



Arizona's Water

Thomas McGuire
October, 2023

Part I:

Water in the Desert

Surface Water

Groundwater

Reclaimed Water

Part II:

Follow the Colorado River

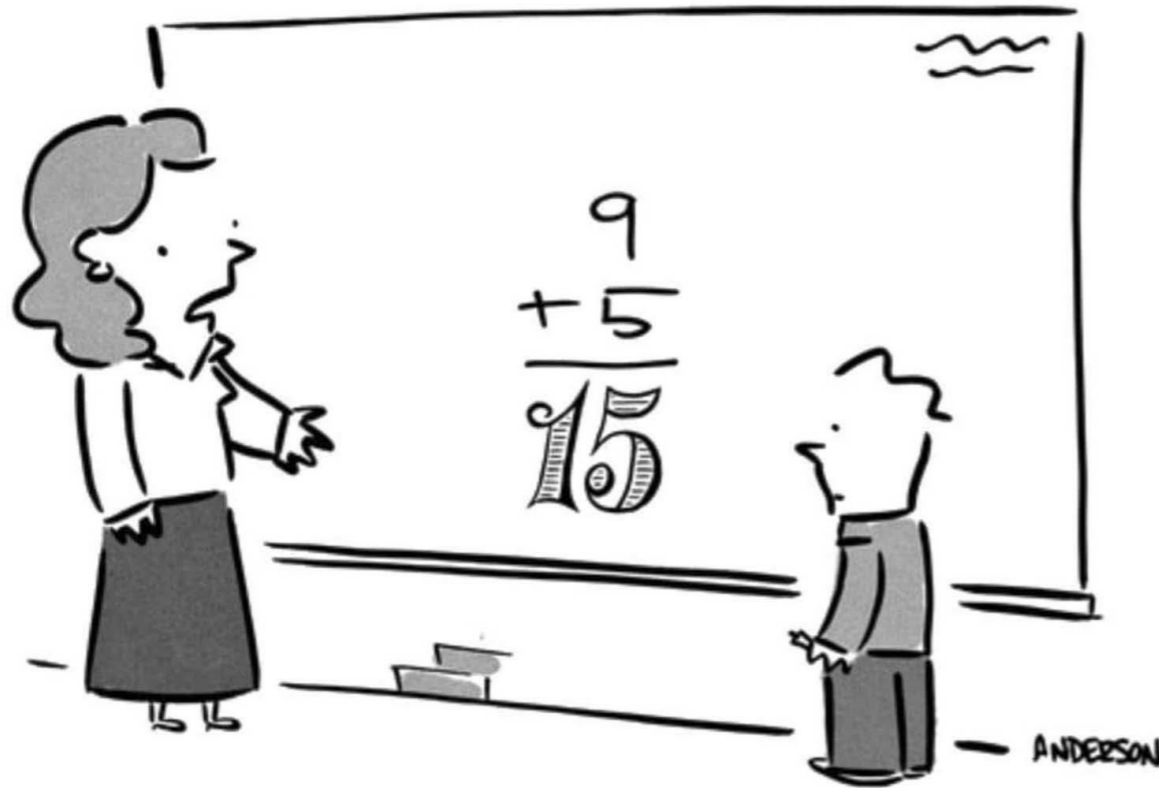
The Colorado River in History

The Colorado River as a Storage System

The Law of the River

The Bad News and the Good News

Solutions



"I couldn't agree more, it looks very nice, but it's still wrong."

Disclaimer:

I am not a lawyer or trained hydrologist.

My training is in geology and education.

But this is my attempt to illustrate Arizona's water situation in a relatively simple narrative.

The actual picture is very complex, and it is constantly changing.

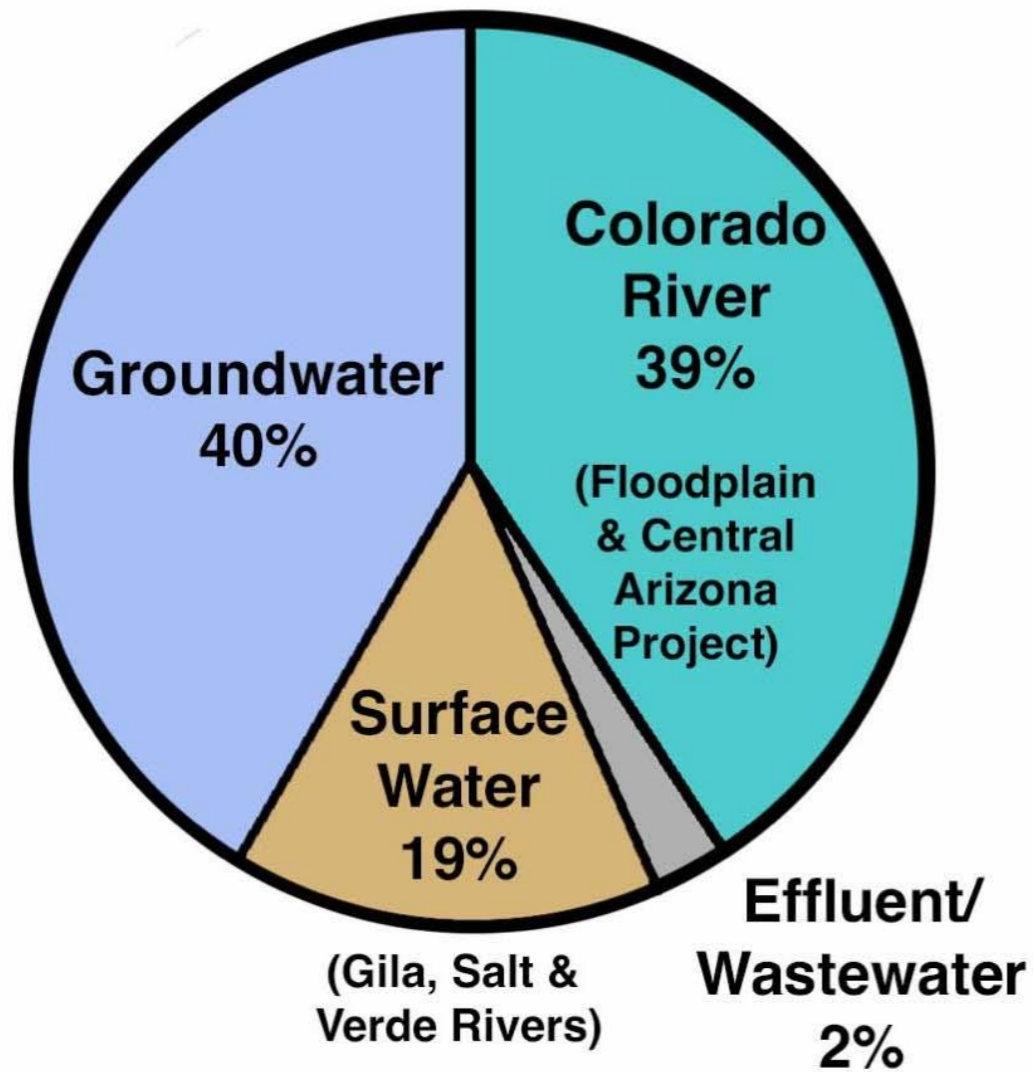
Mantras of Water:

- 1. Whisky's fer drinkin',
Water's fer fightin' over.***
- 2. Water flows uphill toward money.***
- 3. The human history and future of
the Southwest depend on water.***

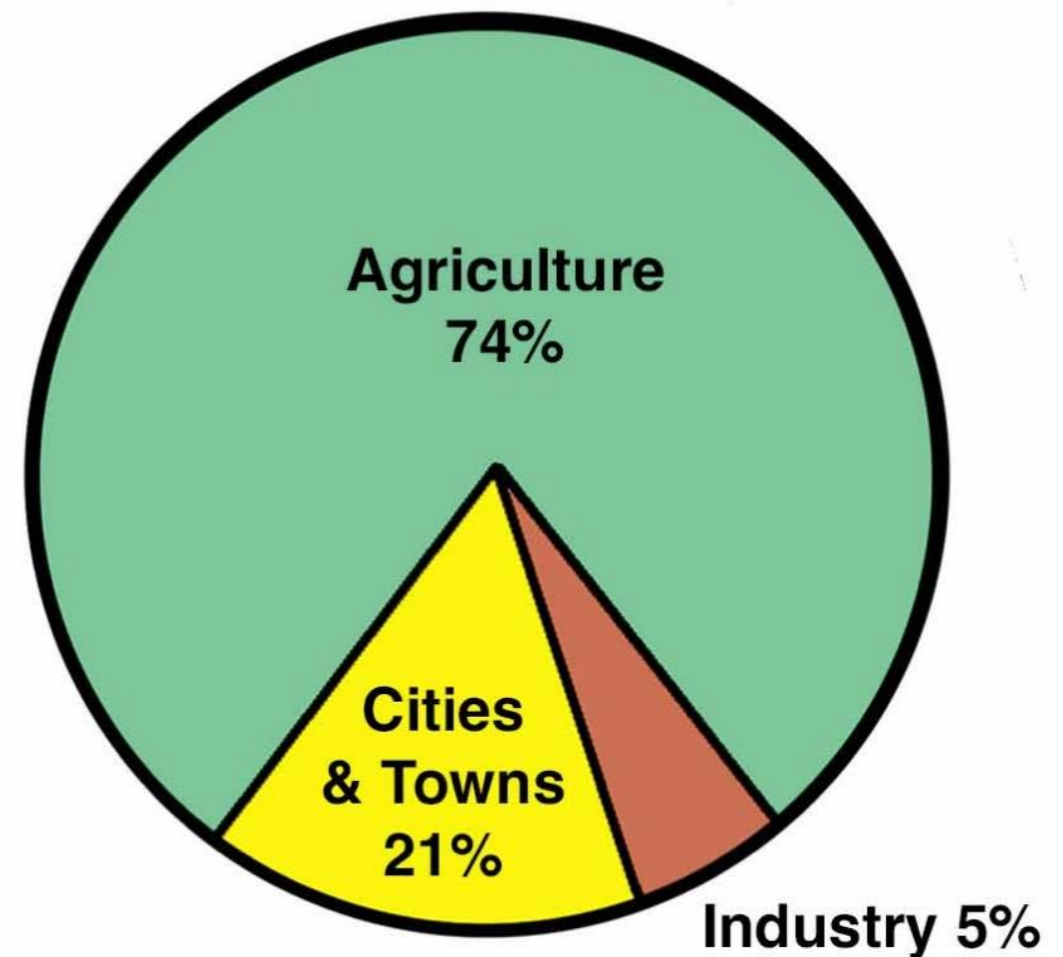
**Gold is currently more than \$1500.00 per ounce.
Municipal water is roughly \$0.000015 per ounce.
That's a ratio of 1 Billion to 1.**



But which is more valuable?



Sources

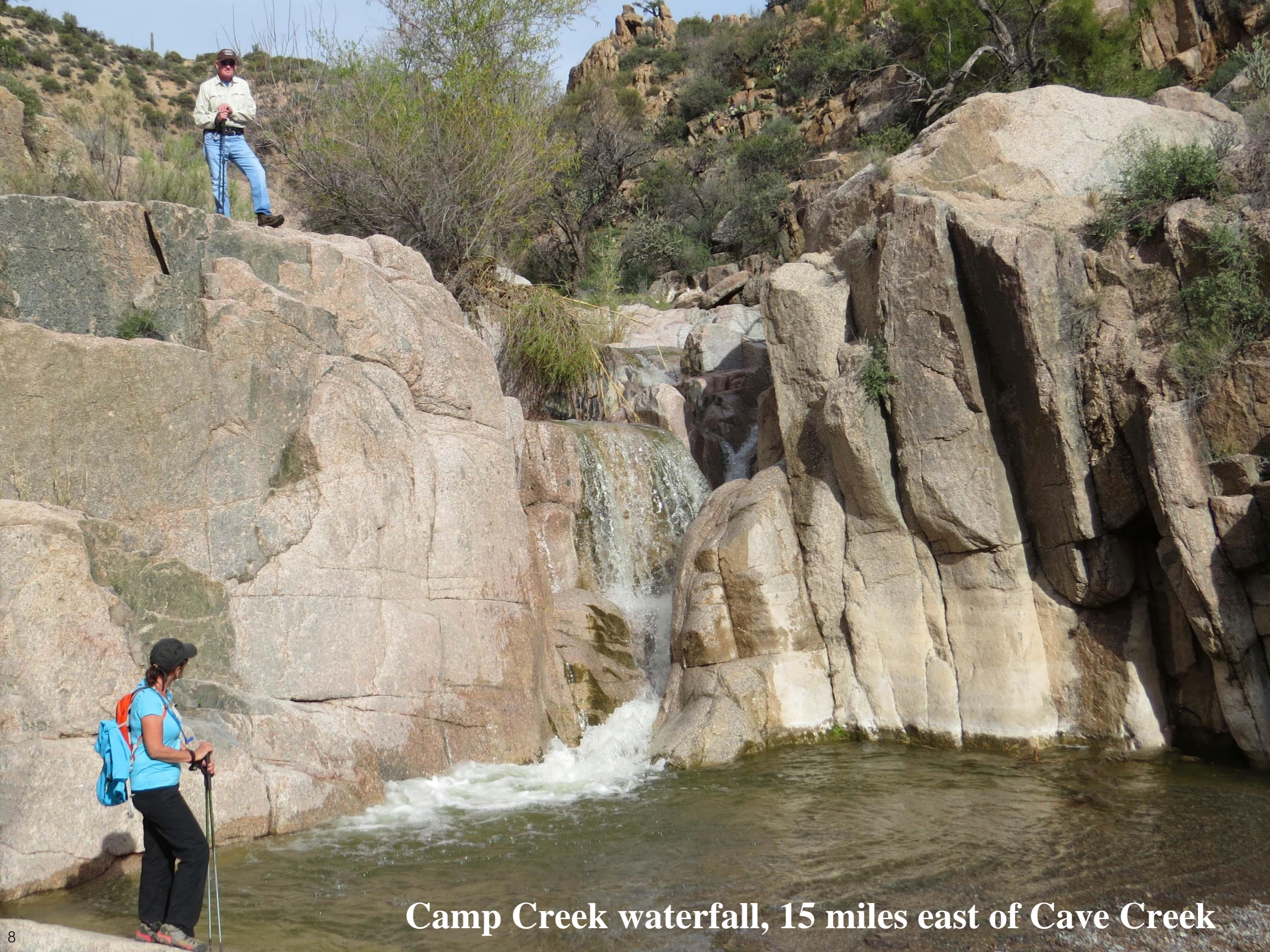


Uses

Most of the water in Arizona is used for agriculture, which is only about only 8% of the economy. More efficient use of agricultural water could free up water for communities and industries.

Part 2

Surface Water



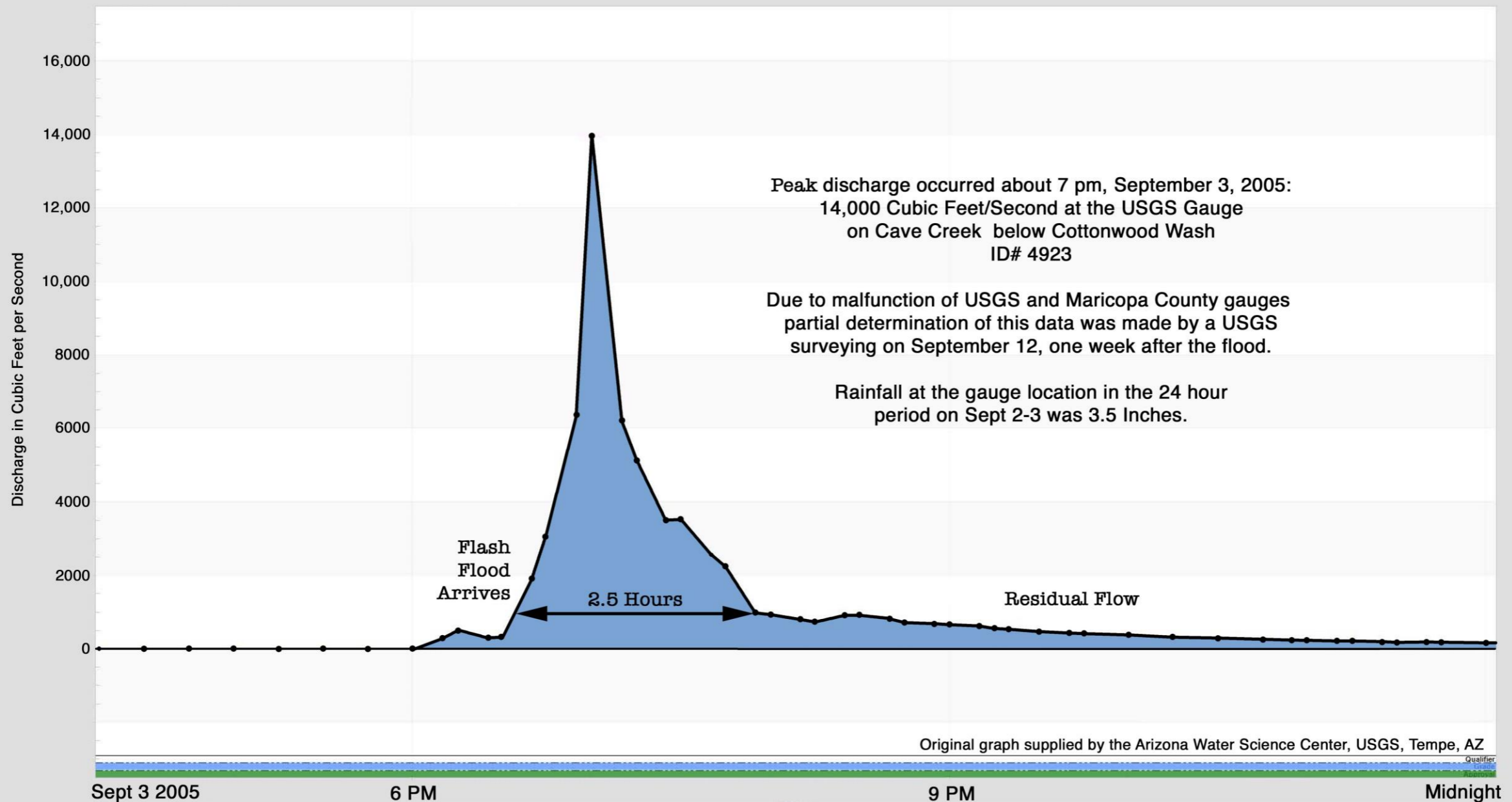
Camp Creek waterfall, 15 miles east of Cave Creek



This crossing of Cave Creek is dry more than half of the year.



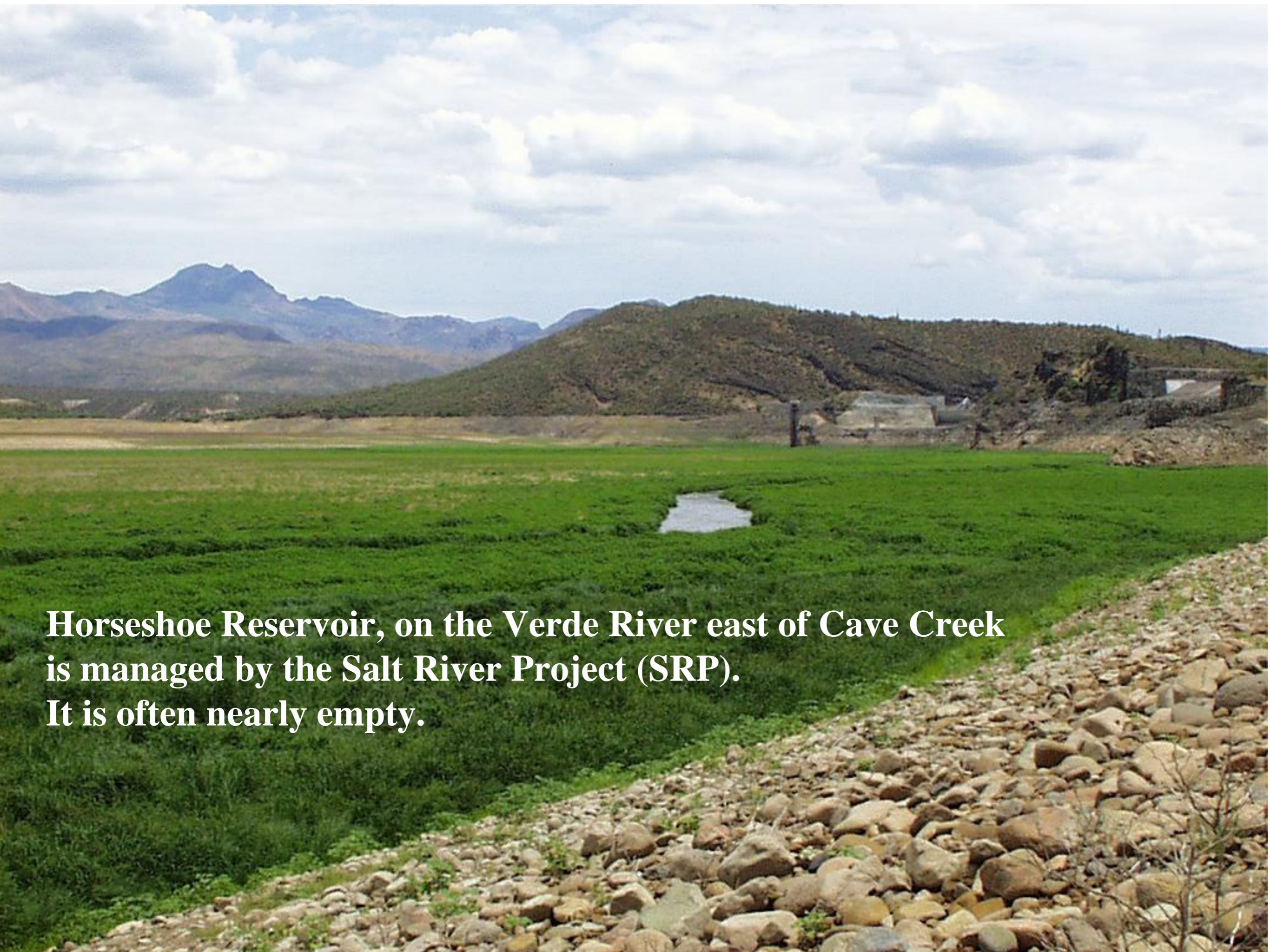
Floods on Cave Creek can carry as much water as the Colorado River through the Grand Canyon, isolating dozens of homes for as long as a week.



Desert streams are sometimes called “flashy.” They can go from bone dry to roaring water in a few minutes in a “flash flood.” As of August 2023, the greatest measured flood on Cave Creek occurred on September 3, 2005, after the Cave Creek Complex Fire.



This is the USGS stream gauge “Below Cottonwood Creek” on the Greenberg historic stamp mill property. The black arrow shows organic debris, possibly from the 2005 flood.



Horseshoe Reservoir, on the Verde River east of Cave Creek is managed by the Salt River Project (SRP). It is often nearly empty.



