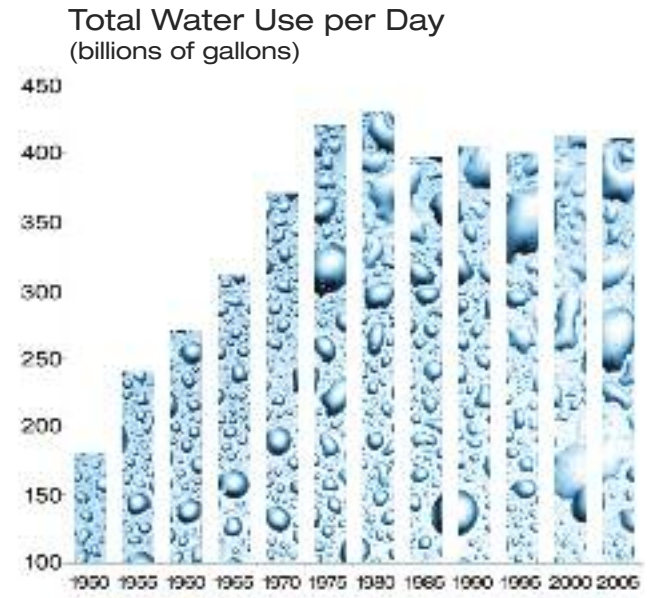
The threat of water shortages has been on the minds of concerned Americans for the past several decades. Planners began to address the issue in the 1970s, and Americans have made remarkable progress on that front. The United States has greatly improved water use over the last 40 years, but rapid population growth has cancelled out those gains. As a result, the United States continues to use water unsustainably and is facing the deterioration of its public water supply infrastructure. Most Americans have easy and cheap access to water that they consider clean and safe, which may create the illusion that the U.S. water supply is efficient, sustainable, and safe for the foreseeable future. In reality, water shortages and other consequences of overconsumption already affect millions of Americans each year. Population growth increases the strain on the water supply and cancels out the effect of conservation efforts.

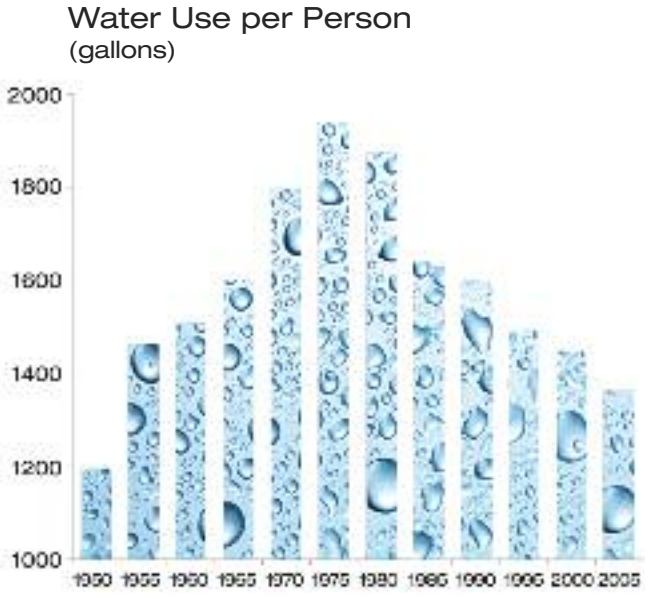
Once confined to Southwestern states, population growth has caused water shortages in new regions of the country, especially the Southeast. The problem is even more severe in areas that depend on groundwater supplies. Groundwater sources are being depleted more rapidly than nature can refill them, and in some places groundwater has become unusable because high levels of pollutants have seeped into groundwater supplies. Some regions that depend on groundwater are already experiencing the consequences of water depletion, and continued unsustainable use will only exacerbate these problems for the rest of the country.

Population growth also puts increased strain on America's aging and outdated water treatment and delivery systems. Repairing those systems would cost hundreds of billions of dollars, and the consequences

of not repairing them include regular releases of raw sewage into rivers and streams, salmonella outbreaks, and massive sinkholes. Each year, over 16 million Americans suffer gastrointestinal illnesses traceable to water contamination.[2] Our sewage and water treatment systems are in desperate need of repair. Population growth strains these systems further and forces the U.S. to spend money building new systems rather than fixing existing ones.

