

# The Colorado River: *Lifeline of the Southwest*

WATER for  
the WEST



# The Headwaters



The Colorado River begins in the Rocky Mountains at elevation 10,000 feet, about 60 miles northwest of Denver in Colorado.



# The Path

Snow melts into water, flows into the river and moves downstream.

In Utah, the river meets primary tributaries, the Green River and the San Juan River, before flowing into Lake Powell and beyond.









Source: George  
Eastman House

It was almost 1,500 years ago when humans first tapped the river. Since then, the water has been claimed, reclaimed, divided and subdivided many times.



The river is the life source for seven states – Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming – as well as the Republic of Mexico.



# River Water Uses

There are many demands for Colorado River water:

- Agriculture and Livestock
- Municipal and Industrial
- Recreation
- Fish/Wildlife and Habitat
- Hydroelectricity
- Tribes
- Mexico



Source: USGS

# Agriculture



The Colorado River provides irrigation water to about 3.5 million acres of farmland – about 80 percent of its flows.



# Municipal



Phoenix



Denver

About 15 percent of Colorado River flows provide drinking and household water to more than 30 million people.

These cities include: Las Vegas and Phoenix, and cities outside the Basin – Denver, Albuquerque, Salt Lake City, Los Angeles, San Diego and Tijuana, Mexico.

# Recreation



Source: Emma Williams



Source: Utah Office of Tourism

Recreation includes fishing, boating, waterskiing, camping and whitewater rafting in 22 National Wildlife Refuges, National Parks and National Recreation Areas along river.



# Lake Mead



Source: Bureau of Reclamation

Lake Mead National Recreation Area draws 10 million visitors to Lake Mead and Lake Mojave every year. The surrounding desert attracts hikers, wildlife photographers and sightseers.

# Grand Canyon



Nearly five million people see the 1-mile deep Grand Canyon each year.



Source: Rita Schmidt Sudman

The north rim of the Grand Canyon offers spectacular views, although most people visit the more easily accessible south rim.



# Wildlife and Plants



American Pika



Gaillardia, the Blanket Flower



Southwestern Willow Flycatcher

Colorado River flows provide habitat and a crucial ecosystem for countless plant and animal species, many of which are native and found only in the Colorado River Basin. More than 70 percent of all wildlife in the region depends on Colorado River habitat for some part of their life cycle.

# Flora



Aspens

Source: Colorado Department of Natural Resources



Desert Marigold  
Source: magnesium.net

More than 1,600 species of plants grow in the watershed, ranging from saguaro cactus and Joshua trees in the desert to the towering pine and fir forests of the Rocky Mountains.



# Fauna



Beaver

Source: HeinOnline



Elk



Cutthroat Trout



Source: Save the Colorado

Animals range from elk, mountain sheep, mule deer and mountain lion in the higher elevations to beavers and muskrat in the lower habitats.

# Hydroelectric Power Plants

Along the river 11 hydropower plants have the capacity to produce 4,177,766 kilowatts a year – enough power to meet all or partial electrical needs of 15 million people.



**What is a kilowatt?**  
A kilowatt is 1,000 watts or 1.34 horsepower. A kilowatt-hour is a unit of energy equal to one kilowatt of power acting for one hour.

Hoover Dam turbines.  
Source: Aquaornia.com



# Tribes



Hopi  
Source: Dr. Smallwood,  
University of Memphis

At least 15 Native American Tribes live in the Colorado River Basin. These include four distinct Tribes: The Mojave, Chemehuevi, Hopi and Navajo with about 3,500 active tribal members.



# Mexico

At the end of the river, Mexico receives 1.5 million acre-feet annually under a 1944 treaty between the United States and Mexico.



The border between the USA and Mexico



Morelos Dam, built in 1950, is located about 1 mile below the border and the Colorado River between the town of Los Algodones, Baja California, and Yuma County, Arizona.



# Connections



Source: National Park Service



Think about how the water is connected, from the Rocky Mountain snowy source through Arizona and south into Mexico. The snow that skiers enjoy all winter might be the same water that thirsty Tucsonans drink on a hot summer day in Arizona.



# Connections

If spinach, broccoli or cauliflower is on the dinner plate during the winter, there's a good chance it came from Southern California's Imperial Valley.