**But Horseshoe Dam overflows when the Verde River is in flood.
This is from the Arizona mountains snow melt in 2023.**



Bartlett Lake is the other major SRP reservoir on the Verde River.



Making Bartlett Dam higher would impound/store more water in flood years, such as 2023, rather than the water being lost by overflow.

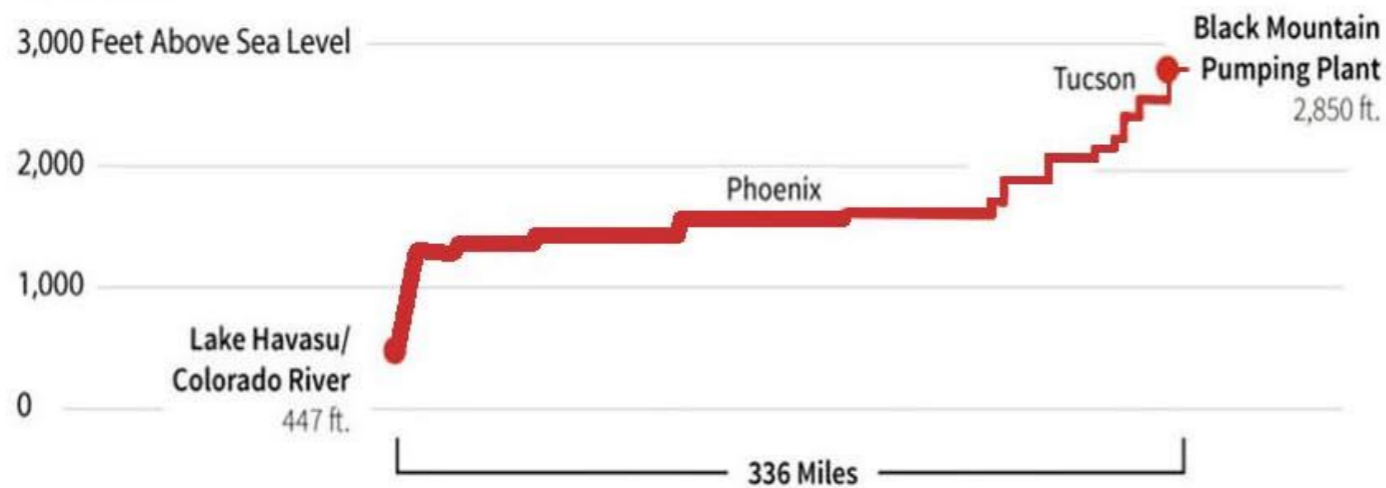
The Central Arizona Project (CAP) canal brings Colorado River water more than 300 miles to the Phoenix-Tucson corridor. It serves about 80% of Arizona's population.

Building it cost about \$5 billion. But to get the needed support of California, Arizona took "Junior Partner" (low priority) status.

The CAP canal was intended to preserve groundwater.



Elevation





The Central Arizona Project CAP aqueduct begins at the Mark Wilmer pump station on the Colorado River at Lake Havasu.



Salt River

The CAP aqueduct includes the canal, pump stations, tunnels, and siphons.



Cave Creek receives its water from the CAP canal at Deer Valley Road. It's pumped uphill 600 feet and 12 miles to the Town of Cave Creek.



The Cave Creek water treatment plant is located on Basin Road in the Town Core. Recent upgrades have modernized potable water treatment, reduced losses and increased efficiency.

Part 3

Groundwater



Groundwater occurs where there is connected pore space within the ground. It emerges at springs.

Seven Springs is a constant source of groundwater that flows down to Cave Creek.



A short distance downstream is the crossing of Forest Road 24. Because of the constant outflow of Seven Springs, it flows like this all year long.



Trucks bring some of the spring water away from the Cartwright Ranch in the high desert north of Cave Creek. The Cartwright water claim has seniority over the U.S. National Forest claim.



Water supply is often expressed in units of acre-feet. (AF) One acre-foot is roughly enough water to cover a football field one foot deep.

One AF can supply 2-4 Arizona homes for a year, assuming average water use.

A large football stadium at night, filled with spectators. The field is illuminated by bright stadium lights. A goalpost is visible on the right side of the field. A light blue layer is overlaid on the field, representing a 1-foot deep water layer. A double-headed arrow points to this layer with the text "1 foot deep".

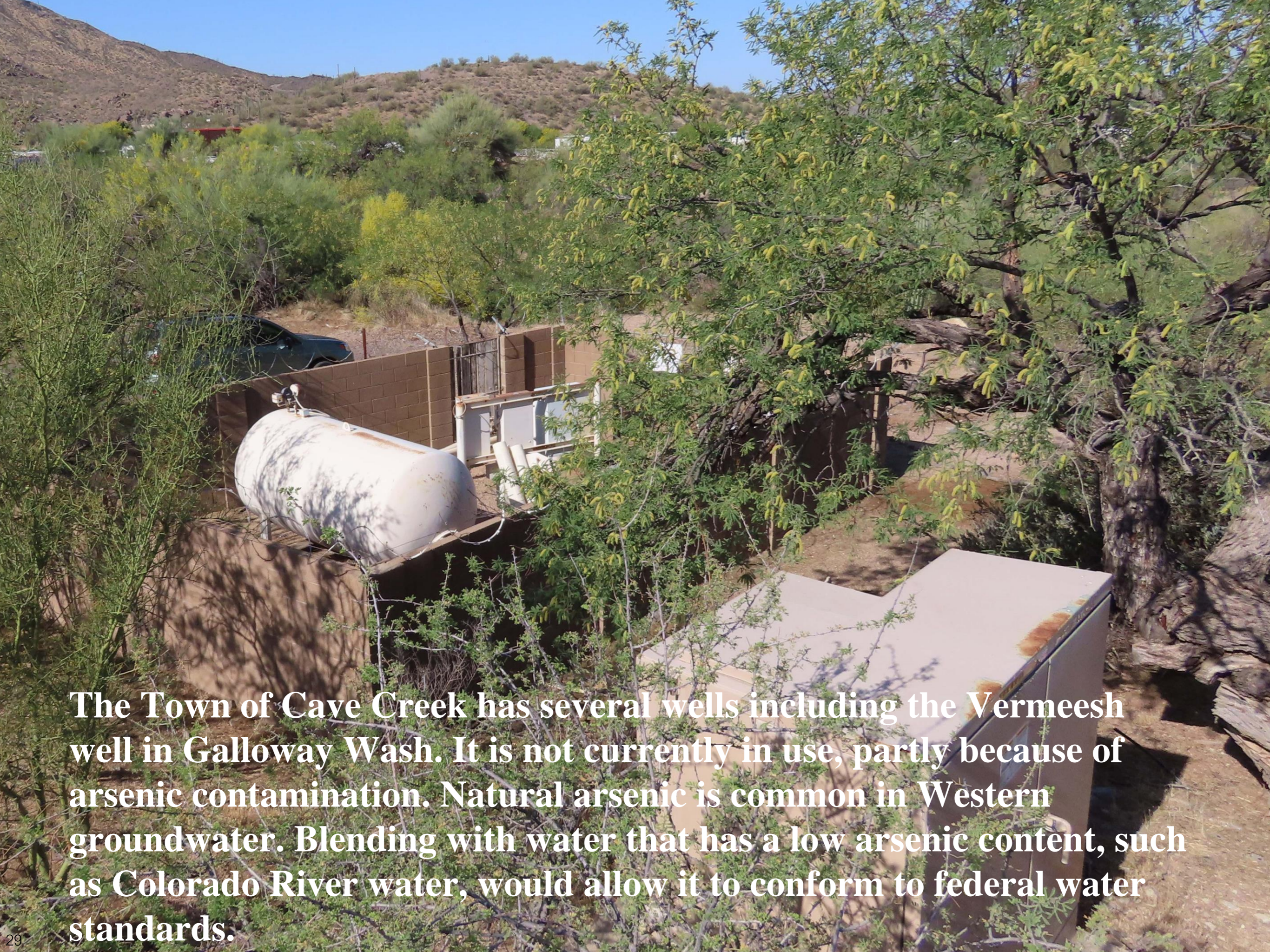
↑↓ 1 foot deep

The Cartwright Ranch has a claim to 60 acre feet of spring water for irrigation and 30 acre feet for domestic use.

This claim pre-dates the Tonto National Forest, but has not been adjudicated and is therefore not a full water right.

The effect this diversion of water flowing into Cave Creek is uncertain.





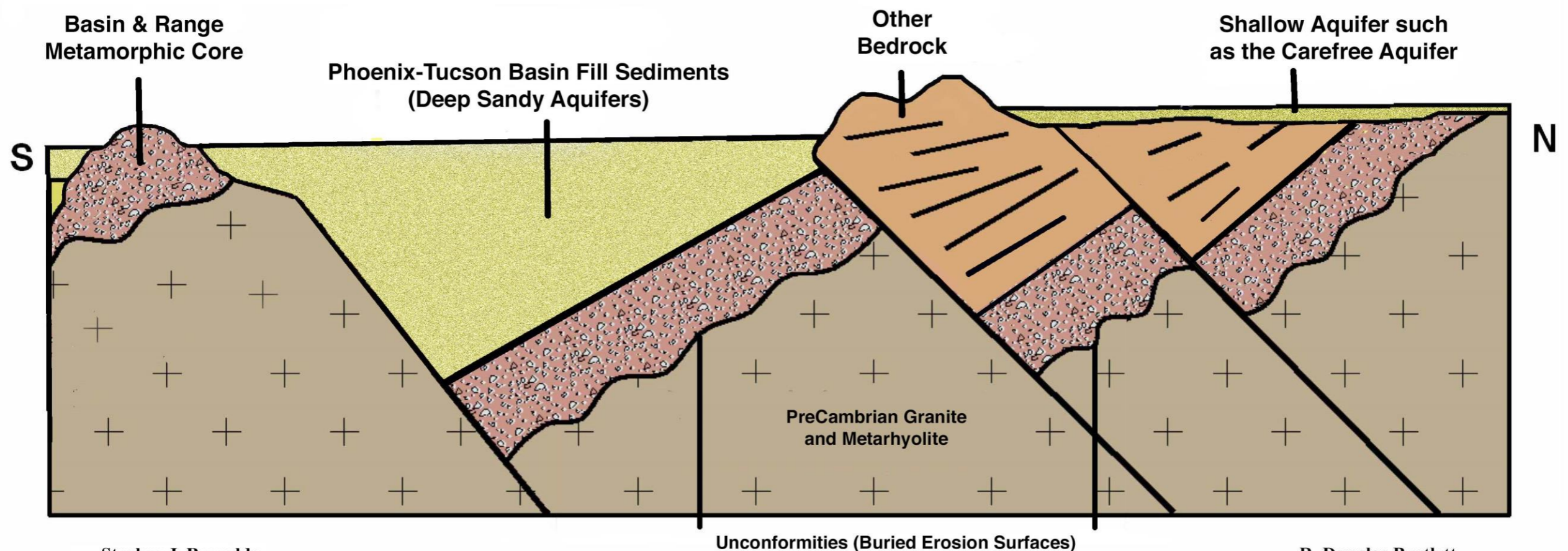
The Town of Cave Creek has several wells including the Vermeesh well in Galloway Wash. It is not currently in use, partly because of arsenic contamination. Natural arsenic is common in Western groundwater. Blending with water that has a low arsenic content, such as Colorado River water, would allow it to conform to federal water standards.



**Small private wells are known as “exempt wells.”
They are unregulated and assumed to have little impact on aquifers.**

Unlike Southern California, the Phoenix-Tucson corridor has a deep aquifer. It could supply most of our water for as much as 10 years. But this is “fossil water,” best managed as a “water reserve account.”

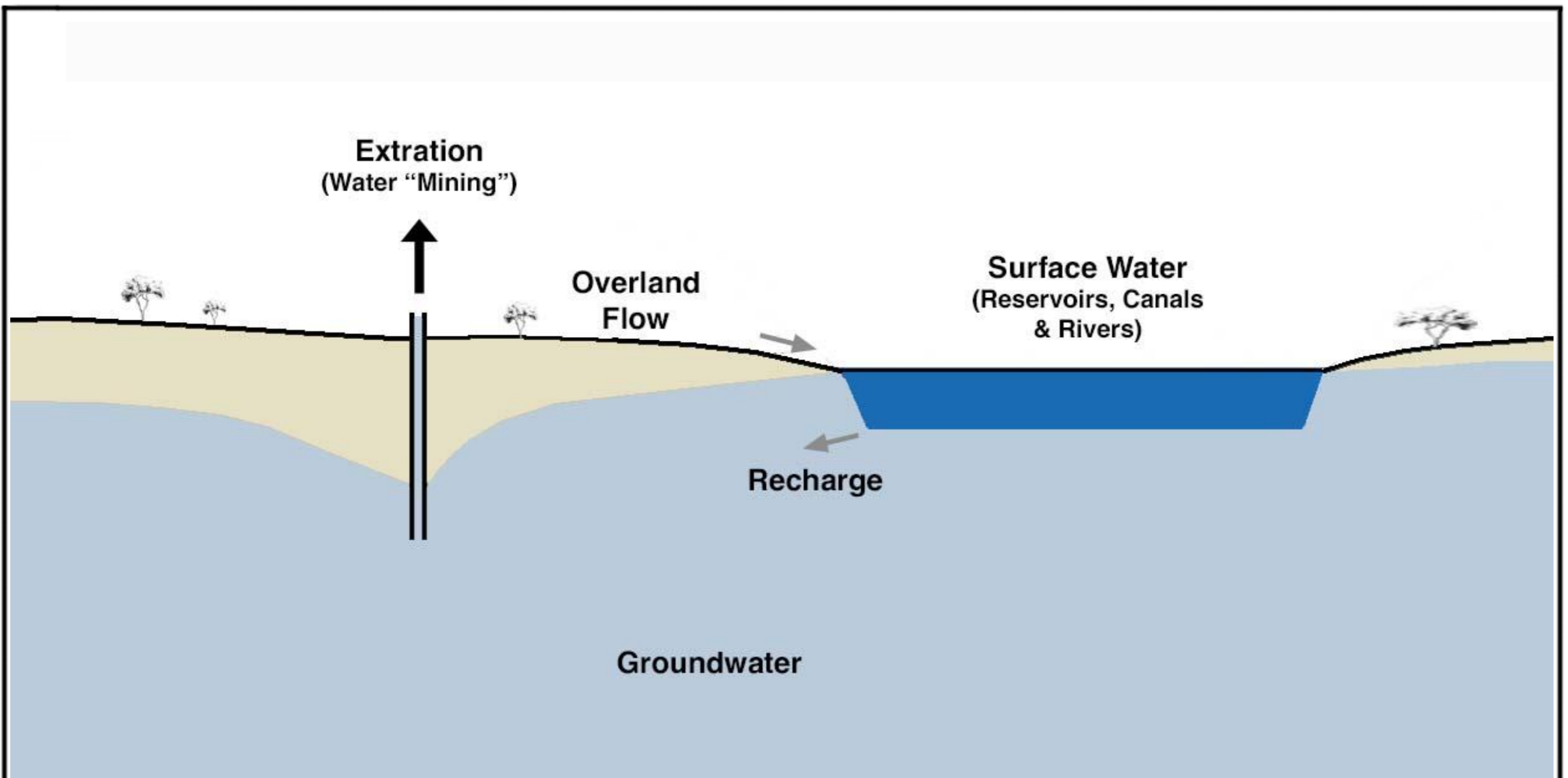
Water recharge/banking can extend its lifetime and our future security. But Arizona’s current groundwater use is not sustainable.



Stephen J. Reynolds
Dept. of Geological Sciences
Arizona State University
Tempe, AZ 85287-1404

Arizona Geological Survey Contributed Report CR-02-A

R. Douglas Bartlett
Clear Creek Associates, PLC
2150 E. Highland Avenue, Suite 201
Phoenix, AZ 85016

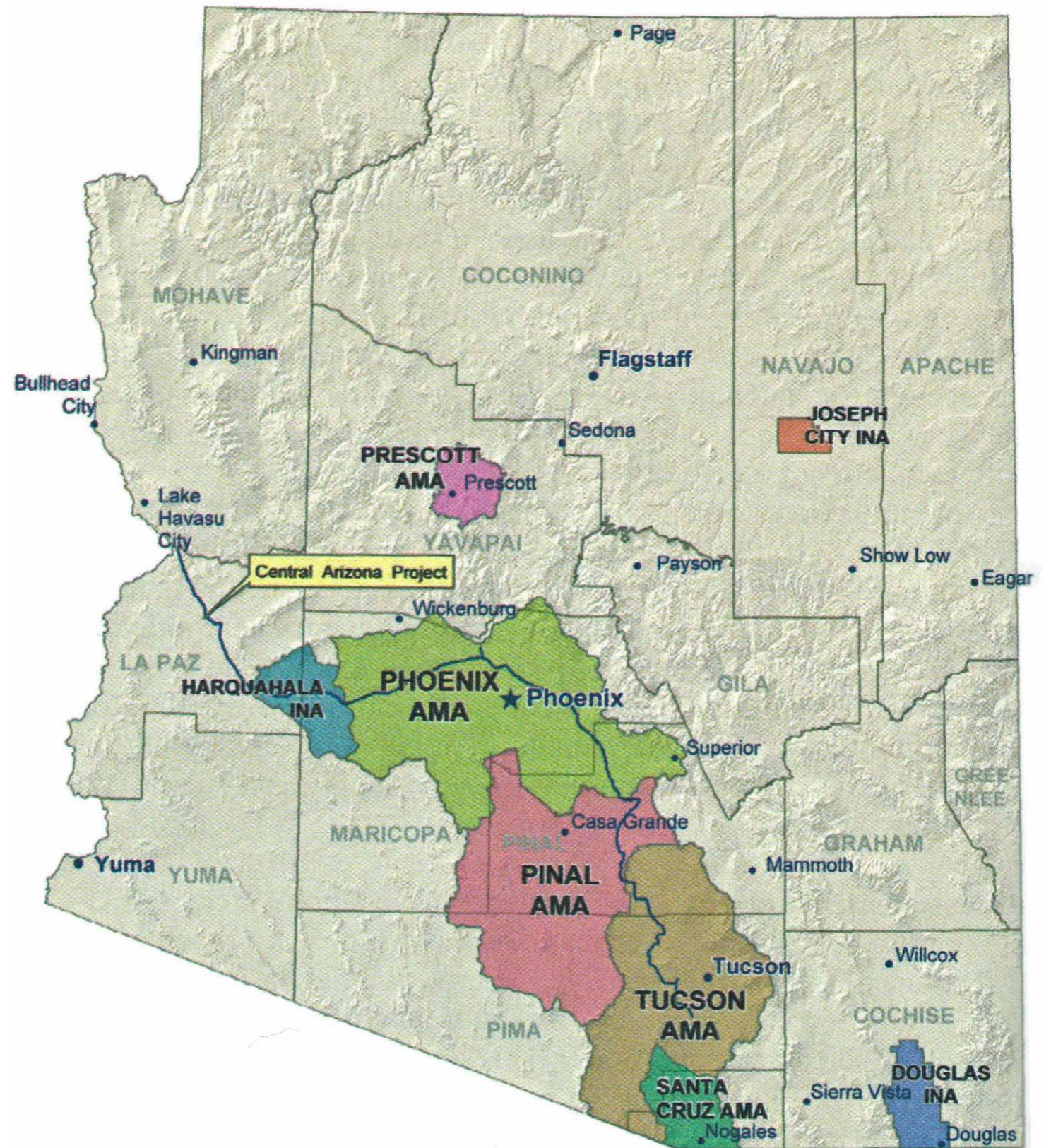


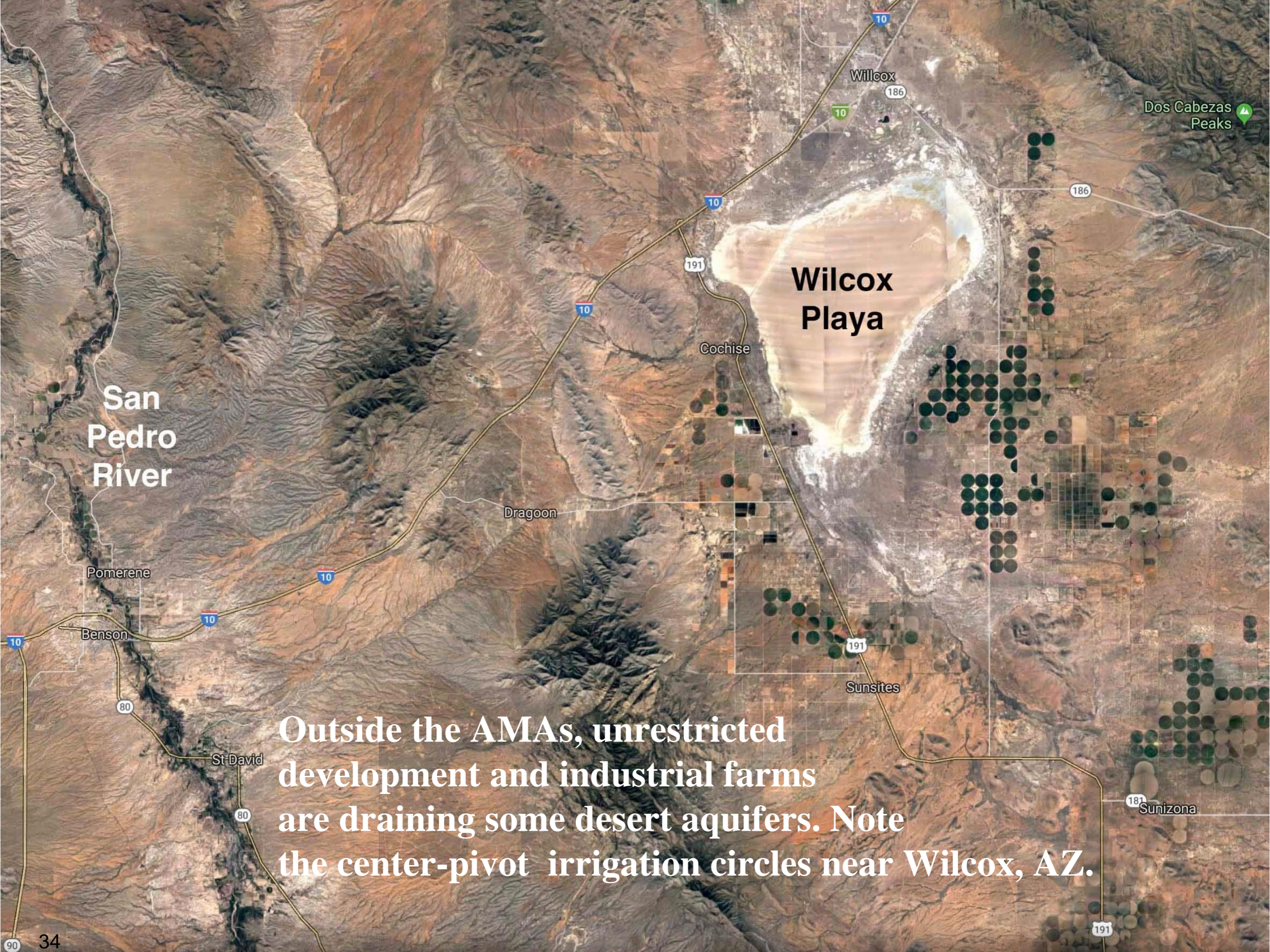
Because recharge can be much slower than extraction, groundwater in Arizona needs to be treated as a non-renewable resource. Therefore we use the term, “water mining.” Surface water and groundwater are separate in some regulations, but they are, in nature, interconnected.