Population, Immigration and the Water Supply





USGS Estimates (see footnote 1)

The U.S. Geological Survey (USGS) estimates that the U.S. used 42 percent more water per person in 1975 than in 2005 (the most recent year for which data are available). However, overall water use decreased by just 2 percent over that period, remaining at the same unsustainable level that made conservation necessary in the first place.[3]

Why has conservation failed to effectively reduce water use? The answer is simple: population growth. Between 1970 and 2010, the U.S. population increased by over 50 percent, from 203 million to 309 million.[4] Even though the U.S. has reduced the amount of water each person uses, population growth has kept overall water usage almost at the same level. In order to address water shortages in the U.S., population stability needs to be at the forefront of the water conservation effort.

In order to achieve population stability, the U.S. must limit immigration. In the Census Bureau's 2009 population projections, the population was only forecast to increase to 323 million by 2050 in a zero net international migration scenario (meaning immigration levels equal emigration).[5] But the United States has a high net migration rate and is growing by about 3 million persons every year, most of this growth due to immigration.

The Pew Research Center has estimated the U.S. population will increase by 117 million between 2005 and 2050 to reach 438 million, with 82 percent of the population increase coming from immigrants and their U.S.-born descendants.[6] Despite successful water conservation initiatives in some areas of the country, surging populations have outpaced efforts to bring total water usage down to sustainable levels, and water usage will only increase as the population grows.[7]

DWINDLING SUPPLIES

Rapid population growth has put pressure on the water supply across the country. Today, Americans regularly experience water shortages, even in places that in the past have not typically been affected by them.[8] In places where water shortages regularly occur, population growth is making the problem much worse.

In recent years, the southeastern Unites States has suffered through a series of increasingly prolonged water shortages, first in the late 1980s, again at the turn of the century, and most recently from 2005 to 2009.[9] Intense and ongoing legal battles over water rights have unfolded between southern states.[10] Researchers at Columbia University determined that the most recent severe drought was not caused by unusual weather patterns. Instead, they determined that "the root of the water supply problem in the Southeast is a growing problem, driven in large part by in-migration," which put a much greater demand on the water resources than in years past.[11] This problem is a costly one for the U.S. economy. Water shortages in the summer of 2011 were estimated to have an impact of $3 to $5 billion on the Texas economy alone.[12] In California, it threatens tens of thousands of jobs in the agriculture industry.[13]

Nowhere are U.S. water shortages more serious than in the West and Southwest. The Colorado River, which provides most of the drinking and irrigation water in Arizona, California, Colorado, New Mexico, Nevada, Utah, and Wyoming, is strained beyond its capacity, but demand is increasing.[14] Lake Mead and Lake Powell, the region's two principal reservoirs, regularly stand at 50 percent capacity or less.[15] Compounding the problem, climatologists predict that the high western water flows of recent decades will not continue. So increasing allocations from these reservoirs based on increased short-term flows will only hasten their decline.[16] One study projected a 50 percent chance that both lakes will begin drying up completely some years by 2021, and a more conservative estimate projects that each lake will be dry about every other year by 2057.[17]

GROUNDWATER DEPLETION

Since 1975, the overall amount of groundwater withdrawal in the U.S. has not changed much.[18] However, groundwater withdrawal rates were unsustainable even before that time. Groundwater shortages have impacted water supplies all over the country, including Atlantic coastal states from Massachusetts to Florida, Gulf Coast states, Midwestern cities like Chicago and Milwaukee, and the Pacific Northwest.[19] However, Plains states and Southwestern states are the most dependent on groundwater.