Construction of the Central Arizona Project (CAP) aqueduct allowed Active Management Areas (AMAs) and Irrigation Non-Expansion Areas (INAs) where groundwater withdrawal is managed for future availability.

Outside the AMAs and INAs, groundwater is neither monitored nor regulated.

Additional AMAs and INAs can be established by state and local action.





San
Pedro
River

Pomerene

Benson

St David

Dragoon

Cochise

Sunsites

Sunizona

Dos Cabezas
Peaks

Wilcox
Playa

Outside the AMAs, unrestricted development and industrial farms are draining some desert aquifers. Note the center-pivot irrigation circles near Wilcox, AZ.



One center-pivot irrigation circle can cover more than 100 acres.



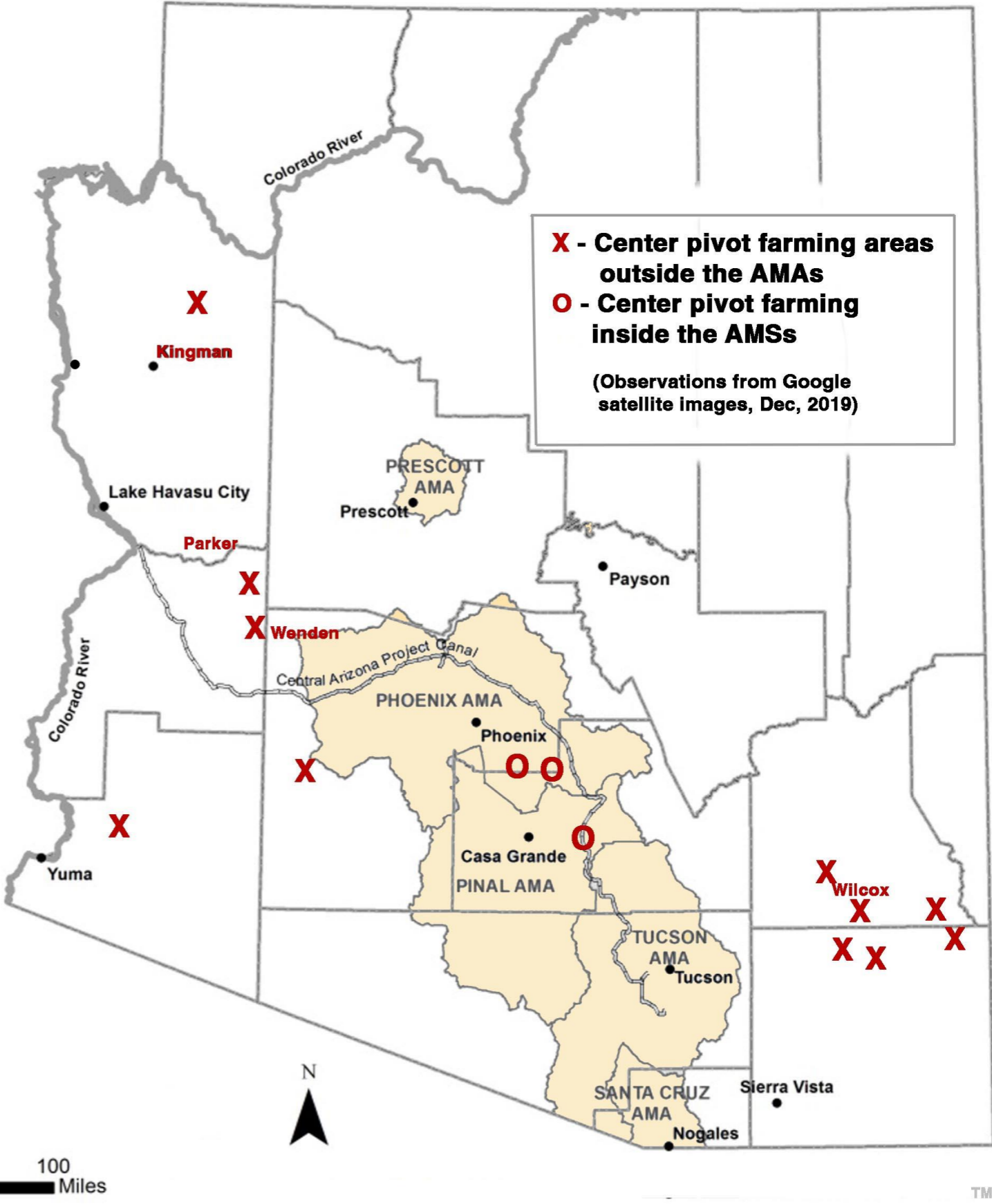
Former Governor Babbitt urged citizens to establish a rural “Active Management Area.” But Wilcox voted not to become an AMA.

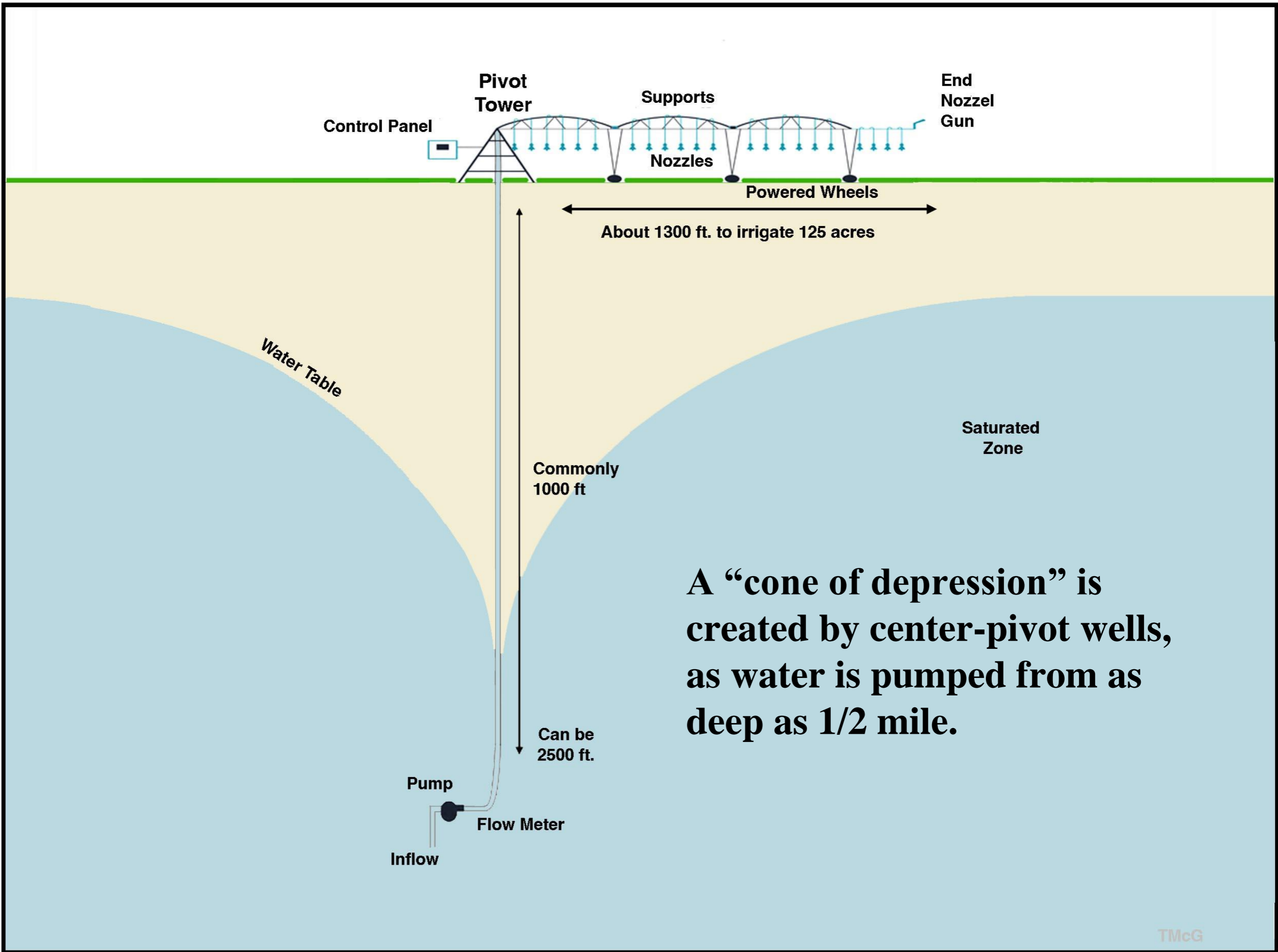
These are center-pivot irrigation locations identified from satellite images.

The circles are easy to spot during commercial air travel.

They are increasingly common throughout the desert southwest.

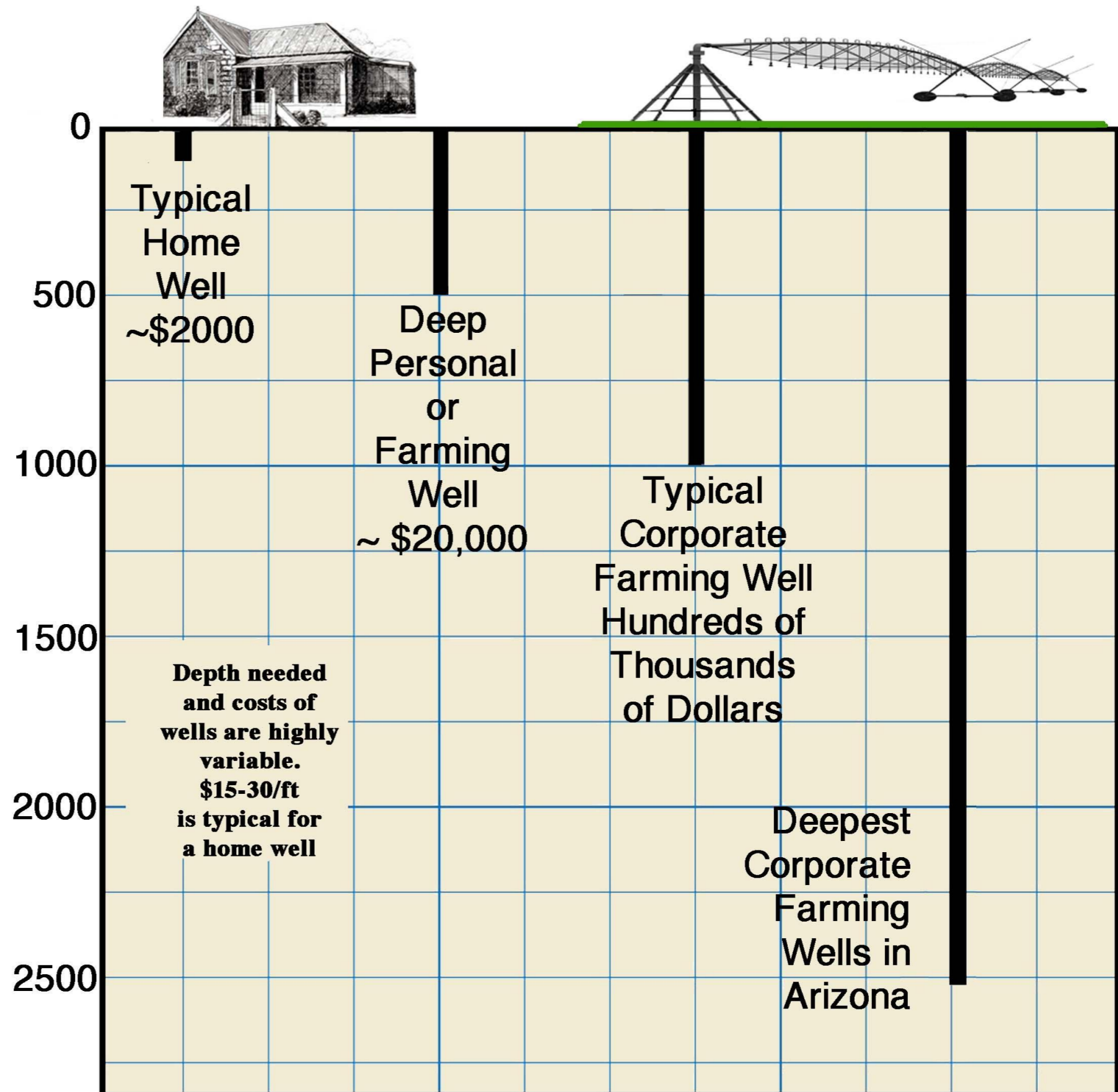
Most are outside the regulations of Active Management Areas.





Withdrawal of water from aquifers sometimes makes nearby wells run dry.

Industrial farms can drill deeper wells to extract “fossil water,” but rural homeowners can’t afford such deep wells.



Arizona's Next Water Crisis:

Eight Corporations Involved in Industrial Farming in Rural Arizona

Arizona Republic, December 2019

Color Key: **Foreign (3)** , **Other USA (4)**, **Arizona (1)** (Some are joint ventures)

1. Riverview LLP (**Minnesota**) Near Wilcox (Probably the largest; up to 150,000 cattle, 420 wells)
Growing water intense alfalfa, wheat, and silage corn to feed their dairy cows on the property
2. International Farming Corporation, Wenden & Salome (**North Carolina**) Alfalfa cattle feed
3. Fondomonte, Almaria, Vicksbug to Salome (**Saudi Arabia**) Alfalfa cattle feed
4. Al Dahra ACX, Wenden & Hyder, Red Lake Ventures, near Kingman (**United Arab Emirates**)
Alfalfa cattle feed
5. Peacock Nuts LLC, Kingman area (**Las Vegas & US Investors**), Pistachios
6. International Farming Corporation (North Carolina) & Integrated Ag, near Wenden (**Scottsdale**)
and leased to Aldahra (**products to Saudi Arabia**), Alfalfa
7. Kingman Farms, Near Kingman (**Las Vegas**)
Formerly alfalfa, but currently hemp & baby potatoes (Which require less water)

Rob O'Dell & Ian James, Arizona's Next Water Crisis, (series) The Arizona Republic, December 2020, These 7 industrial farm operations are draining Arizona's aquifers, and no one knows exactly how much they're taking <https://www.azcentral.com/in-depth/news/local/arizona-environment/2019/12/05/biggest-water-users-arizona-farms-keep-drilling-deeper/3937582002/>



Groundwater withdrawal fissures in Queen Creek undermine roads and homes.

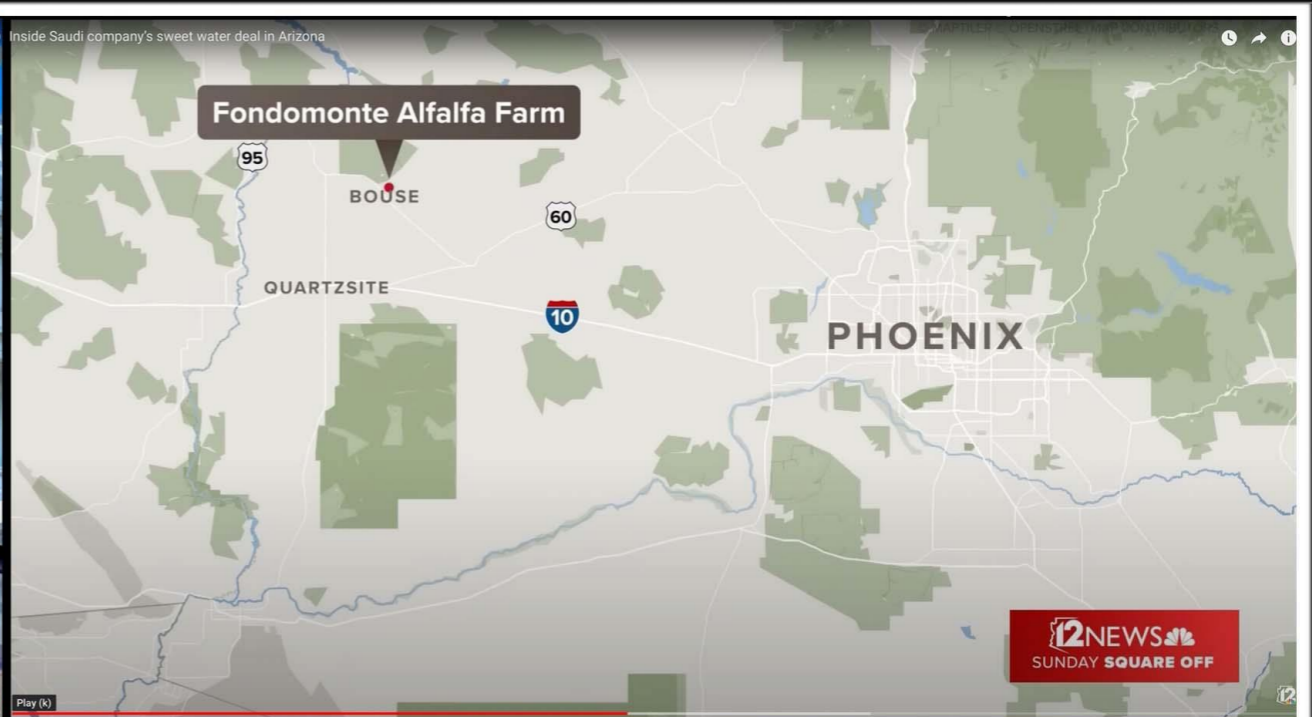
We wouldn't allow Arizona water to be shipped out like this...



<http://www.modsats.com/ownable-durahaul-water-tanker-1-41/>



...so we turn the water into animal feed and export it.

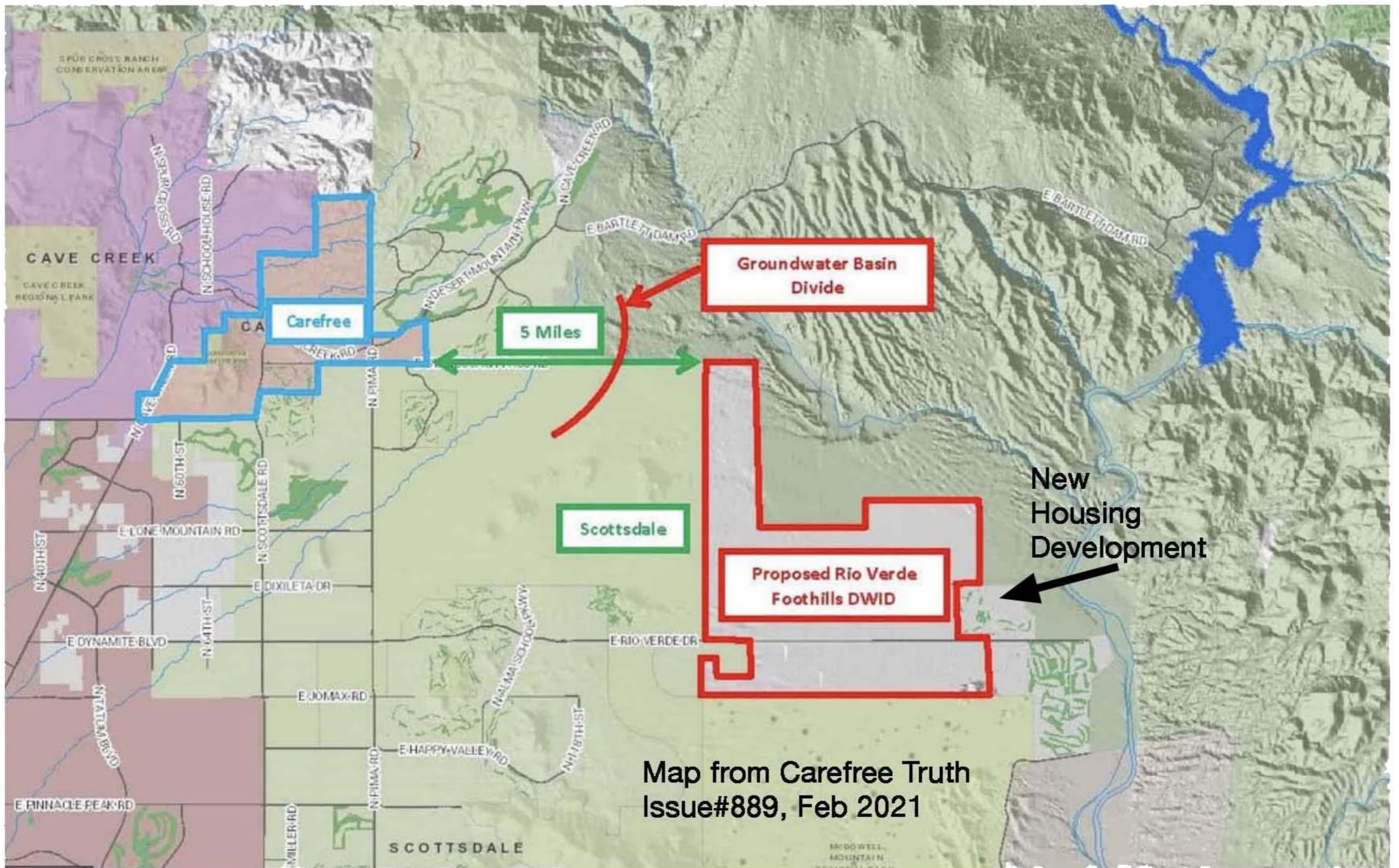


In 2022 the governor allowed a Saudi Arabian company to lease state land for as little as \$25 per acre per year. This allowed them to extract unlimited groundwater to grow animal feed that is shipped to the Persian Gulf. This contract is now under review.

www.youtube.com/watch?v=7kj29qM1d1U



Residents of Rio Verde Foothills purchased homes enabled by lot splits on county land north of the Scottsdale city limits. Unlike larger developments, homes on lot splits do not require a “100 year assured supply.” Although they were given notice, residents were allowed to temporarily haul in Scottsdale water. In order to prepare Scottsdale for a water shortage, hauling was terminated.



Map from Carefree Truth Issue#889, Feb 2021

Rio Verde Foothills could have formed a DWID (Domestic Water Improvement District), but some balked at the high cost. Maricopa County negotiated with Scottsdale to resume supplying water. But Scottsdale insisted on guarantees that their own citizens would not be disadvantaged by incurring extra costs, having to supply uncontrolled residential growth or loss of their own allocated water.

The Central Arizona Groundwater Replenishment District (CAGRD) allows a housing development to extract local groundwater in an AMA with a commitment to replace it. It's a "workaround" allowing developments to be built where groundwater extraction is normally prohibited. CAGRD grew from 4 developments in 1995 to 1,248 subdivisions in 2022. Anthem is a CAGRD project with 10,000 homes.

Homeowners are responsible through their water supplier to pay for water to constantly replace the groundwater. It's controversial because the groundwater recharge doesn't have to be where it is withdrawn. This can result in the collapse of the local aquifer.



<https://www.cagr.com/enrollment>, <https://www.realliving.com/rentals/1748-W-MORSE-Drive-Anthem-AZ-85086-289186601>, <https://cals.arizona.edu/arec/sites/cals.arizona.edu/arec/files/publications/2006-03ferrismegdaleden.pdf>, <https://www.cagr.com/documents/enrollment/CAGRD-Member-Land-Enrollment-Summary.pdf> Bowling, Joshua, The Arizona Republic, February 23, 2020

The ASU Kyle Center has published on-line reports about Arizona water supplies. Groundwater is especially critical. A critical goal is to equalize withdrawal with recharge for sustainable use.

Because of historic uses, contracts and state-wide policies, Arizona is using more ground water than is being replaced.

Three other booklets are also available at the Kyle Center for Water Policy website.

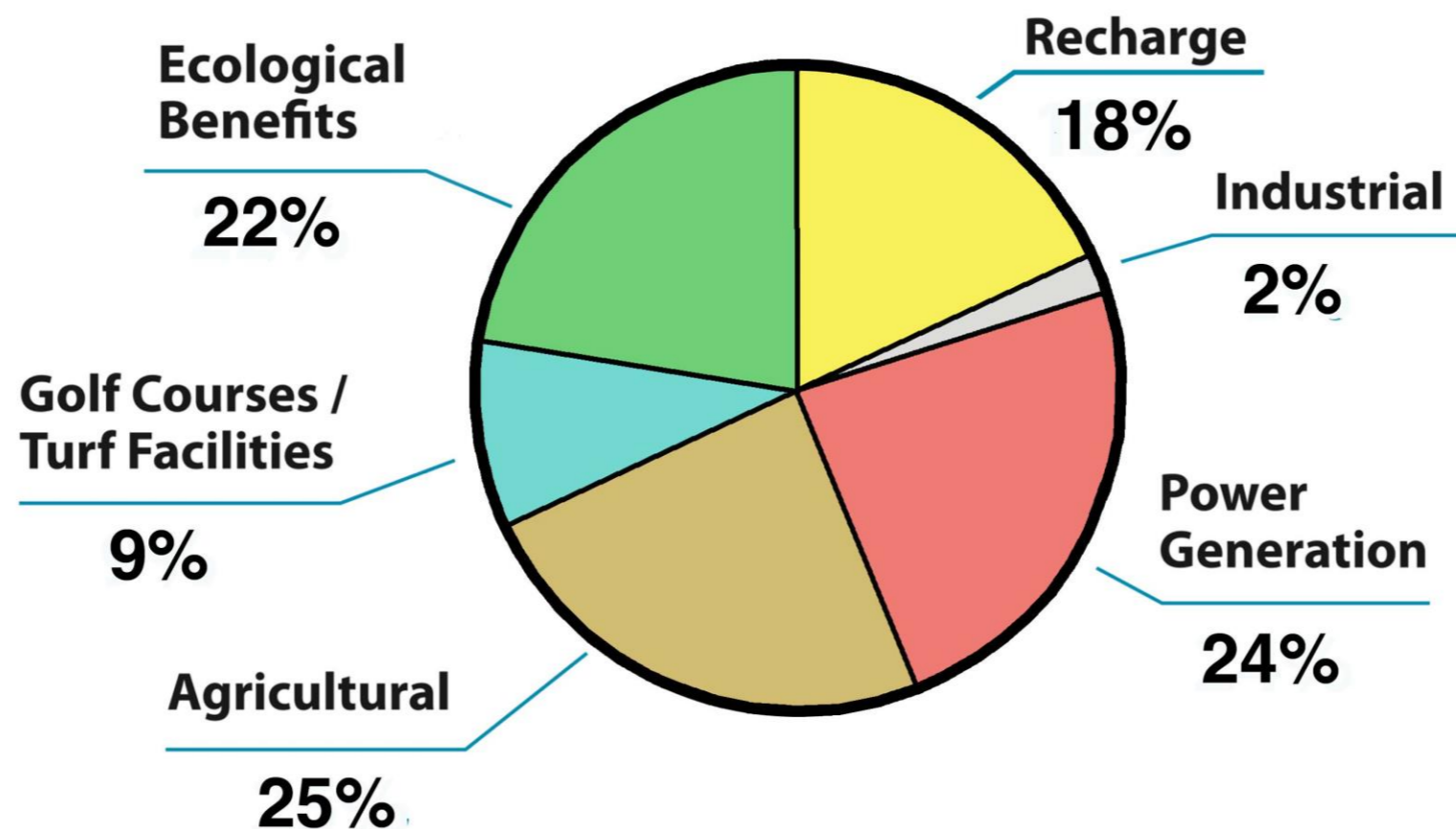
The Myth of Safe-Yield: Pursuing the Goal of Safe-Yield Isn't Saving Our Groundwater



Kathleen Ferris, Senior Research Fellow
Sarah Porter, Director

Part 4

Reclaimed Water (Effluent)



Treated wastewater is a valuable commodity in the desert. Here are the six major uses for effluent in Phoenix. This includes cooling water for the Palo Verde nuclear power plant west of Phoenix.

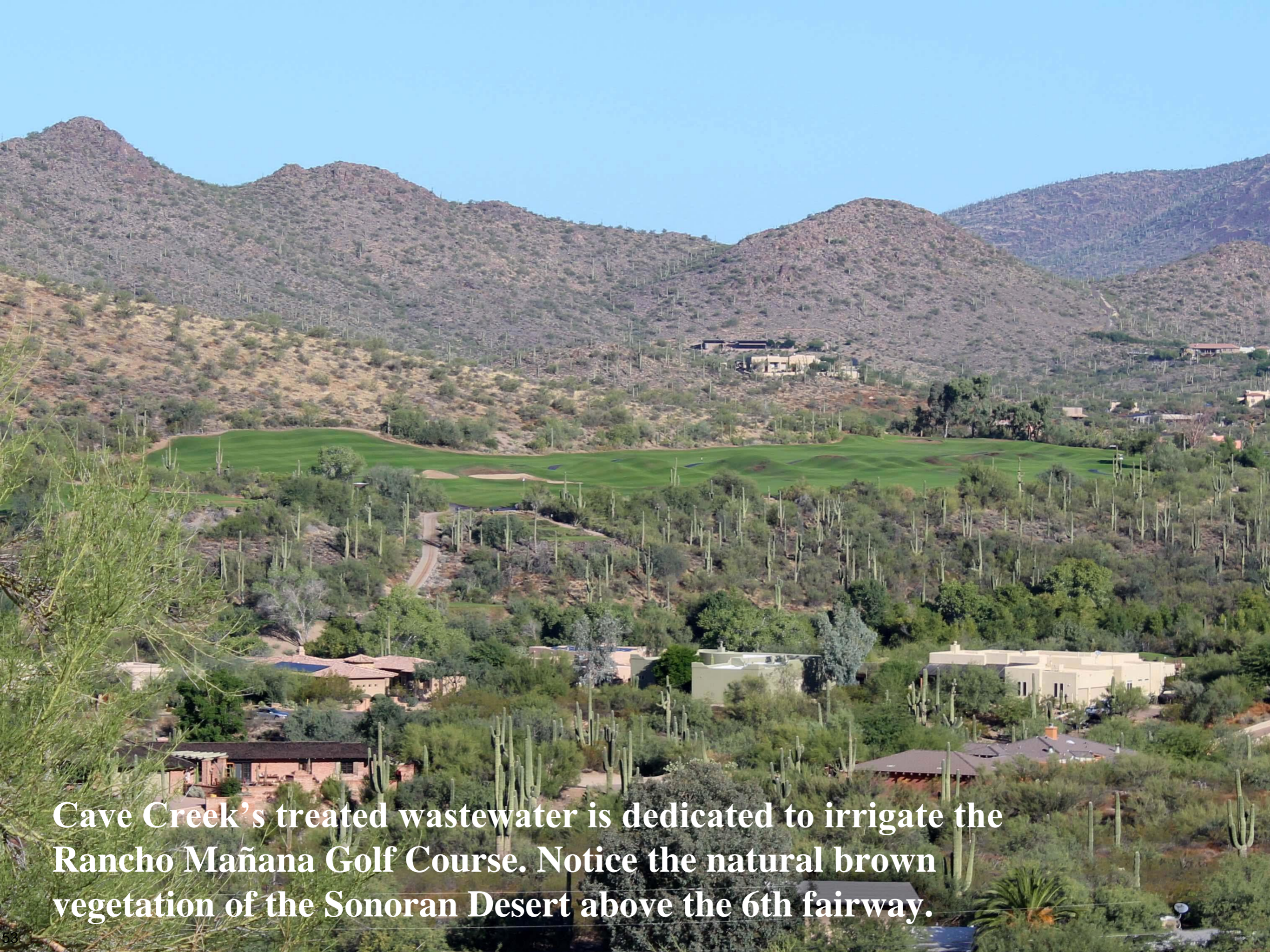
In fact, reclaimed water can be made more pure than traditional potable water supplies such as groundwater and surface water.

Supplying potable reclaimed water is being explored in Phoenix and other valley cities. This water fountain at the “end of the line” in Scottsdale’s very high-tech demonstration water purification facility.





The Cave Creek wastewater treatment plant is located along Carefree Highway.



Cave Creek's treated wastewater is dedicated to irrigate the Rancho Mañana Golf Course. Notice the natural brown vegetation of the Sonoran Desert above the 6th fairway.

Part 5

Follow the Colorado River



The Colorado River starts high in the Rocky Mountains of Colorado.

It is not a large river. It drains 8% of the United States, but has only 1.2% of the water volume. Yet the Colorado River serves 40 million people.

The Columbia River has the same size watershed as the Colorado, but carries 12 times as much water.

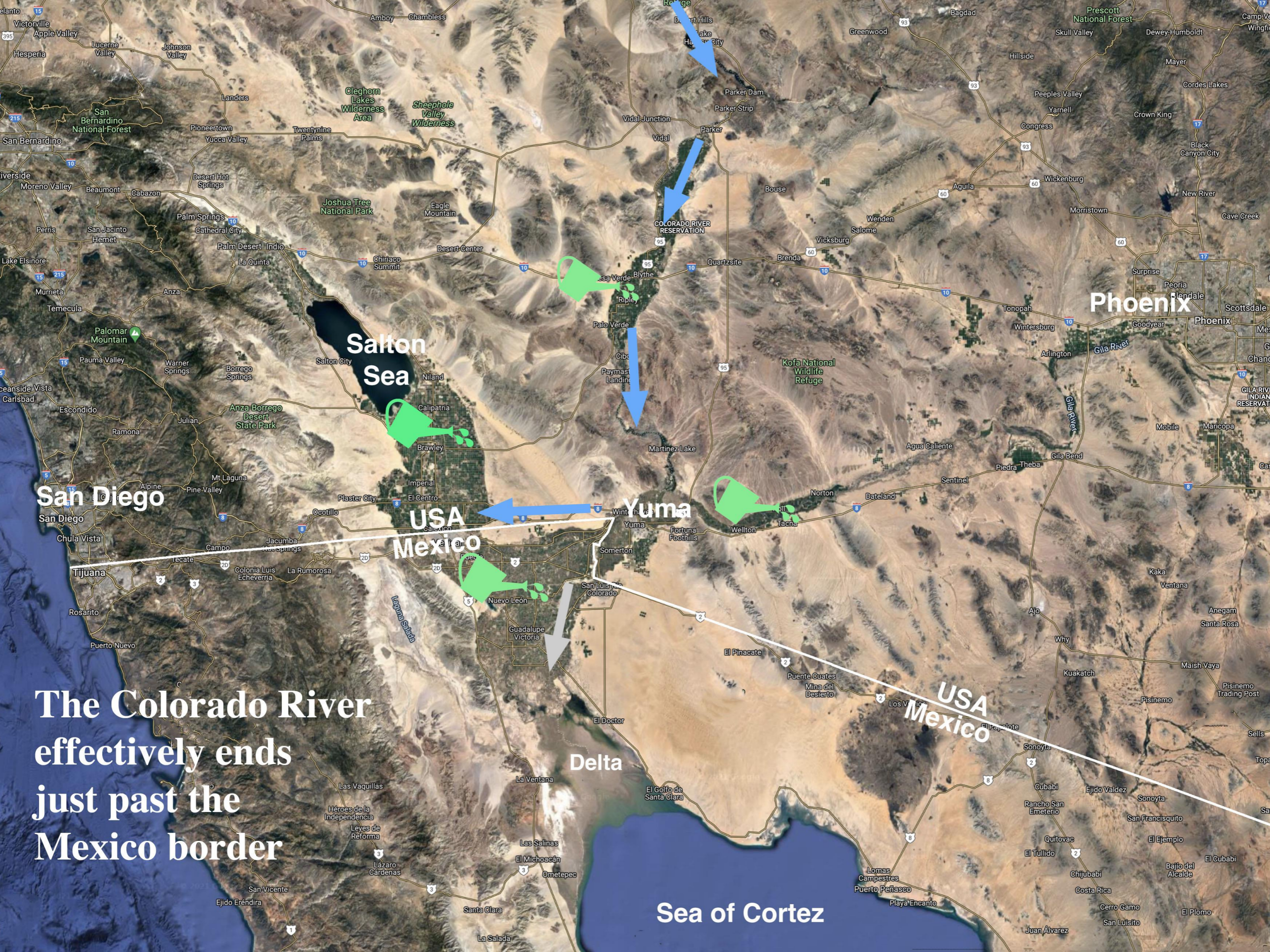
85-90% of the total water in the Colorado River comes from annual snowpack in the Rocky Mountains. Between there and Mexico it is completely used up.



Loveland Pass, CO.

After the Colorado River leaves the Rockies, discharge begins to decrease.





Phoenix

Salton Sea

San Diego

USA Mexico
Yuma

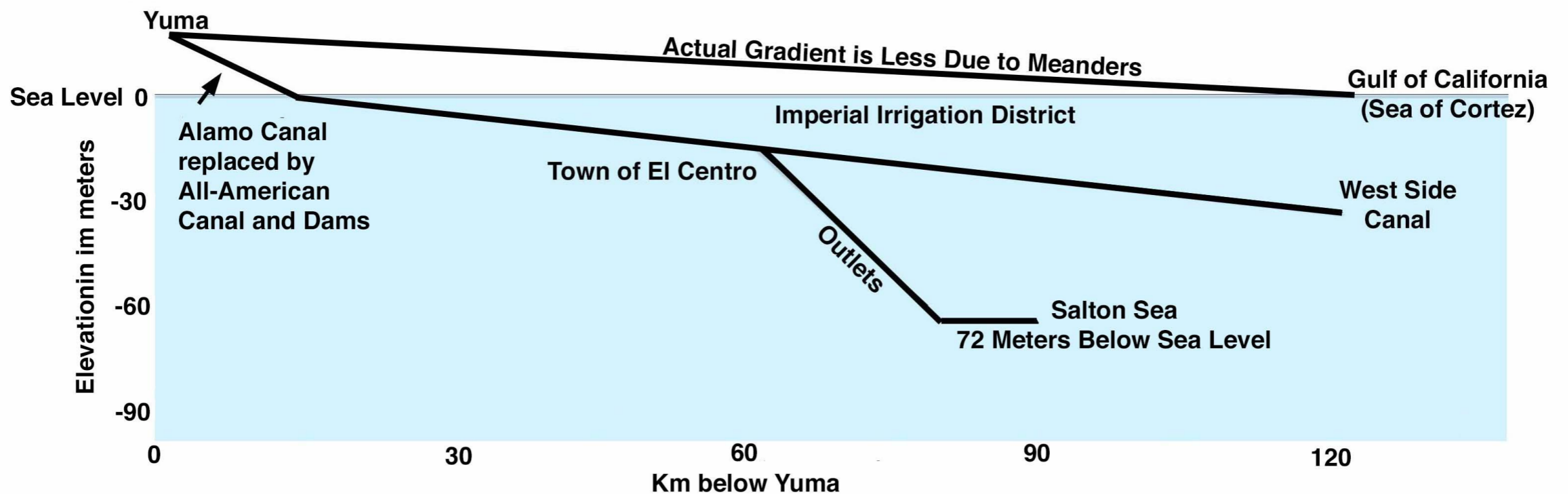
The Colorado River effectively ends just past the Mexico border

Delta

Sea of Cortez

USA Mexico

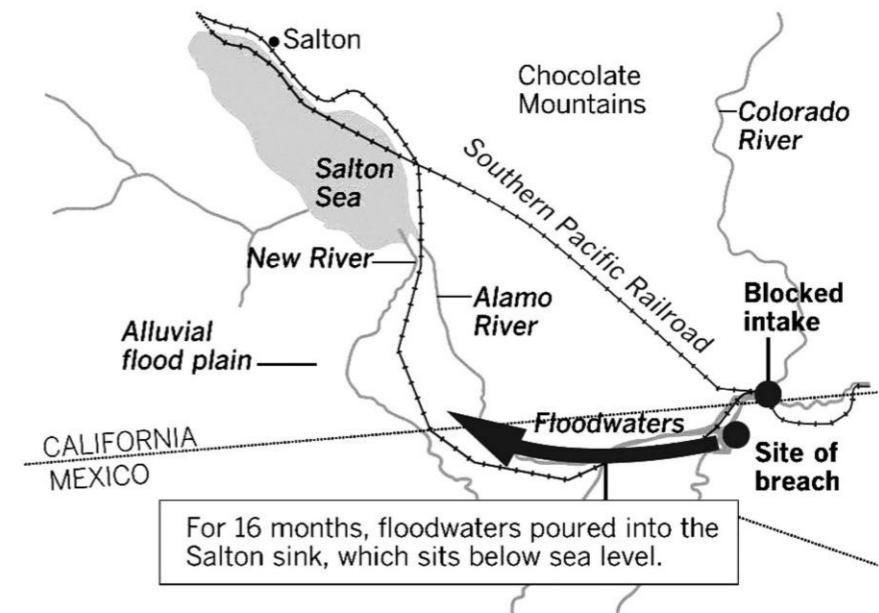
A profile of the Colorado River below Yuma shows that the gradient is steeper west into the Imperial Valley than it is to its natural terminus into the Sea of Cortez.



Note that the path down the Alamo Canal is steeper than the path out to the Sea of Cortez. That's why the whole river so easily jumped into the Alamo Canal and made the Salton Sea.



Demise of the Alamo Canal



The original canal to irrigate California's Coachella/Imperial Valley was built in 1900. Floods overwhelmed the intake from 1904 to 1906. Flooding created the Salton Sea, 200 feet below sea level. It was replaced by the All-American Canal with better control gates.



Salton Sea

California's Imperial Valley, along with nearby Yuma, Arizona irrigation lands, provide most of the winter vegetables for the whole United States.