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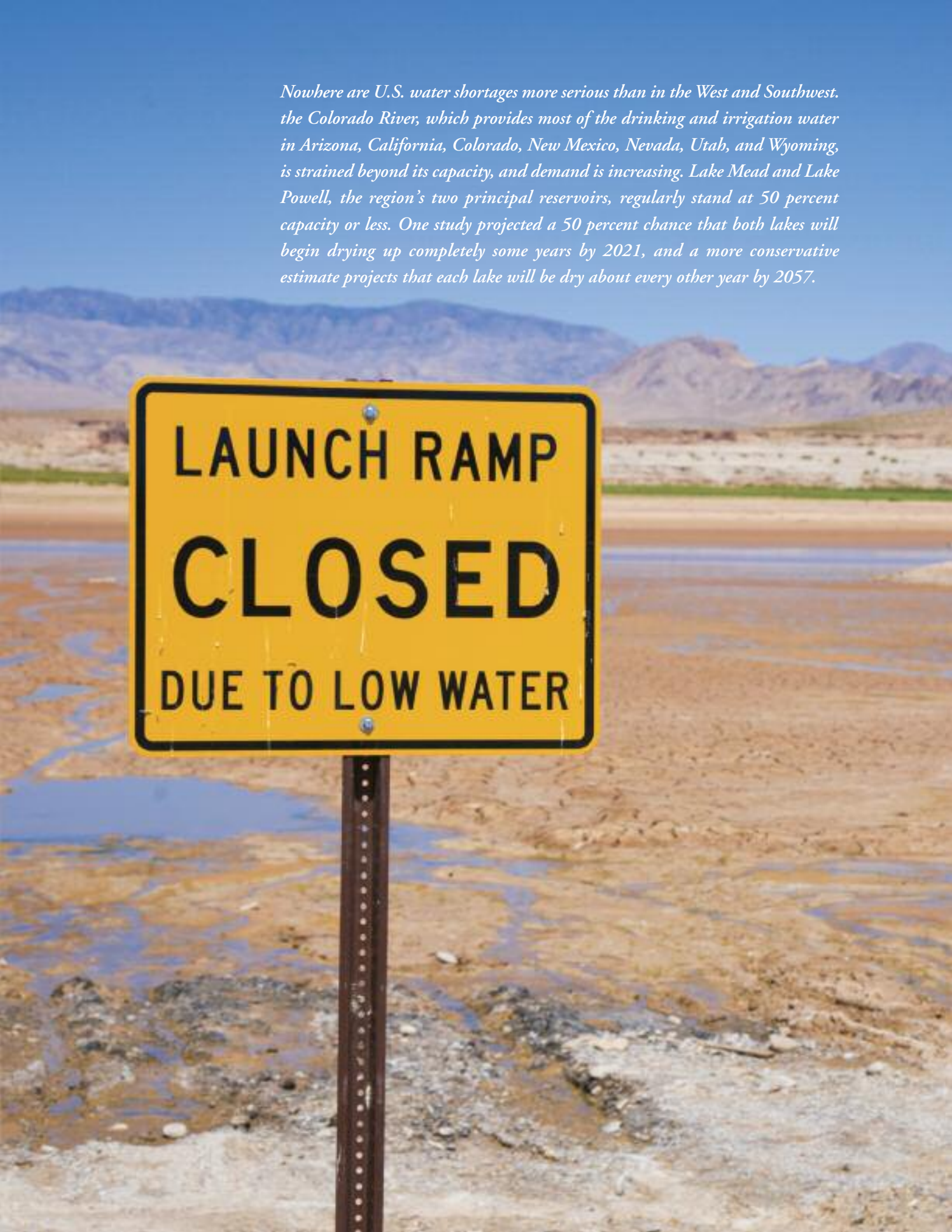


Golf Courses: Are the Greens Really "Green"?

The Environmental Impact of Golf Courses

WATER USAGE

Of the 1,504,210 acres of turf grass, greens, tees, fairways and rough of our nation's golf facilities, 80% of those acres are irrigated.[20]

Unlike trees and shrubbery, turf has little capacity to store water and nutrients and withstand droughts.[21]

Thus, maintaining healthy luscious grounds can take upwards of 300,000 gallons per day, per course. In 2006, U.S. golf courses used approximately 2.1 billion gallons of water per day for irrigation.[22] Water audits of the country's courses show that these courses use 20%-50% more irrigation water than necessary, and making reductions could save the average golf course 50,000 – 500,000 gallons per year.[23] An Arizona golf course removed 8 acres of turf. The impact? It saved an estimated 16 million gallons of water and 800 gallons of fuel. [24]