**The Last Diversion is at the
Morelos Dam just inside Mexico.**

**USA
Mexico**

**Colorado
River**

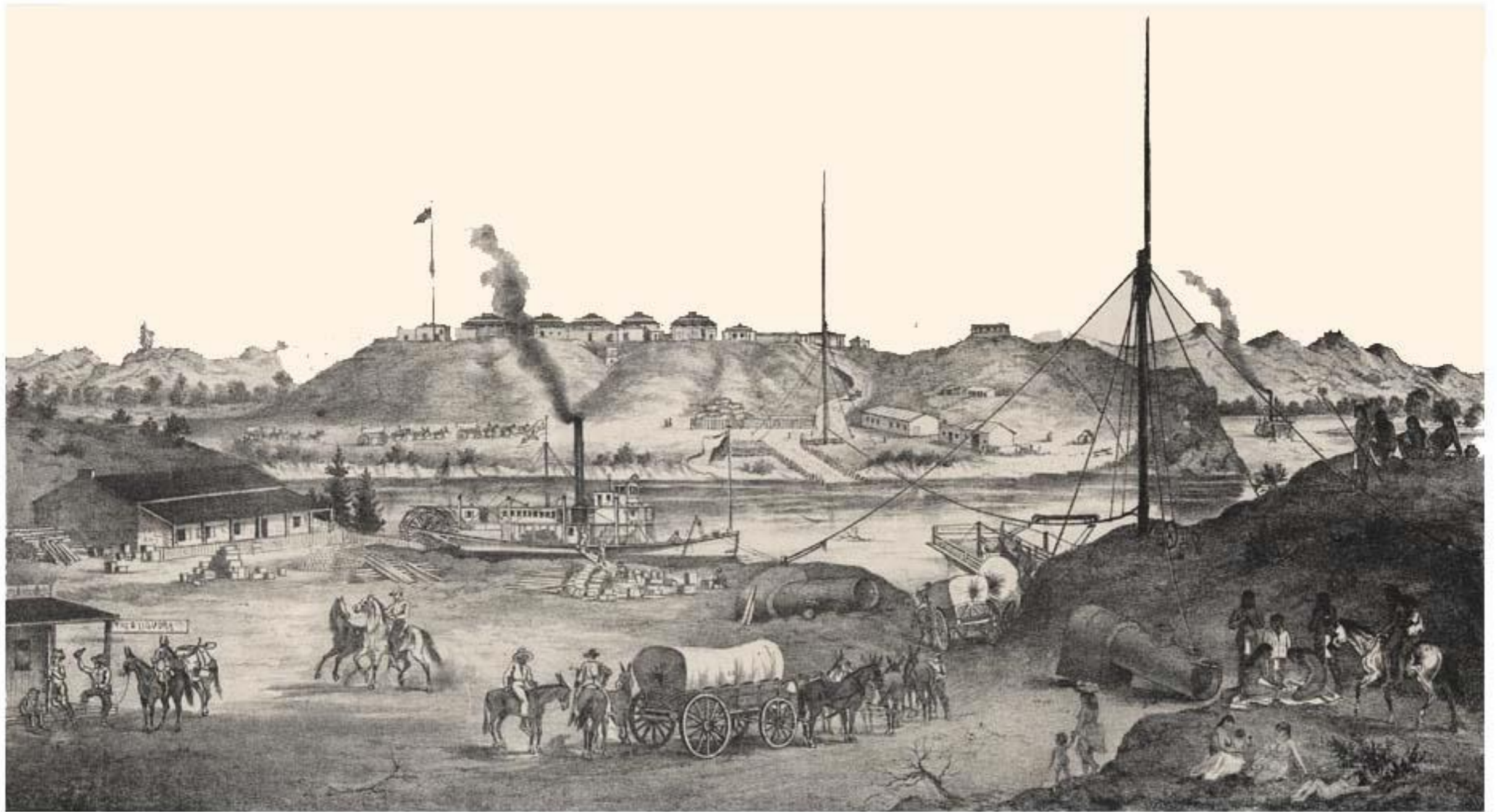
Morelos Dam

Irrigation Canal

Usually Dry River Bed

Part 6

The Colorado River in History



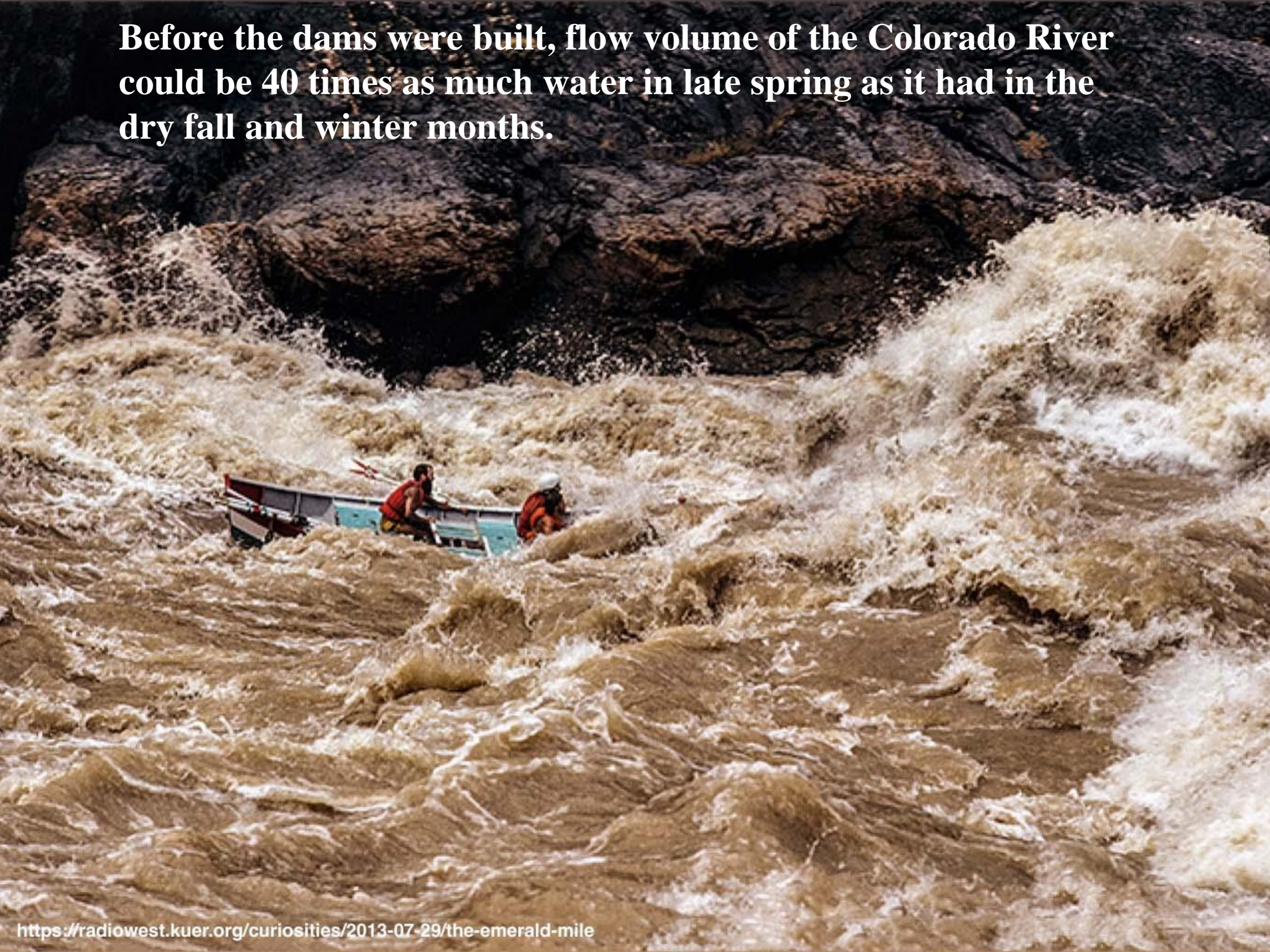
FORT YUMA COLORADO RIVER CALIF

From 1852 to 1909 shallow draft boats could travel 300 miles up the Colorado River past present day Las Vegas depending on water flow conditions.



River discharge is low above the major dams, until the the spring and summer Rocky Mountain snow melt.

Before the dams were built, flow volume of the Colorado River could be 40 times as much water in late spring as it had in the dry fall and winter months.



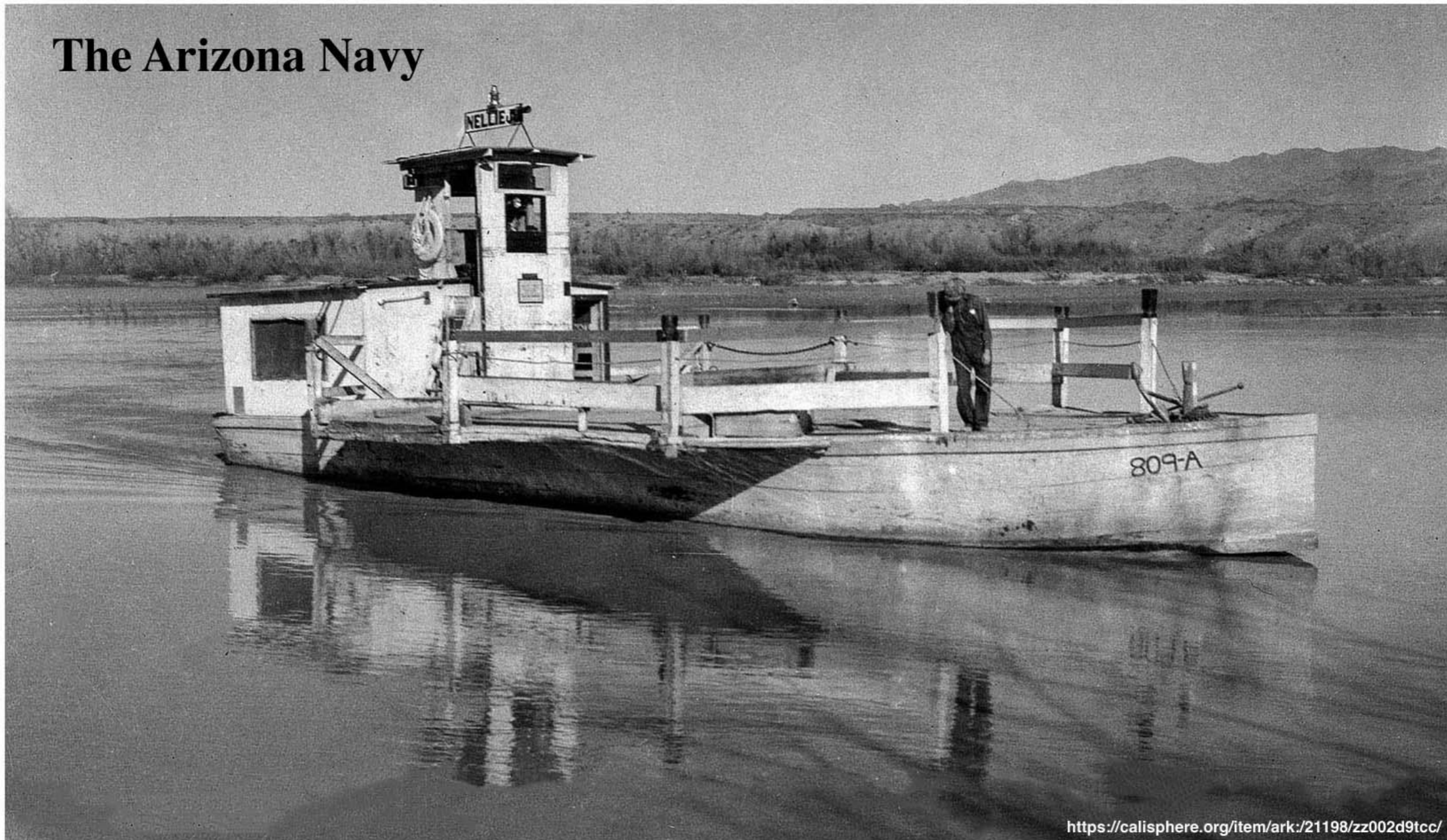


California needed Hoover Dam to even out the extremes in discharge of the river. This allowed controlled flow into the Imperial Valley and the intake of the California Aqueduct carrying water to California cities.



After Hoover Dam was finished, the government started to build Parker Dam as a place to start the California Aqueduct. The cities of Los Angeles and San Diego were growing quickly with very little surface or ground water.

The Arizona Navy

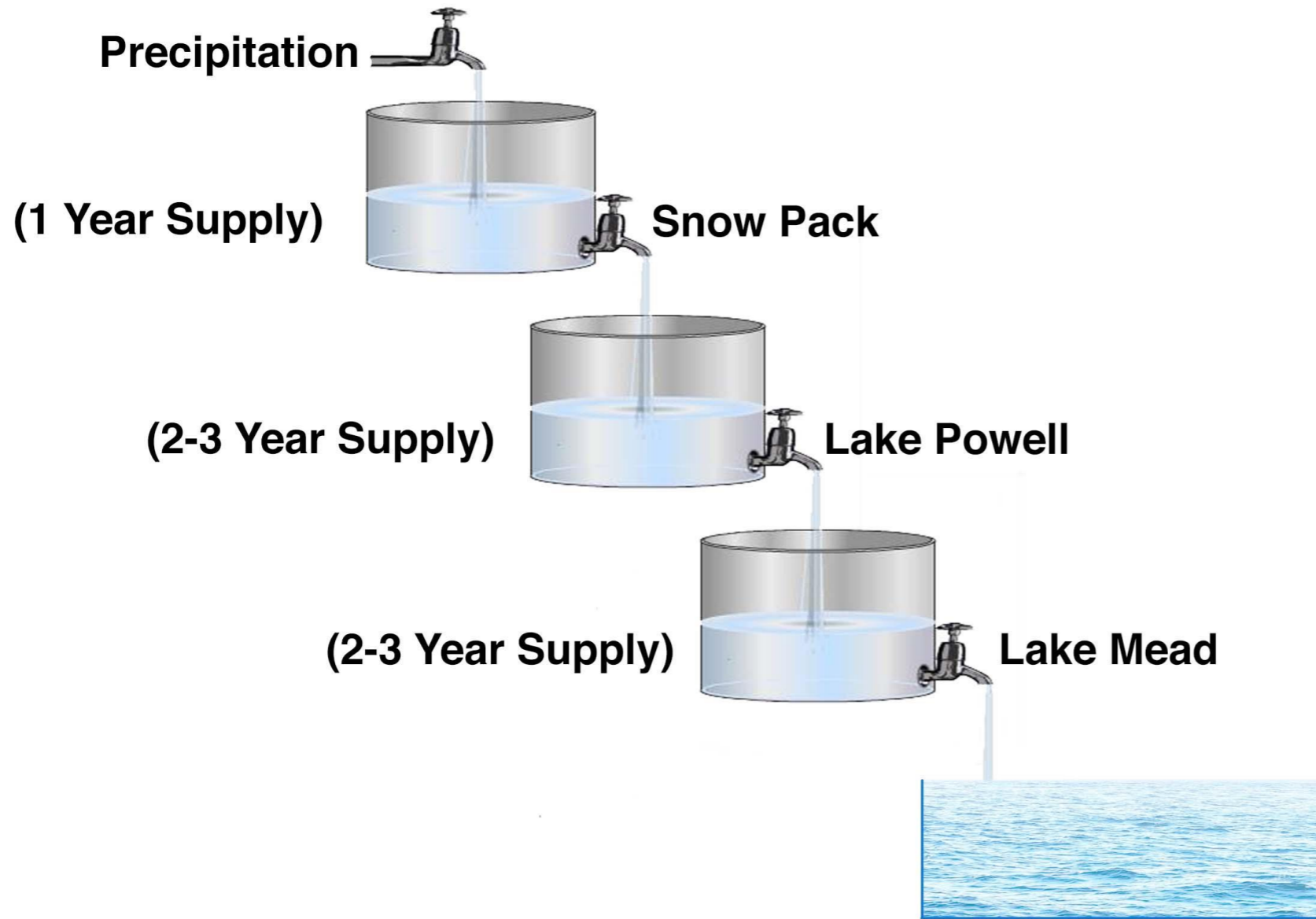


<https://calisphere.org/item/ark:/21198/zz002d9tcc/>

In 1934 Arizona Gov. Benjamin Baker Moeur declared martial law because the government did not have permission to anchor Parker Dam on the Arizona side. He called out the National Guard with 40 riflemen and 20 machine gunners to defend Arizona's water. Arizona had no way to pump it's water up to where it was most needed. But it didn't want California to steal the Arizona allotment. Two ferry boats owned by "Navy Admiral Nelle T. Bush" became entangled by cables and had to be rescued by "the enemy;" California.

Part 7

The Colorado River as a Storage System



**Approximate loss
to evaporation:
15-20% of a one
year supply**

**Arizona, California, Mexico
& The Sea of Cortez**

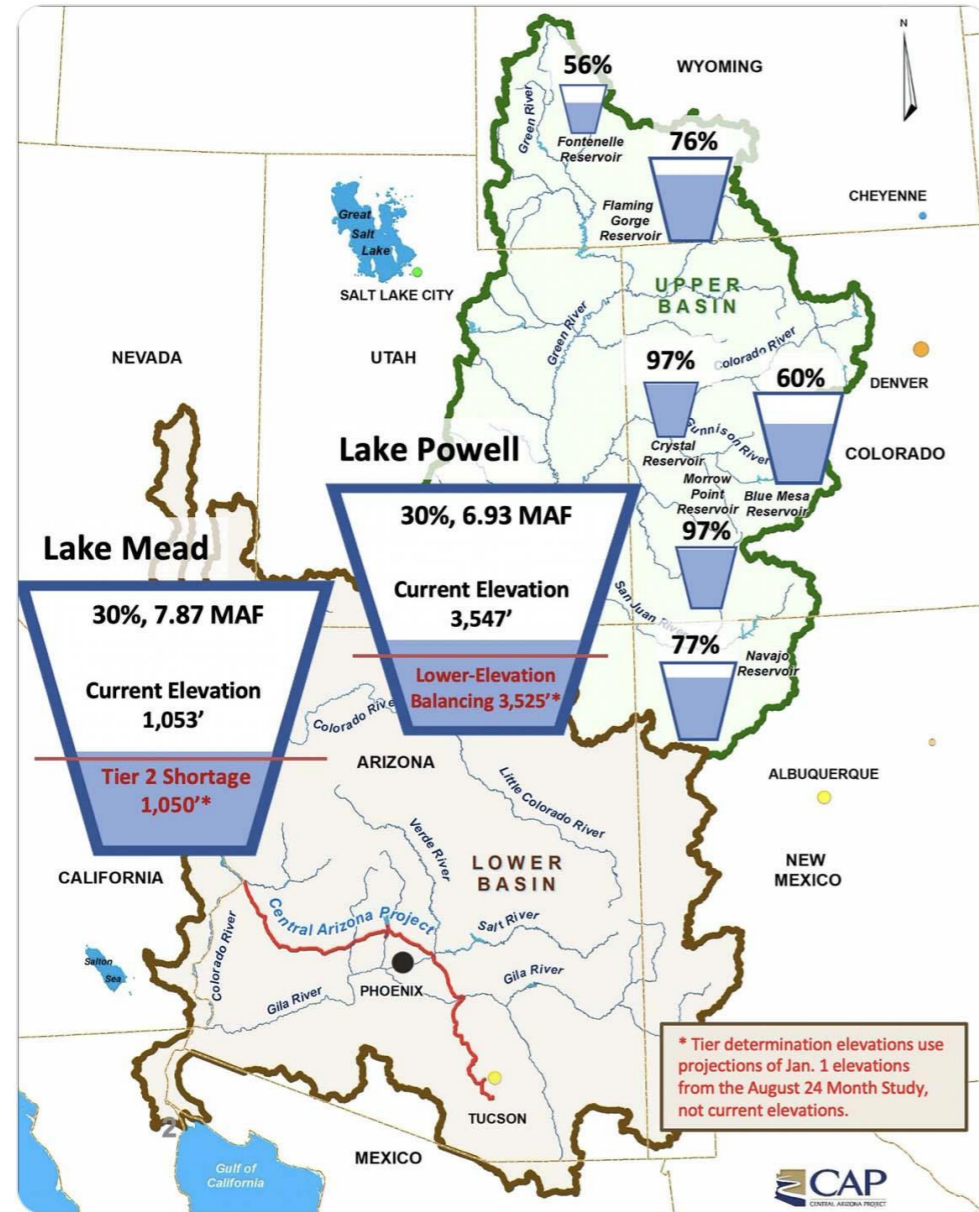
This is a simplified model of the Colorado River as a storage System from the Rocky Mountains to the Sea of Cortez. Water lost to evaporation, now estimated as 1/8 of the water, is not shown.

COLORADO RIVER WATER SUPPLY REPORT

System Contents*: 21.92 MAF

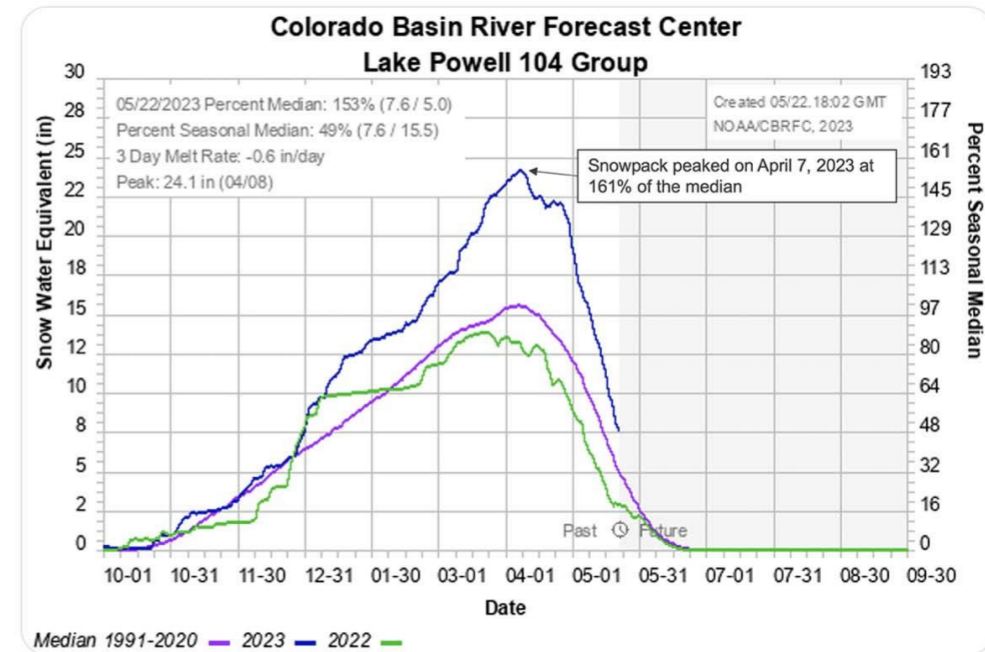
As of May 22, 2023

Last Year System Contents: 20.44 MAF

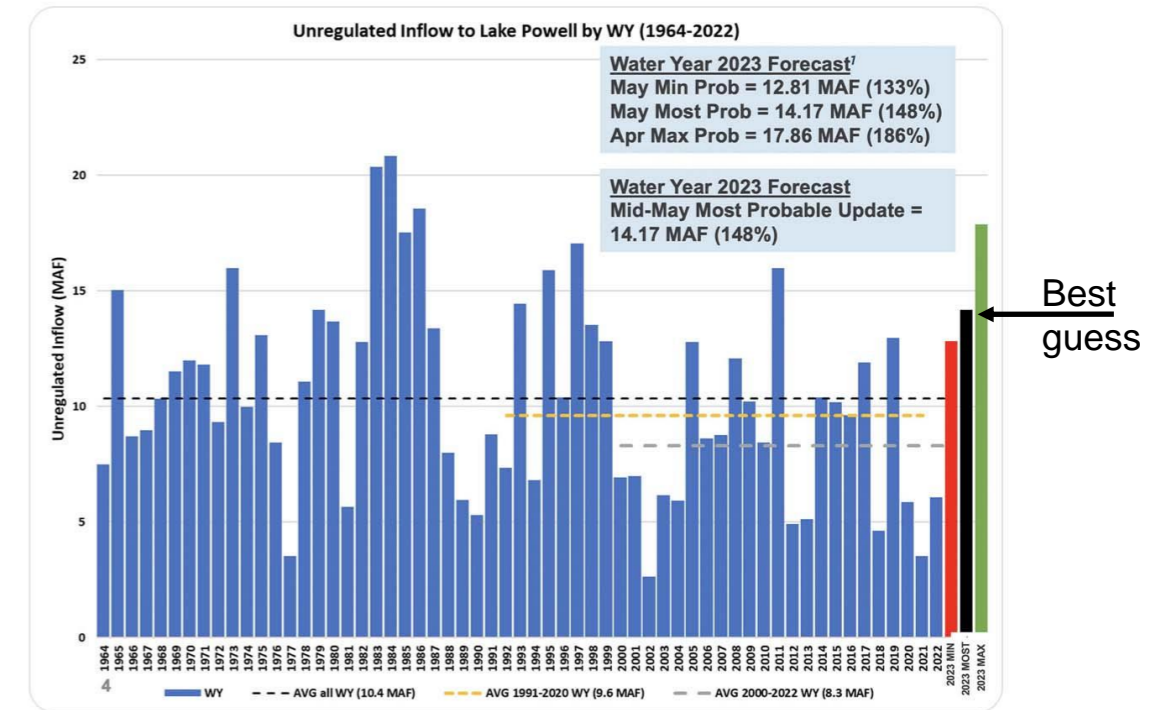


System contents include Reservoirs Flaming Gorge, Fontenelle, Navajo, Blue Mesa, Morrow Point, and Crystal, and Lakes Powell, Mead, Mohave and Havasu and is shown in million acre-feet (MAF).

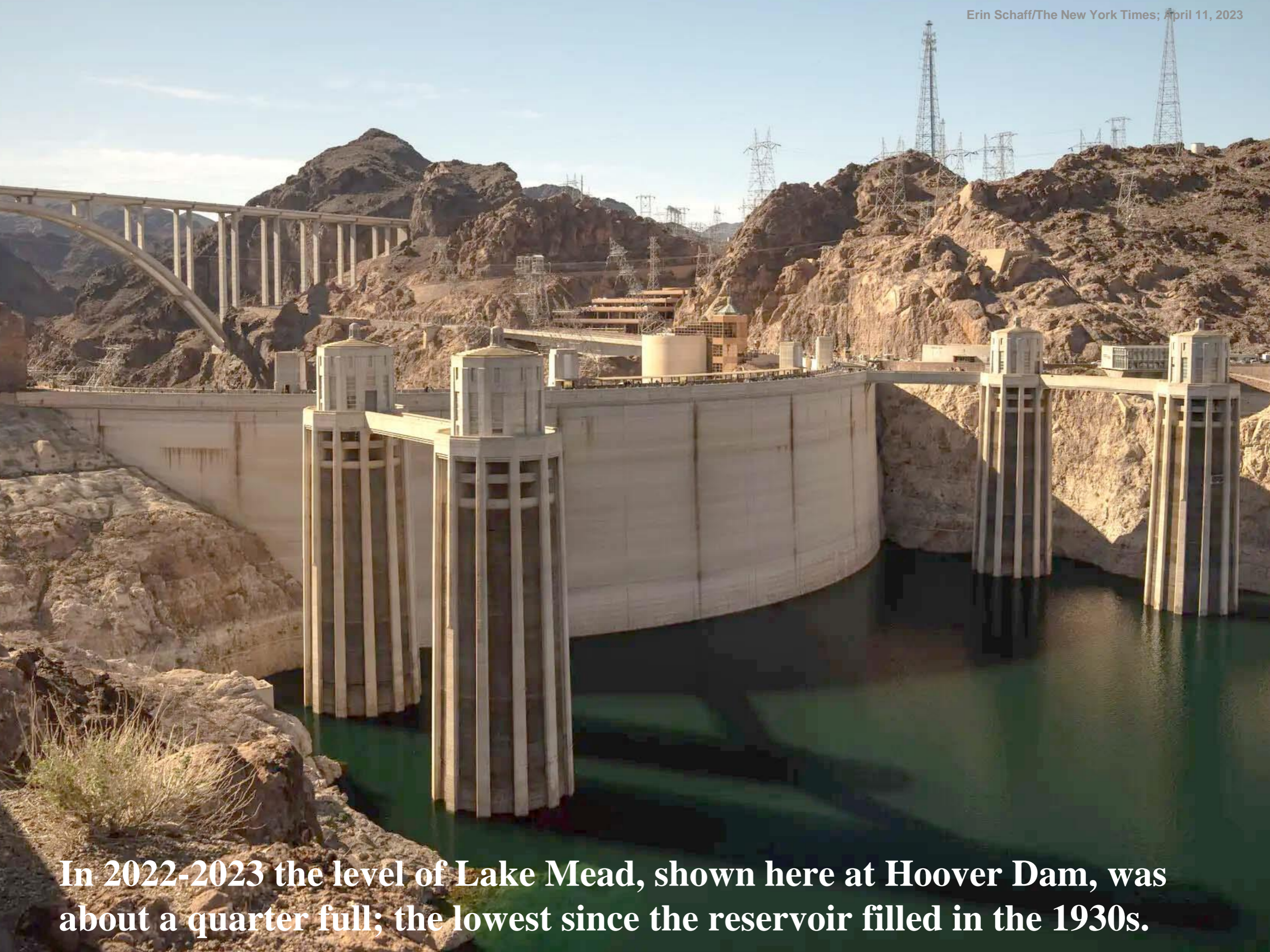
SNOW ACCUMULATION



UNREGULATED INFLOW TO LAKE POWELL



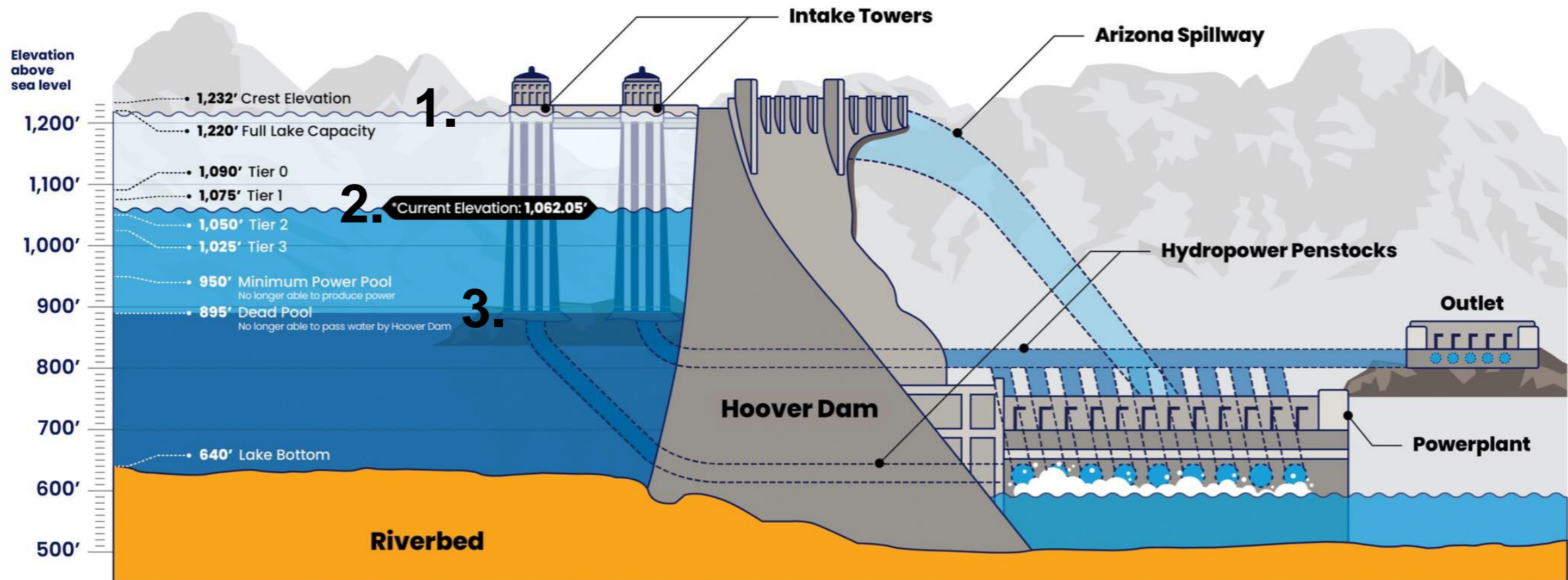
These graphics show that 2023 was an excellent year for mountain snowfall. But much of the snow evaporated due to climate change.



In 2022-2023 the level of Lake Mead, shown here at Hoover Dam, was about a quarter full; the lowest since the reservoir filled in the 1930s.

HOOVER DAM

Key Elevations



NOT TO SCALE: *Current Elevation as of August 8, 2023

Notable elevations of Lake Mead at Hoover Dam

1. Full Lake Capacity (It was near this level in 1983 and 1999)
2. Elevation in August, 2023, after our 20+ year drought
3. Dead Pool (Below this level no water can pass through.)

(Note that because of the shape of the bottoms of the reservoirs, Dead Pool is far below half full.)

In May 2022 the ramp of the Lake Powell Bullfrog to Halls Crossing ferry had been closed for years. At capacity, the water would be close to the blue sign, and most of the land you see here would be under water.



Part 8

The Law of the River

The Law of the River:

The “Law of the River” is a huge accumulation of regulations consisting of scores of compacts, federal laws, court decisions, joint decrees, contracts, and regulatory guidelines worked out among the seven Colorado River Basin States. Conflicts among the regulations abound.

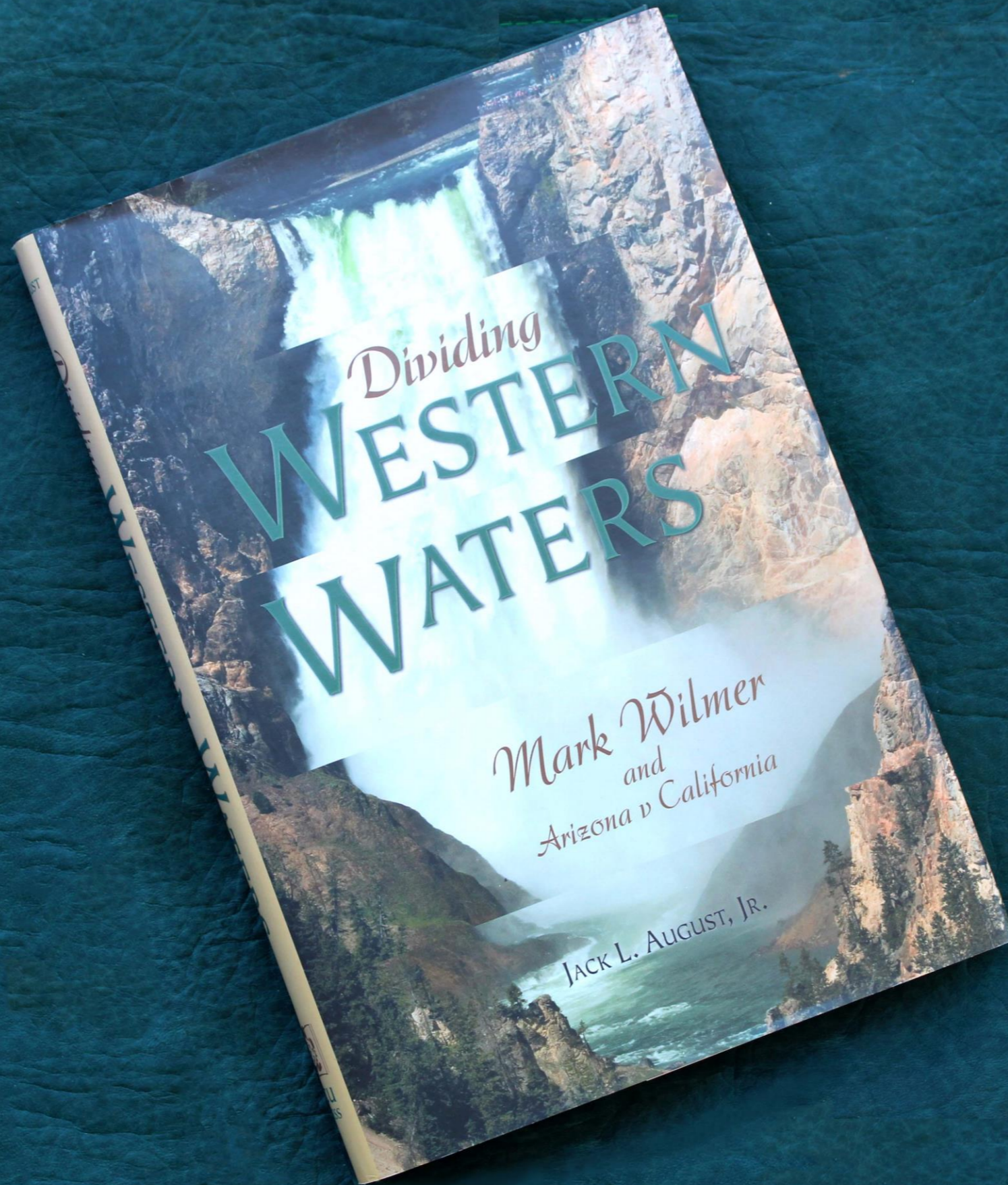
Since 1922, as conditions and needs have changed, it is in a constant state of flux.

It can be a lawyer’s dream or nightmare.

(“Water’s ‘fer fightin’ over.”)



A good read



**Eastern United States Water Law - Riparian Rights:
You “borrow” water by virtue of your shoreline property.**



Western United States Water Law - Prior Appropriation:

“First in time, First in right.” (Water as a commodity)

California



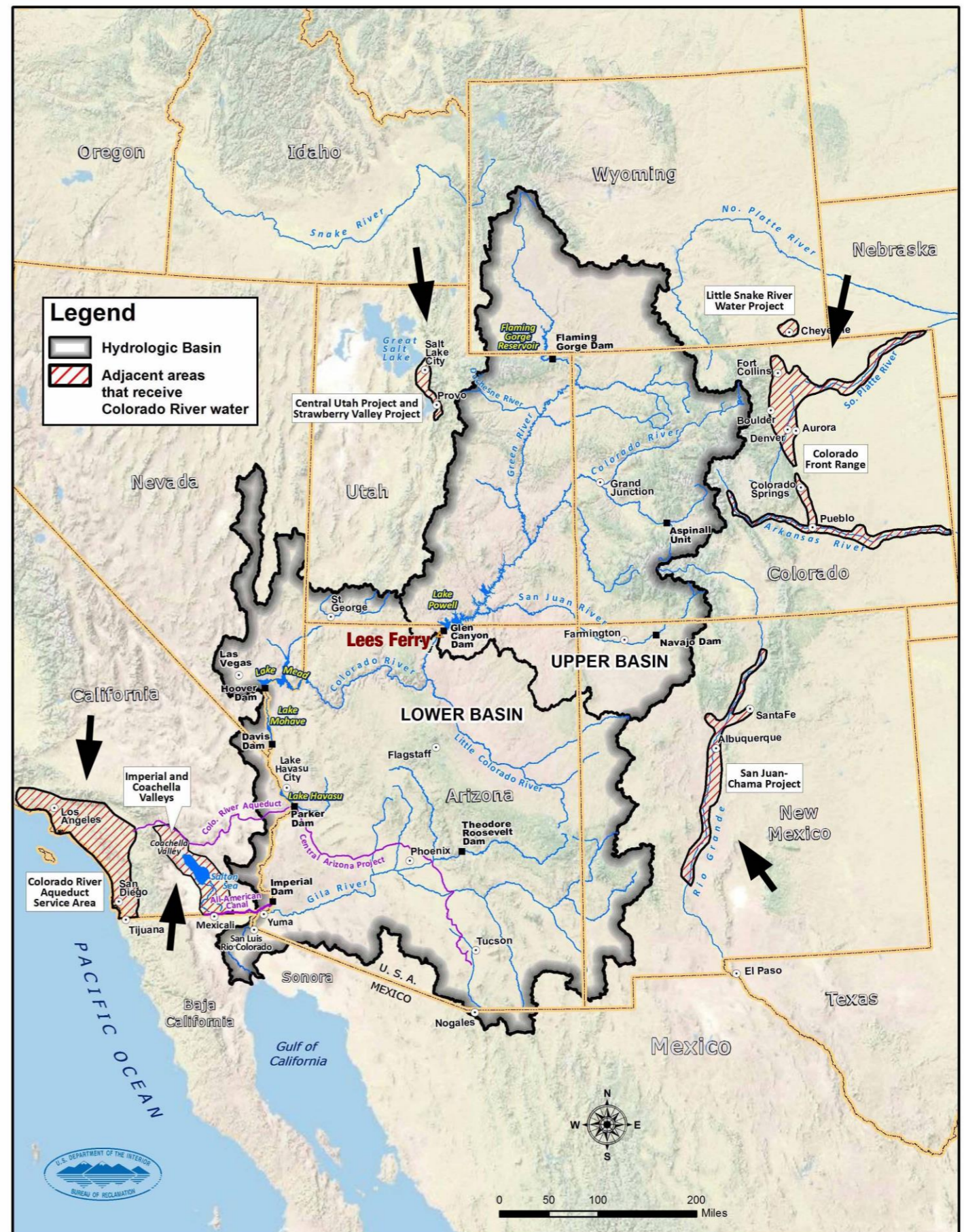
Arizona



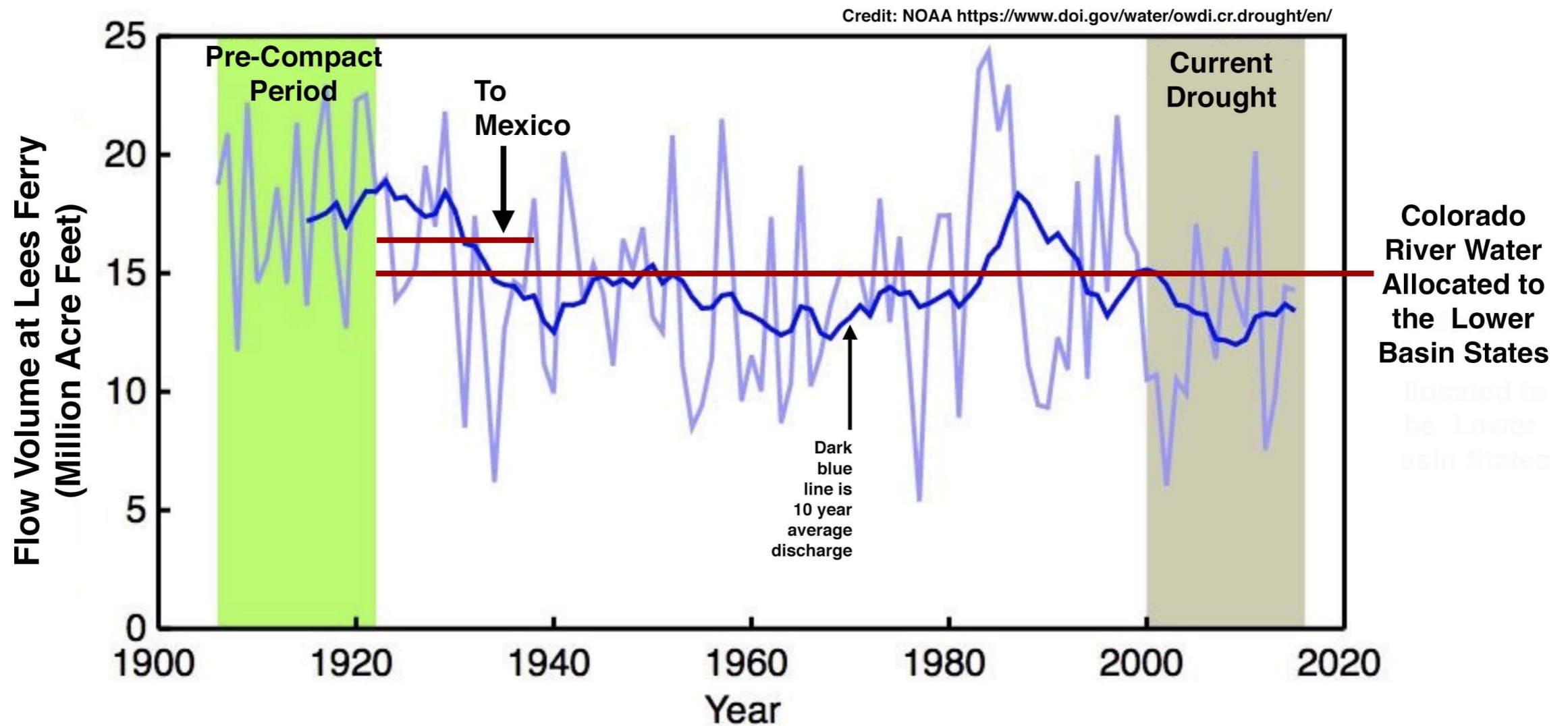
The Colorado River Compact of 1922 divided the watershed into four Upper Basin States and three lower basin states. The boundary is at Lees Ferry.

The upper basin states were expected to send 7.5 million acre feet (MAF) of water to the lower basin states.

Arizona did not initially sign the Colorado River Compact due to inclusion of the Gila River. But Arizona later claimed it was entitled to 2.8 MAF.

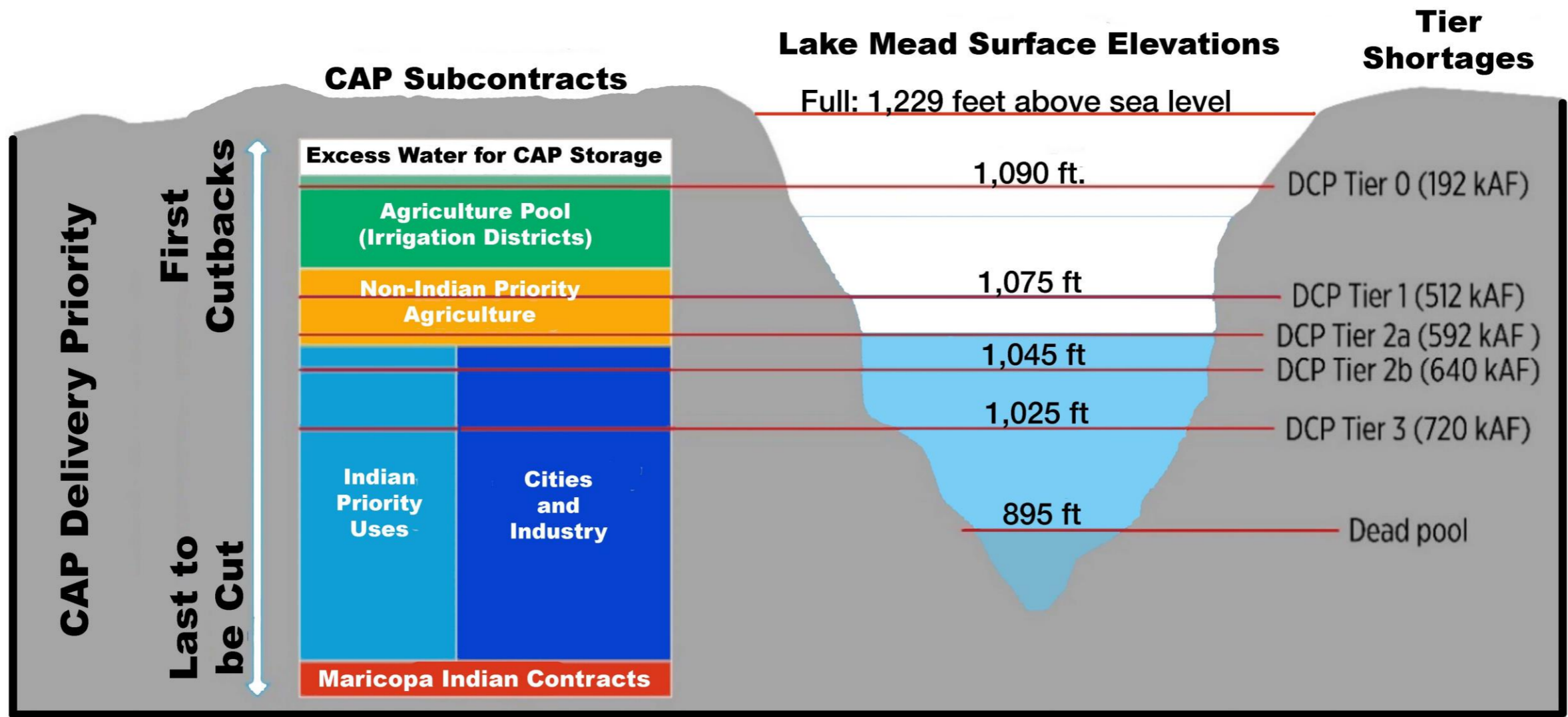


<https://www.usbr.gov/dcp/>



Colorado River water was allocated (red lines) to the states and Mexico based on discharge in the early 1900s. These were relatively wet years. (green) Since then discharge has been lower. (white) But most of the years after 2000 have been drought years. (brown)

Bottom line: the river is over-allocated.



Based on a graphic from the City of Tempe

The colored, left side of this graphic shows user priorities for CAP water. (The highest priorities are on the bottom.) For example, cities and towns and Indian reservations generally have a higher priority than agriculture.

The right side shows various water levels of Lake Mead at which particular users are impacted. They are called Tier levels. Red lines indicate when restrictions can be expected in the various priority groups. As conditions have been changing, so have the Tier level restrictions.

The Secretary of the Interior directed the Basin States to formulate a plan to save 20% of current water use. In spite of conflicting rights, six of the seven states negotiated a preliminary agreement in 2022. But California will not “buy in.” California cites its prior appropriation and senior partner status.