PESTICIDES

A study by the Environmental Institute for Golf (EIGF) explains how sand-based root zones, although well-suited for putting greens, have a low capacity for retaining nutrients and water — thus, management must fertilize the grass frequently to keep it green and bright. In combination with the poor drainage systems below putting greens, this can lead to nutrients leaking into surrounding watersheds.[25] The pesticides used on golf courses can pose both acute and chronic health risks to humans when they seep into local water supplies.[26] Nationally, the average 18-hole golf course applies about 780 pounds of pesticides each year.[27]

The most widespread water quality problem on golf courses, found in a 2010 study by the EIFG, was excessive phosphorus in ground and surface water: 86.5% of studied courses had excessive phosphorus levels.[28] Virginia recently signed a bill prohibiting the sale, use, and distribution of lawn fertilizers containing phosphorus, and requiring golf courses to implement nutrient management plans by 2017.

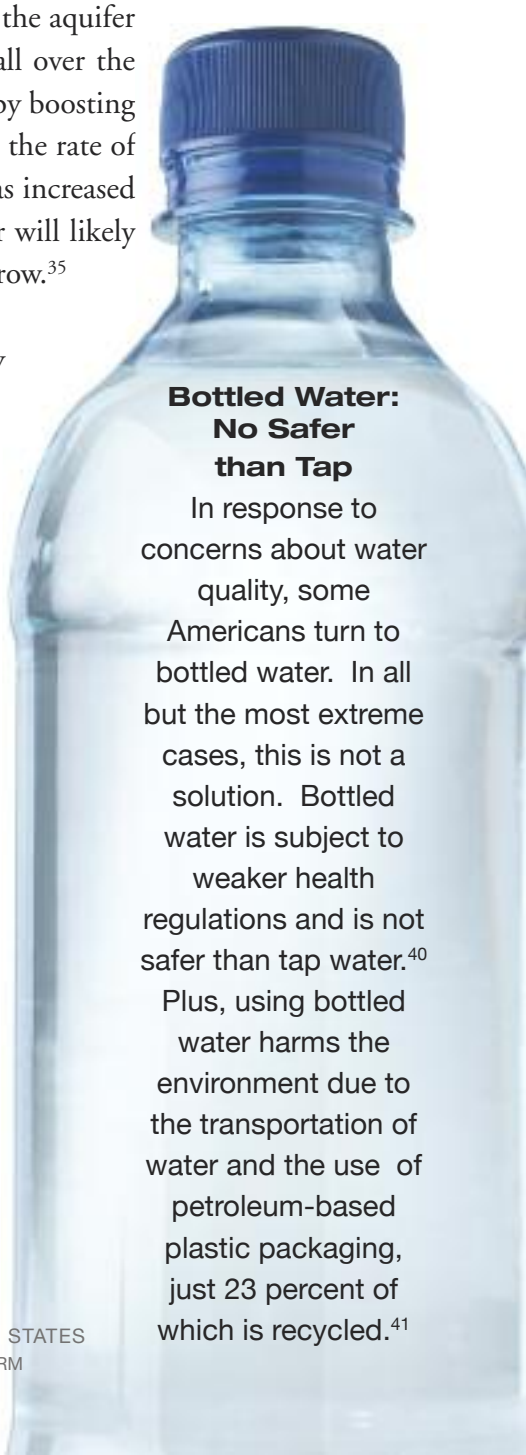
The Ogallala Aquifer, sometimes called the High Plains Aquifer, may be the best example of groundwater overdraft. Aquifers are natural underground water storage cisterns made of permeable sediment and rock. The Ogallala Aquifer underlies 173,000 square miles of land in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. First used for large-scale irrigation projects in the 1930s, the aquifer has become a critical part of the U.S.'s water supply. Since that time, its total capacity has declined by 9 percent, but because most water in an aquifer is unusable or inaccessible, this figure masks the severity of the problem.[29] Deep groundwater is about as saline as ocean water and is not suitable for drinking without extensive treatment.[30] Conservative estimates say that the Ogallala is currently being drawn down ten times faster than it can be naturally replenished.[31]

The Ogallala has already become unusable in many areas, and a report by Texas Tech University's Ogallala Aquifer Program predicts that in the most heavily irrigated areas of Texas, the aquifer will become too depleted for use by 2023.[32] Well yields have declined all over the region, increasing the amount of energy required to withdraw it and thereby boosting water prices.[33] Irrigation efficiency programs have been unable to reduce the rate of groundwater depletion — in fact, the rate of drawdown in the Ogallala has increased significantly since the 1980s and 1990s.[34] Worse, demand on the aquifer will likely increase dramatically in the coming years as the population continues to grow.[35]