Negotiating Colorado River water is similar to a “zero sum game.” In order for one state to win, someone else must lose. But it’s even worse. The total “pot” (river discharge) is decreasing. The Law of the River gives Arizona a weak hand to play with.

On What Basis Should, or Is, Colorado River Water Apportioned?

1. Prior Appropriation

(California historically used the most in the Imperial Valley.)

2. Water Source

(Colorado contributes the most water from the Rocky Mountains.)

3. Watershed Area

(Arizona, even without the Gila watershed, has the most.)

4. Population

(The population of California nearly twice the population of all the other Colorado Basin states combined.)

5. Dependence

(Arizona and Nevada have the least alternative sources and these are the two states with the greatest growth in population.)

6. Historic

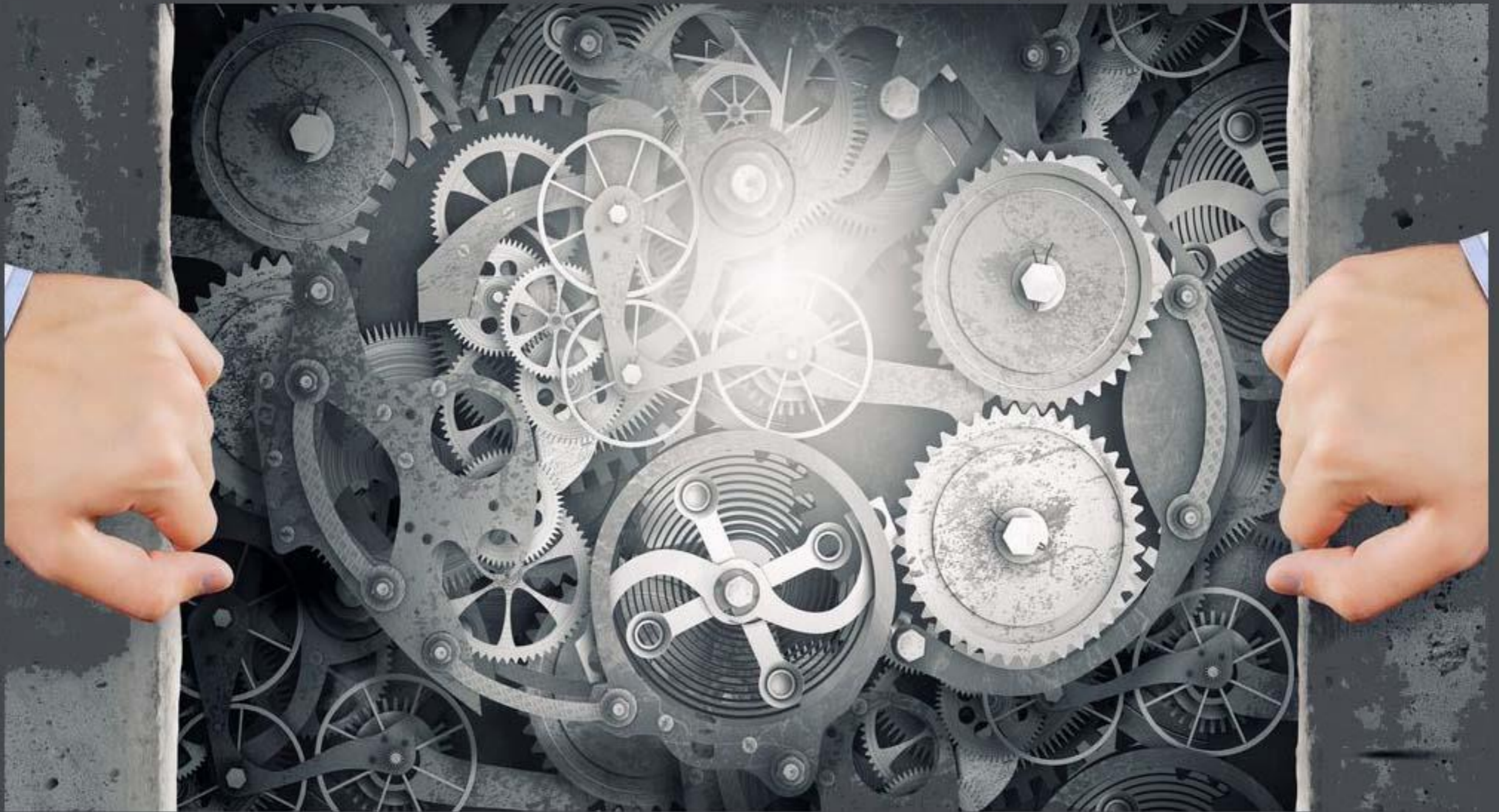
(The Colorado River Compact, Boulder Dam Contract, Arizona vs California.)



These are the suggested Federal “Bookends,” April 2023:

- A. Cut back all Lower Basin states by 25%.
California, the greatest user, would lose the most total water.**
- B. Base reductions on prior appropriation.
Arizona would experience, by far, the greatest loss.**

The final allocations will probably be a hybrid of these two.

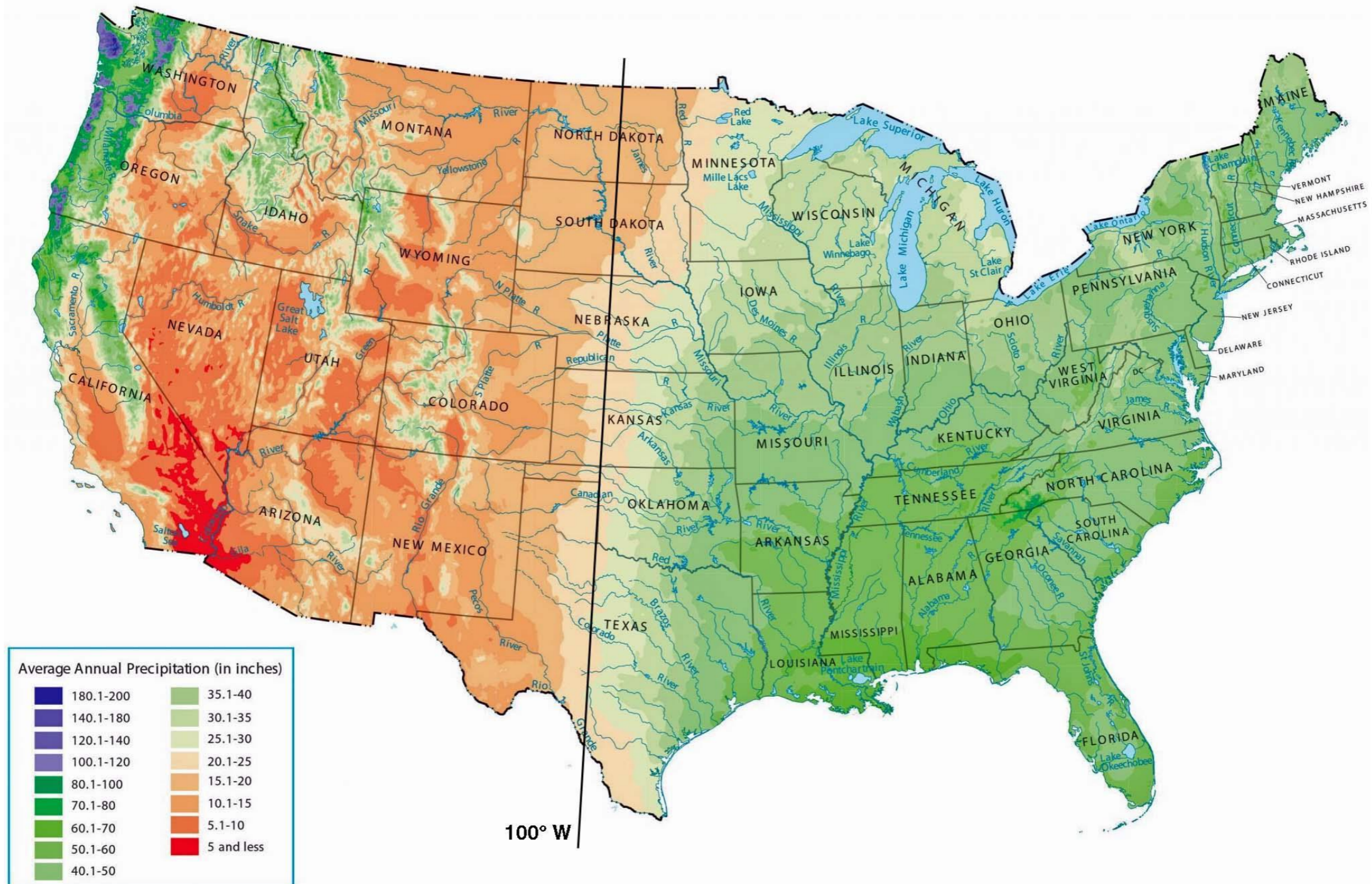


So many moving parts:

- 1. Yearly variations in weather**
- 2. Climate Change/Global Warming**
- 3. Balancing dozens of reservoirs**
- 4. Department of the Interior policy**
- 5. State and tribal allocations**

Part 9

The Bad News and the Good News



John Wesley Powell cited the 100th meridian as separating the moist Eastern climate from a climate requiring irrigation for agriculture.



AUGUST 2010

22 Parks, 3 Proposed Monuments, 1 Million Opportunities

ARIZONA

HIGHWAYS
ESCAPE • EXPLORE • EXPERIENCE

Celebrating
100 YEARS
OF THE
NATIONAL
PARK
SERVICE

DISCOVER
OUR
NATIONAL
PARKS

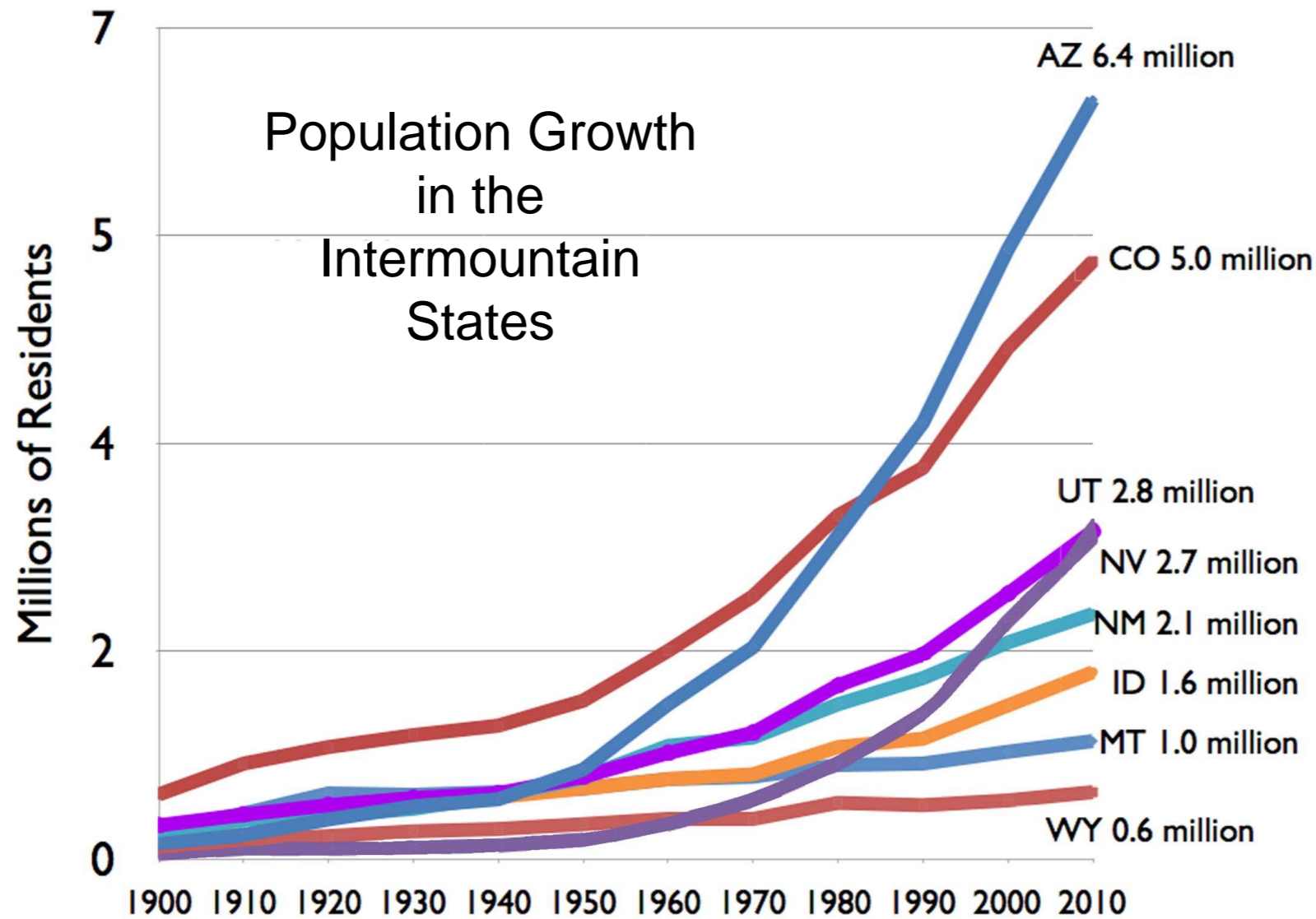
A GUIDE TO ARIZONA'S PARKS,
MONUMENTS, HISTORIC SITES,
RECREATION AREAS & MORE

"National parks are the best idea we ever had." — WALLACE THOMAS

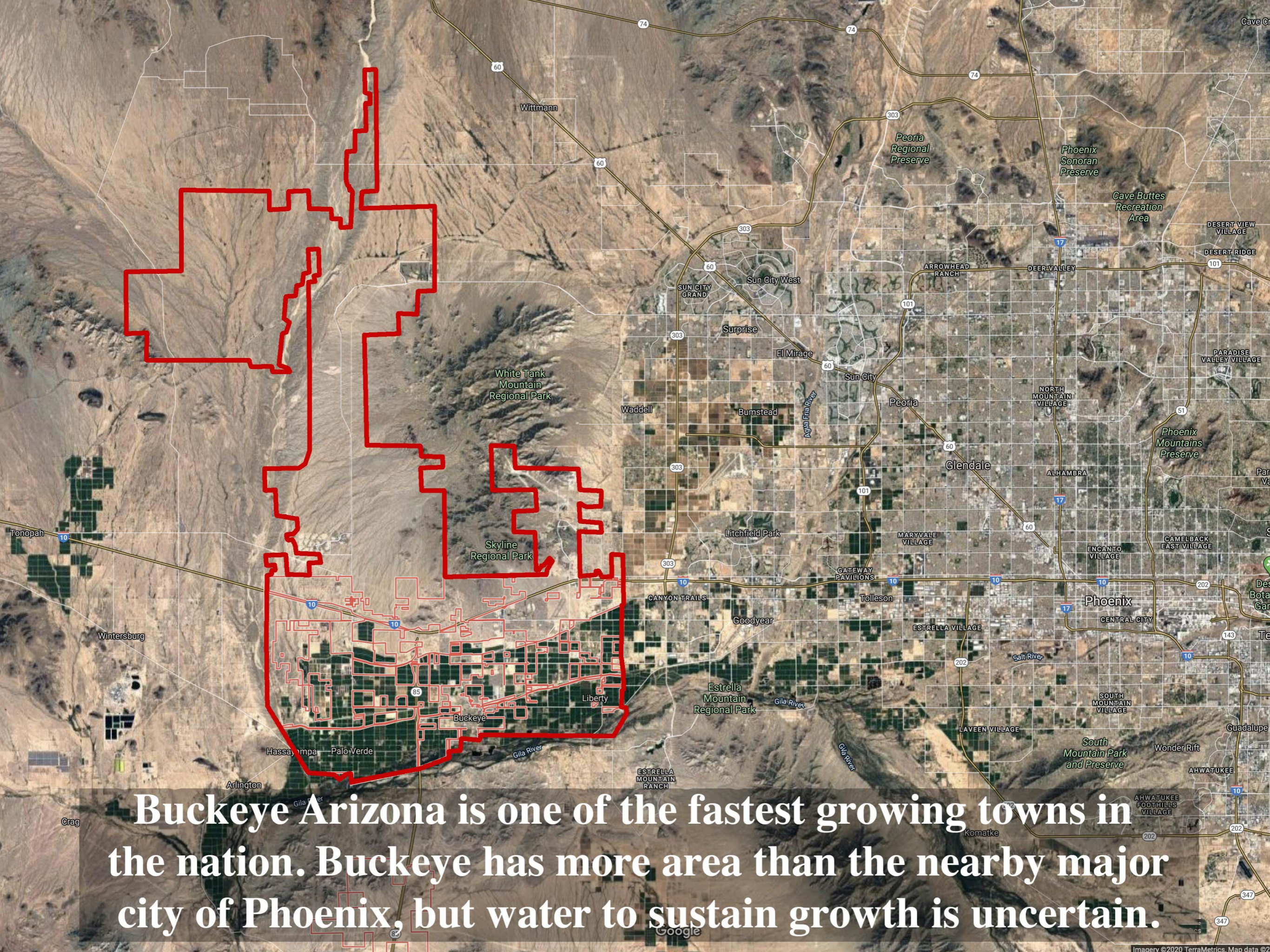
Arizona has done too good a job of convincing people it's a great place to move to.

Arizona Highways Toroweap Overlook, Lower Grand Canyon

Toroweap Point, Grand Canyon National Park

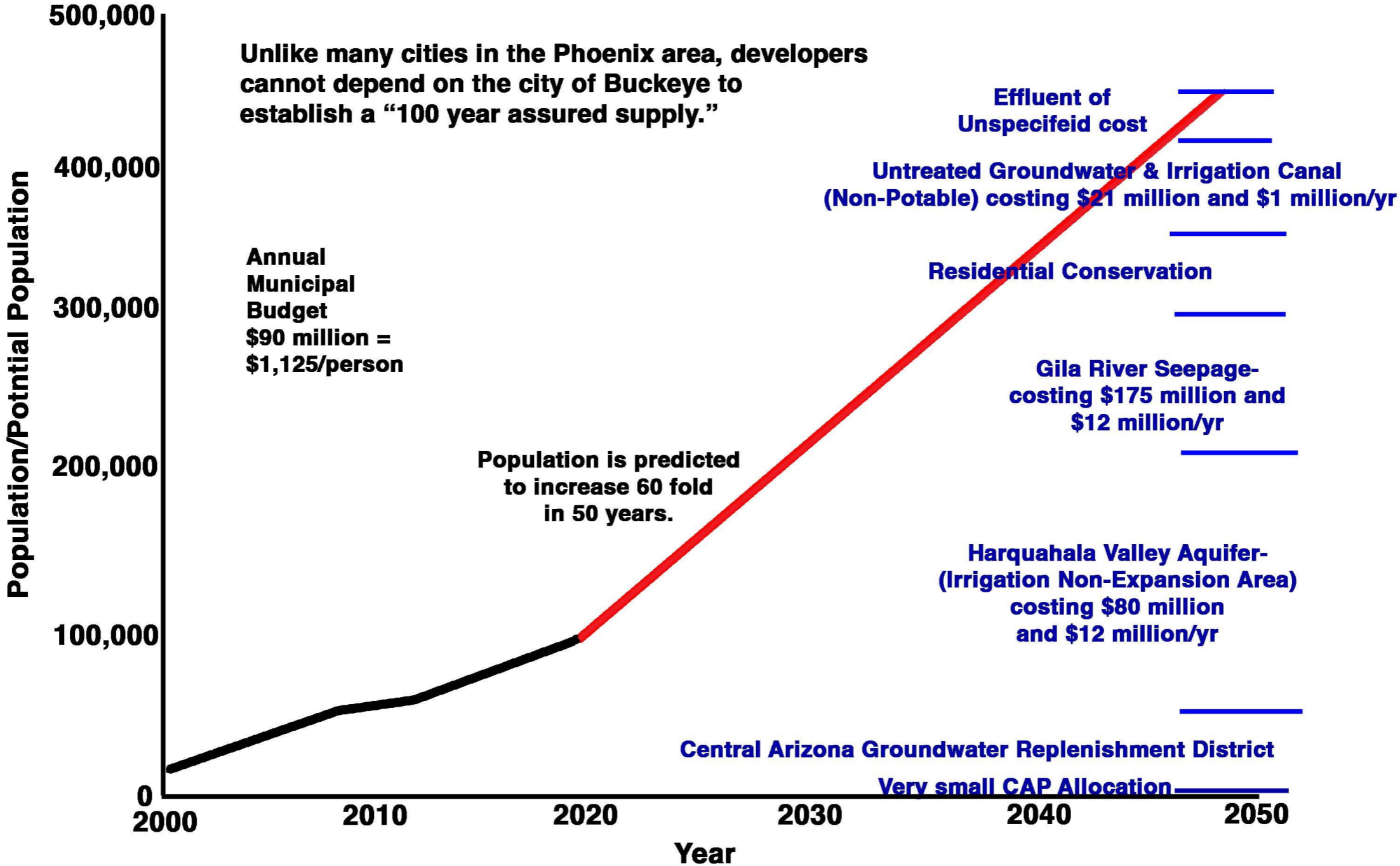


Arizona has the fastest population growth among all the US Intermountain States. Widespread use of air conditioning in the late 20th century had a huge impact on Arizona's growth.