The unsustainable use of the Ogallala Aquifer threatens the region's supply of clean water and harms the regional economy.[36] Water shortages force farmers to cut acreage, hire fewer workers, and lose sales. In turn, the decreased supply of crops leads to increased prices for consumers. Not only is the aquifer being depleted much more quickly than it can recharge, but much of the water that re-enters the aquifer is polluted.[37] Studies have found that contaminants are spreading deep into the aquifer and may spread throughout the entire aquifer over many years.[38] Further, the increasing rate of drawdown will make the problem worse.

INCREASINGLY UNSAFE

Groundwater depletion does more than just threaten water supplies — it also threatens the safety of remaining groundwater. When groundwater is drawn out it is slowly replenished by surface water, which often contains pollutants in the run-off from roadways, fertilized lawns, and farmland treated with pesticides. Water seeps extremely slowly through these aquifers, meaning that once polluted water enters an aquifer, it can gradually spread through the entire underground water source over many decades.[39] Drawing down groundwater sources faster than they can be replenished causes them to be even more pol-



Bottled Water: No Safer than Tap

In response to concerns about water quality, some Americans turn to bottled water. In all but the most extreme cases, this is not a solution. Bottled water is subject to weaker health regulations and is not safer than tap water.[40] Plus, using bottled water harms the environment due to the transportation of water and the use of petroleum-based plastic packaging, just 23 percent of which is recycled.[41]

luted.[42] For example, volatile organic compounds (VOCs) have been detected in most groundwater sources throughout the U.S.[43] When the population grows rapidly, groundwater quality deteriorates even more quickly. This is because population growth increases the rate of groundwater withdrawal and increases the rate at which polluted water re-enters aquifers.

Population growth also damages the quality of surface water. Today's threats to water quality are not as easy to see with the naked eye, but they are equally dangerous.[44] Ideally, federal regulations would keep water safe to consume, but regulations are rarely updated and barely enforced. A mere 1 percent of power plants that violated the Clean Water Act between 2004 and 2009 were punished, as well as just 6 percent of public water systems that broke state or federal law.[45] In addition, entirely new classes of chemicals are entering the nation's water supply, but they will not even fall under federal regulatory guidelines until they are proven to increase cancer risk by a factor of 100.[46] New technology now allows us to test for unregulated pharmaceutical pollutants, which wastewater treatment is not designed to remove.[47] Pharmaceutical pollutants have been connected to reproductive problems, diabetes, and other hormone-related medical problems, at concentrations in human cells as low as one part per trillion.[48] Without effective regulation, reducing population growth is the only hope of controlling the concentrations of these chemicals.

Population growth further degrades water quality by placing increased strain on water systems. All over the U.S., water systems are old and decaying, and population growth increases the strain on these systems. Among drinking water systems that serve over 100,000 people, 40 percent of water pipes are older than 40 years and 10 percent are older than 80 years.[49] The cost to upgrade water systems in the United States that are in "urgent need" could reach as high as $1 trillion.[50]

Outdated water systems result in leaky pipes, which is why more than 7 billion gallons of water leak out of pipes every year.[51] When leaks develop, pollutants and pathogens seep into the water. For example, about 1,300 people in Colorado were infected by salmonella from their water supply in 2008.[52] In 2006, researchers from the EPA's Office of Ground Water and Drinking Water estimated that 16.4 million Americans suffer gastrointestinal illnesses each year because of drinking water.[53]

Overburdened, outdated, and decaying water systems also release sewage into the water supply. Between 2007 and 2009, nearly 40 percent of U.S. sewage systems reported dumping untreated or partially treated sewage into water systems — but fewer than one in five was punished.[54] In the 750 municipalities that still use combined storm water and sewage systems, the problem is even worse. When pipes overflow during heavy rains, these systems divert raw sewage into nearby streams.[55] In New York City, where the average age of city water pipes is 76 years, city workers report that raw sewage is released into waterways about every other time it rains, and during every hard rainfall.[56] Still, residents complain about their high water bills, either unaware or unconcerned about the decrepit state of their water system.[57] Growing populations place increased strain on these systems.