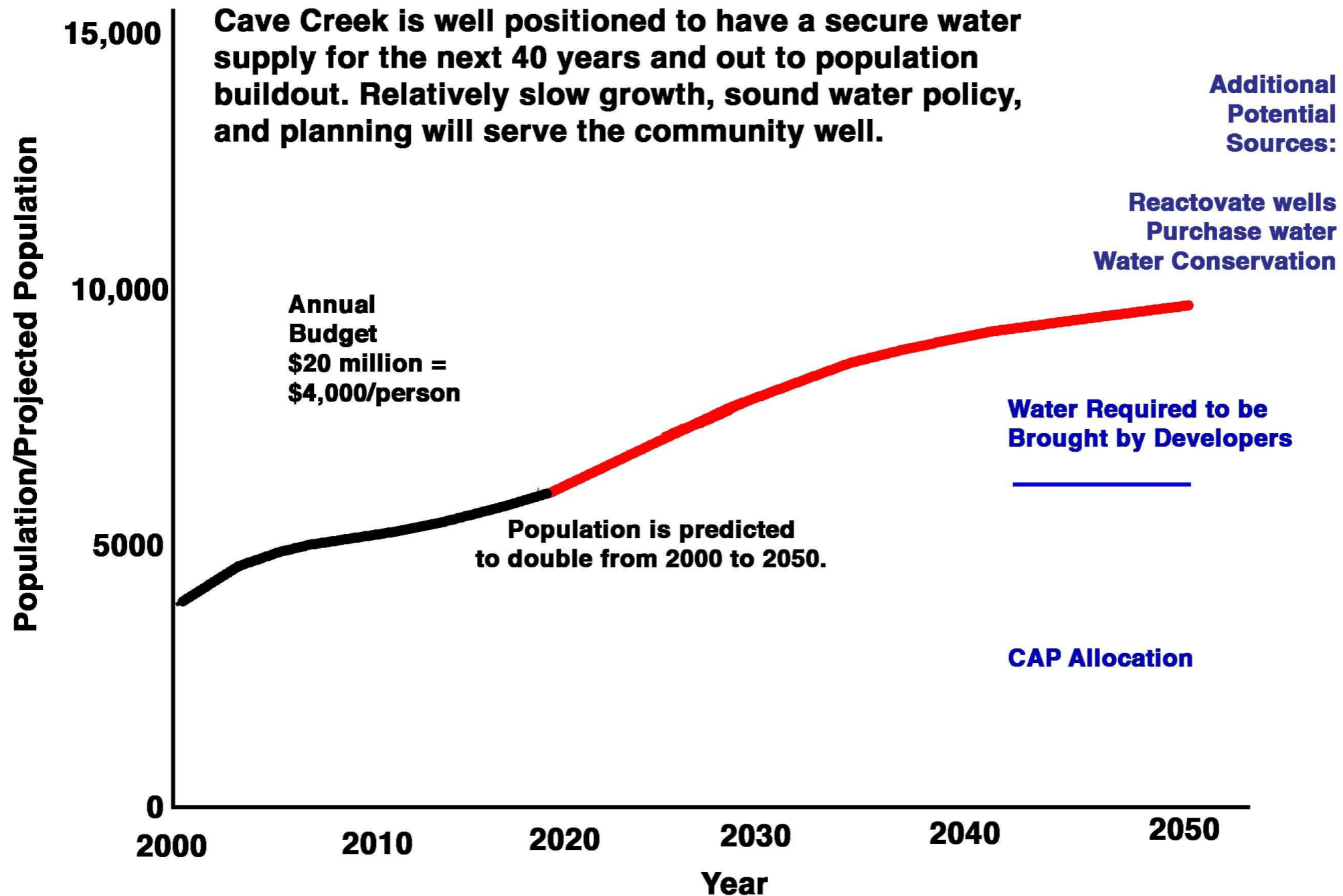
Buckeye Arizona is one of the fastest growing towns in the nation. Buckeye has more area than the nearby major city of Phoenix, but water to sustain growth is uncertain.

Buckeye's Population Growth and Water Supplies 2000-2050

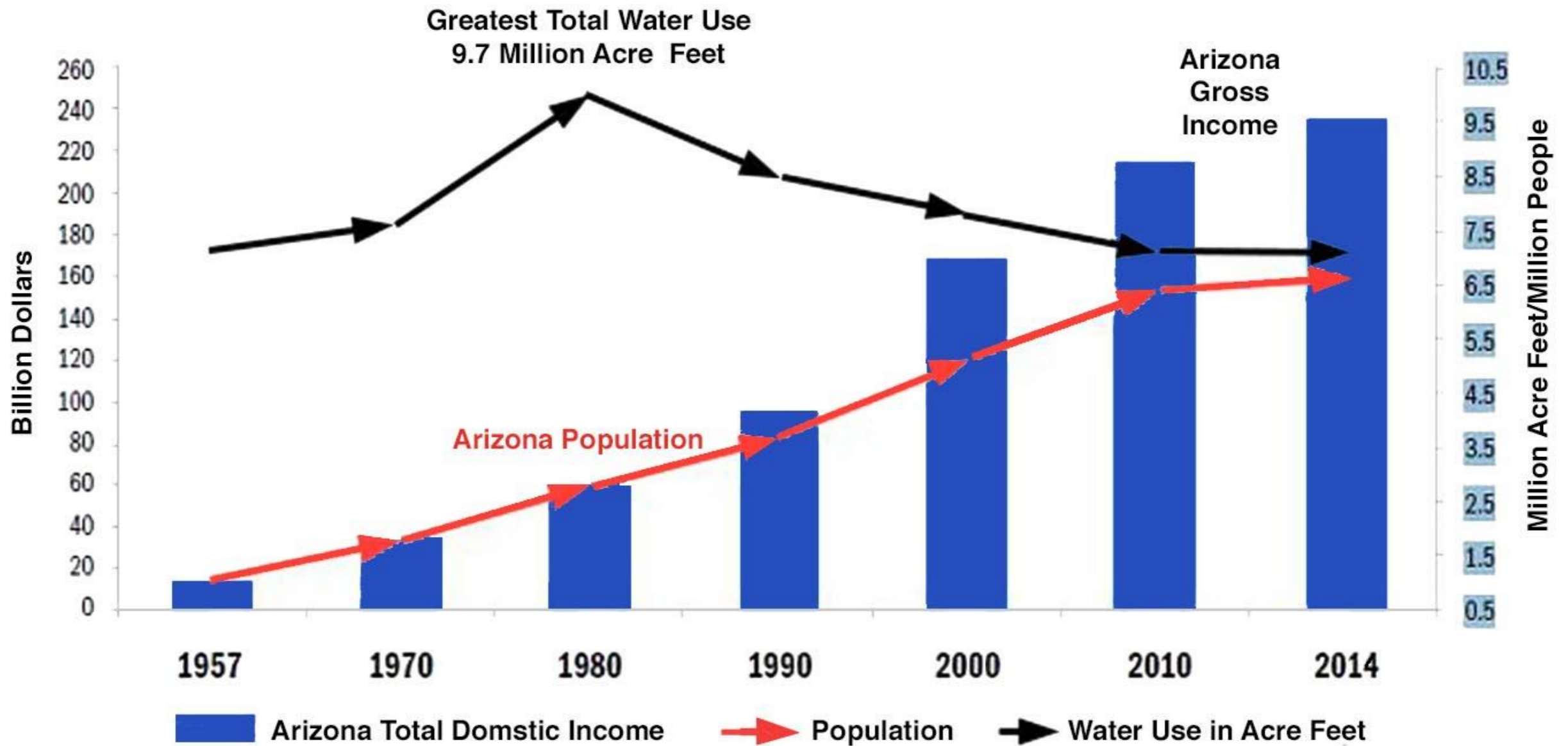


Based on reporting by Jashun Bowling, *Arizona Republic*, March 2, 2020

Cave Creek's Population Growth and Water Supplies 2000-2050

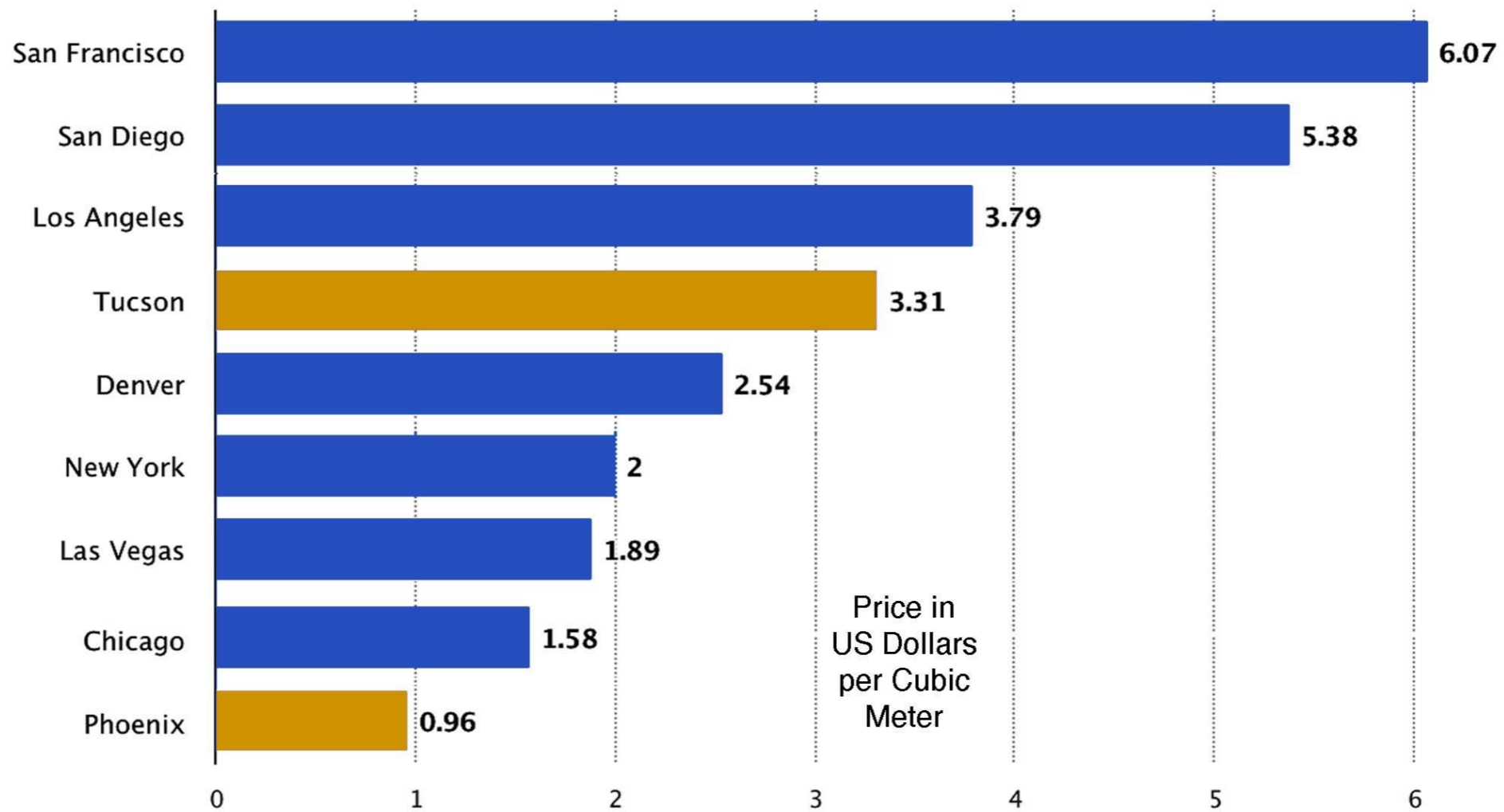


Although the population and gross income of Arizona have steadily increased, water usage in Arizona has actually decreased slightly since the early 1980s as water is being used more efficiently.



Source: Arizona Department of Water Resources, 2014

If water in Arizona is kept relatively cheap, conservation of water by individual Arizona customers will not be a high priority
Compare Arizona rates with the largest cities of California.



Part 10

Solutions

Basically,

Arizona **can't control economic growth and population.**

Arizona **can't control how much water is available.**

Arizona (alone) **can't control climate change/global warming.**

But we **can control how our water is used.**

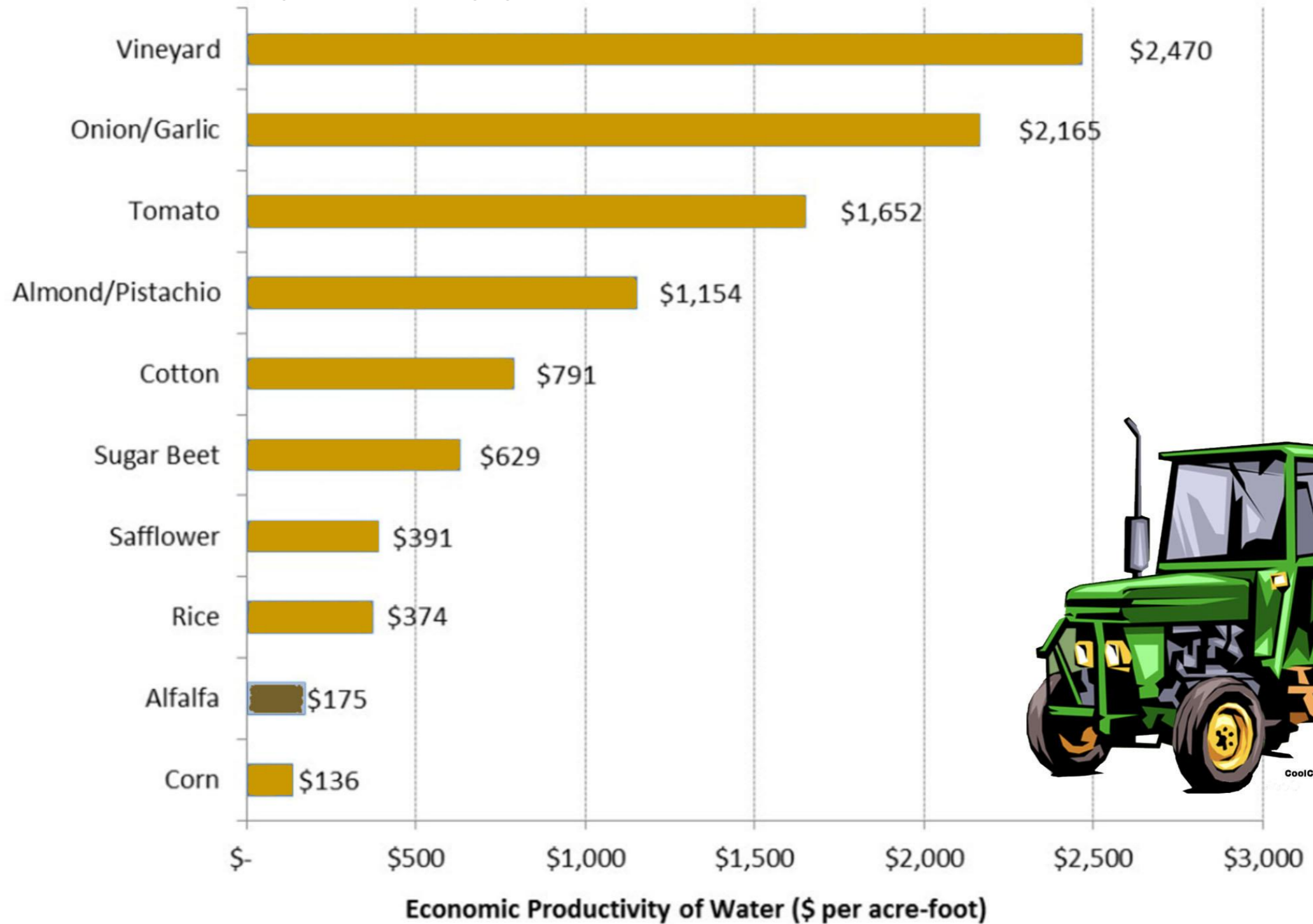
Xeriscape:

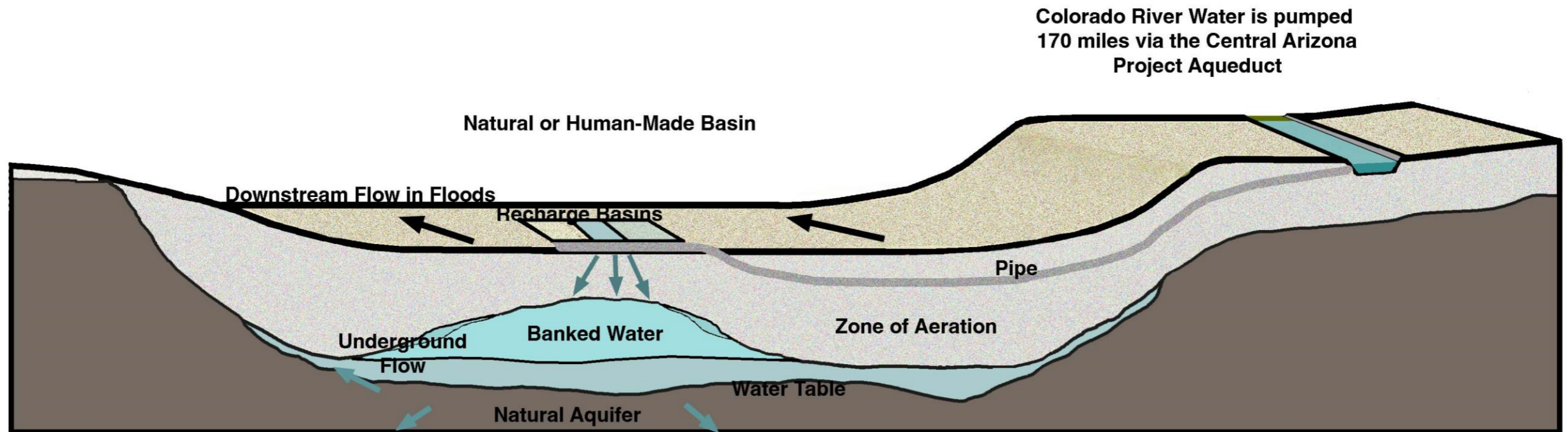
A landscape that does not require irrigation
Irrigation of grass and gardens is most
often the greatest use of household
water in the dry southwest.



Crops can be changed from high-water use per dollar like alfalfa, to crops that yield a better value per gallon of water.

Regenerative no tilling agriculture (Arizona Republic, March 13, 2023)





TMcG
2022

The Cave Creek Vice Mayor organized a water policy seminar in 2021.

Following the seminar, by early 2023, the Town of Cave Creek has banked a one year supply of water. This will give Cave Creek customers “water credits” to augment supplies when they are needed in the future. The most active banking/recharge sites are located near the CAP aqueduct, northwest of Phoenix.

The Phoenix water interconnect, now being constructed, will give the town water security if our water line up from the CAP canal is interrupted.

Desalination of sea water is a possible long-term backup supply. But brine from desalination can harm the aquatic environment. It would take 10 or more years and the cost could be 10 times the present bulk rate for water. Furthermore, we have no ocean coast in Arizona and California has told us it won't desalinate water for Arizona. Mexico is being considered to desalinate their portion of the river allocation, leaving more for Arizona.



Desalination plant, Carlsbad CA.



In 2022, the Arizona legislature passed a bill to establish a long-term, \$1 billion program to explore ways to preserve and increase Arizona's water supplies. Among the options are negotiations, desalination and conservation. But specific details are not in it.



Conservation: The most available water resource is the part we don't use.

Tom's suggested solutions...

1. **Adjust water pricing** to long term goals, not supply costs. This will encourage conservation, and xeriscaping. It will motivate farmers and all other users to make more efficient use of water.
2. Require water supply awareness through **educational** institutions and public media.
3. As citizens, vote and demand **accountability** to a long-term integrated water strategy.
4. Require that all communities have **public participation** in groundwater planning. This will encourage the owners exempt (small, unregulated) wells to conserve.
5. **Coordinate** state and federal water agencies, agricultural users and builders.
 6. **Meter** all major wells to enable analysis and craft realistic regulations.
 7. Make all of Arizona an **Active Management Area** with AMA regulations.
8. Protect aquifers by requiring **recharge** in the same place where usage occurs.
 9. **Adjudicate** all watersheds to establish long-term water rights.
 10. Make a plan for **desalination** and establish potential locations.
11. Plan conservative use of water for all foreseeable contingencies including accelerated **climate change**.

Part 11

Appendices



Our latest water authority: John Oliver.

True in essence, if not in many “critical details,” this may be a more effective (and certainly more irreverent (!)) message than you’re getting from your elected officials. When your most effective sources include HBO’s John Oliver, we have a communication issue. (It’s R rated!)

<https://m.youtube.com/watch?v=jtxew5XUVbQ> (06/26/22)

Thanks to JP!

Bibliography:

Arizona Department of Water Resources & Central Arizona Project, *Joint Briefing: Lower Basin Drought Contingency Plan*, June 28, 2018
<https://www.cap-az.com/documents/departments/planning/colorado-river-programs/Steering-Committee-AZDCP-08-23-18.pdf>

Arizona Republic, The newspaper published roughly a dozen feature articles for at least a 3 month period by reporters Ian James, Rob O'Dell and Joshua Bowling. Most of them featured industrial farming outside the AMAs, Buckeye's planning for water demands to keep up with accelerating population growth and land purchase for water transfers from the Colorado River to the Phoenix-Tucson corridor. Some are referenced on individual slides.

August, Jack L. Jr, *Dividing the Waters; Mark Wilmer and Arizona v California*, 2007

Culp, Peter W, Glennon, Robert, Libecap, Gary, *Shopping for Water*, Stanford Woods Institute for the Environment, The Hamilton Project. Oct 2014

Davis, Tony, *Arizona's Plan to Withdraw Years Worth of 'Banked' CAP Water Lagging*, Arizona Daily Star, Decembr 11, 2018

Doorn, Peter L. & Péwé, Troy L, *Geologic and Gravimetric Investigations of the Carefree Basin, Maricopa County, Arizona*, Arizona Geological Survey, 1991

Fleck, John, *Water is for Fighting Over (and Other Myths about Water in the West)*, Island Press, 2016

Glennon, Robert T, *Water Follies, Groundwater Pumping and the Fate of America's Fresh Waters*, 2002

Halloway, Jim, Director, Babbitt Center for Land and Water Policy, *Arizona Groundwater Management Reflections & Lesson Learned*, ~2011
<https://www.getches-wilkinsoncenter.cu.law/wp-content/uploads/2018/06/Jim-Holway.-AZ-GMA.pdf>

Hogan, *Cave Creek could be nearly tapped out*, East Valley Tribune, 2006
https://www.eastvalleytribune.com/news/cave-creek-could-be-nearly-tapped-out/article_56be202f-805e-5b6b-8015-bed688928070.html

Kyle Center for Water Policy, , *The Myth of Safe Yield, The Elusive Concept of an Assured Water Supply, The Role of CAGR and Replenishment Lessons from the Past*
<https://morrisoninstitute.asu.edu/content/kyl-center-water-policy>

Kuhn, Eric & Fleck, John, *Science be Dammed*, University of Arizona Press, 2019,

O'Dell, Rob & James, Ian, These 7 industrial farm operations are draining Arizona's aquifers, and no one knows exactly how much they're taking, Arizona Republic, Dec 11, 2019,
<https://www.azcentral.com/in-depth/news/local/arizona-environment/2019/12/05/biggest-water-users-arizona-farms-keep-drilling-deeper/3937582002/>

Outcalt, Chris, *Colorado River water use may have to be slashed by a quarter to avert crisis, federal official warns*, The Colorado Sun, Jun 16, 2022

Owen, David, *Where the River Runs Dry: The Colorado and America's Water Crisis*. New Yorker, May 18, 2013

Reisner, Marc, *Cadillac Desert: The American West and Its Disappearing Water*, 1986

Shannon, Noah Gallagher, New York Times, *The Water Wars of Arizona*, July 19, 2018,
<https://www.nytimes.com/2018/07/19/magazine/the-water-wars-of-arizona.html>

Stern, Charles V. & Sheikh, Pervaze A. of the Congressional Research Service, *Management of the Colorado River: Water Allocations, Drought, and the Federal Role*, Updated August 16, 2021
<https://sgp.fas.org/crs/misc/R45546.pdf>

Town of Cave Creek, The Cave Creek Water System (Web page updated as needed)
<https://www.cavecreek.org/DocumentCenter/View/2176>

University of Arizona, *85th Arizona Town Hall, Arizona's Water Future: Challenges and Opportunities*, 2004

Other references are shown as URLs on various slides.

Books by Thomas McGuire

2022