This giant sinkhole in Guatemala swallowed a 3-story building. It was caused by decaying water infrastructure.

Sinkholes

When water or sewer pipes develop tiny leaks, dirt slowly infiltrates the water supply, sometimes too slowly to be noticed by the people drinking it. Over time, however, this erodes the soil, often under roads and homes, due to the placement of the pipes.[58] Sometimes, the damage can be extreme. The widely reported massive sinkhole in Guatemala City in 2010 was attributed to decaying water infrastructure.[59] Even small pipes can do big damage — a leak in a 1 inch thick pipe caused a 12 foot wide sinkhole in 2010 under the road in Charlotte, North Carolina.[60] Sinkholes can be deadly and require expensive infrastructure repair. Population growth increases strain on outdated water systems, which means more sinkholes and more money spent on repair.

The Price of Unsustainable Use

Americans often take cheap and seemingly clean water for granted. However, as a nation, we are engaged in a massive exercise in self-deception. The water is not as clean as people think, and the U.S. has been putting off costly but vital repairs to its water infrastructure for years. In 2009, the American Society of Civil Engineers rated the country's water infrastructure a "D minus" and estimated that an investment of $255 billion would be needed before 2014 to repair it. It also found that the U.S. has a $21.7 billion annual shortfall in water infrastructure investment.[61] New population growth adds to these costs by increasing the strain on existing water systems and requiring expansion or construction of new systems.[62]

An increasing population places a greater strain on each water source, and also means that less desirable sources must be tapped when insufficient quantities are available. As a result, localities all over the world are turning increasingly to saline water, using desalinization plants to remove the salt from water. There are desalinization plants in every U.S. state, with the largest operations in California, Florida, Texas, and Arizona, the desalinization only provides 0.3 percent of total freshwater used in the United States.[63] It is predicted that coastal communities will increasingly come to depend on desalinization to meet their water needs by the middle of the next decade.[64]

Desalinization plants generally do not treat pure ocean water, but rather "brackish" water that has about 10 to 15 times less salt than ocean water.[65] Even so, desalinization is about twice as expensive as other methods of purification, and is extremely energy-intensive.[66] Had the population not grown by more than 50 percent since 1970, the U.S. would not need to use these sources. Instead, the cost of desalinization will be piled on top of the costs of upgrades to the water system and repairs.

Population growth puts pressure on all of the most common uses of water. Agriculture needs irrigation, especially in the dry Midwestern and Western states that are dependent on the Ogallala Aquifer and Colorado River. Thirty-one percent of all freshwater withdrawn annually in the United States is used for agricultural irrigation.[67] Water is also needed to produce energy. A typical 500 megawatt power plant uses 288 million gallons of water per day.[68] Hydroelectric power is also hampered by water shortages — for example, during the 2006-09 Southeastern drought, the Tennessee Valley Authority had to reduce hydroelectric power and substitute more expensive power sources.[69] The extraction of fossil fuels also requires massive amounts of water, competing for the same water supplies needed for hydroelectric power and irrigation.[70]

Meanwhile, our decaying water infrastructure needs hundreds of billions of dollars in maintenance, and population growth strains that infrastructure and requires that we build even more of it. With current use unsustainable and population growing every year, these problems will all become worse in the coming years. Simply put, America's population is outgrowing its water supply. We can still become more efficient in our use of this finite resource, but efficiency and conservation cannot offset the effects of population growth forever.

Conclusion

Despite remarkable improvements in water efficiency, population growth has caused the U.S. to continue using water at the same unsustainable rate as it did in the 1970s. Most Americans don't think about the cost and effort needed to provide them with safe water when they turn on their taps and don't realize the detrimental impacts of overconsumption.

Water shortages threaten water supplies and harm the economy all over the country, especially in groundwater-dependent areas. Population growth also degrades water quality by increasing pollution and groundwater overdraft. Decaying water systems increase the risk of disease, and making needed repairs will cost the U.S. hundreds of billions of dollars. Declining supplies have caused the U.S. to turn to desalinization, an expensive and environmentally harmful alternative. If the U.S. does not reduce water consumption, these problems will only become worse in the coming years. Achieving population stability is a key step to managing our water resources.

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