The desert region is called the nation's "winter salad bowl" because it produces about 80 percent of the nation's winter vegetables.





# Connections

The water along the 1,800-mile shoreline of Lake Powell might flow downstream and become the source of electricity that lights up the Las Vegas strip.



# Colorado River Overview

More water is exported from the Colorado River's 250,000 square-mile basin than from any other river basin in the world.

Every drop of its average 5 trillion gallons of water is used each year. In fact, the river often runs dry before it reaches its final destination at the Sea of Cortez in Mexico because of use by the United States and Mexico.

There's no doubt: All the competing demands for the water make it one of the most controlled and controversial rivers in the United States.





The river flows, which were historically erratic, now are controlled by an extensive system of dams, reservoirs and aqueducts. This system has kept the water supply relatively stable over the past 50 years, but the controlled flows have diminished wildlife populations from the headwaters to the Colorado's mouth.

And the demands and consumption have increased.

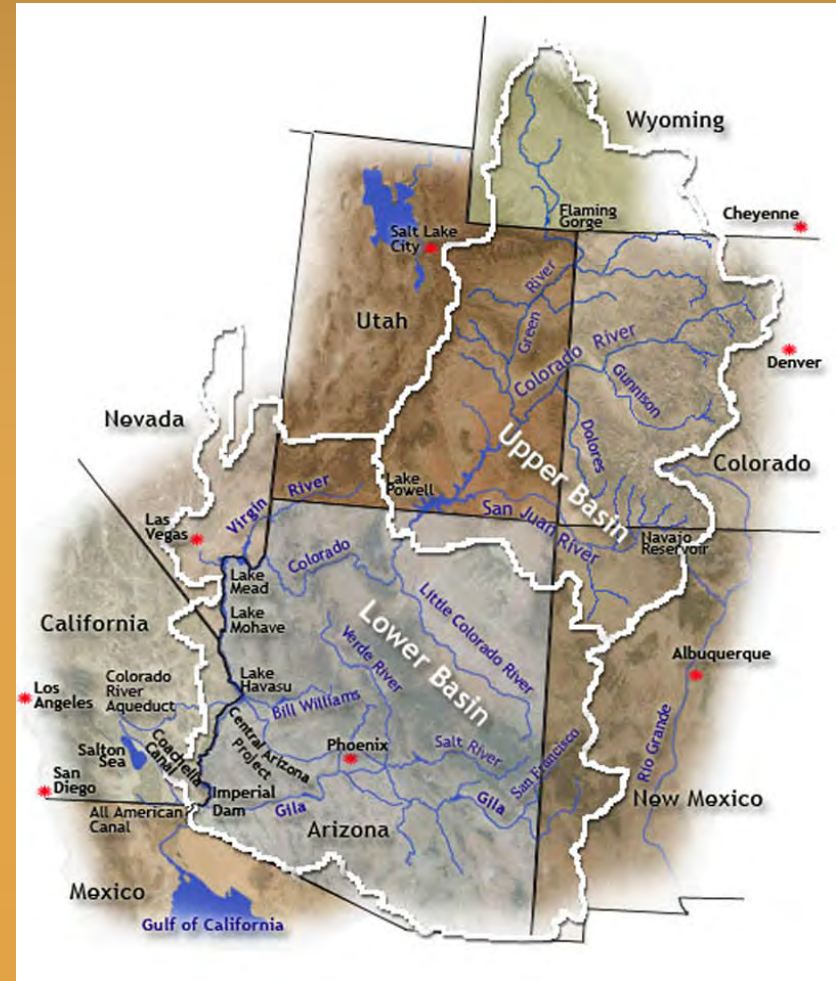
# Colorado River Compact

The 1922 Colorado River Compact was a milestone agreement. The Compact divided the seven states into the Upper and Lower basins and allocated 7.5 million acre-feet annually to each basin.



Colorado River Commissioners (standing) represented each of the seven states, and Herbert Hoover (sitting third from left) was the chairman and federal government representative.

Photo: *Denver Post*



An acre-foot of water, 325,851 gallons, will cover one football field to a depth of 1 foot and can meet the annual indoor and outdoor needs of one to two households in the United States.



## Upper Basin states:

- Colorado
- New Mexico
- Utah
- Wyoming

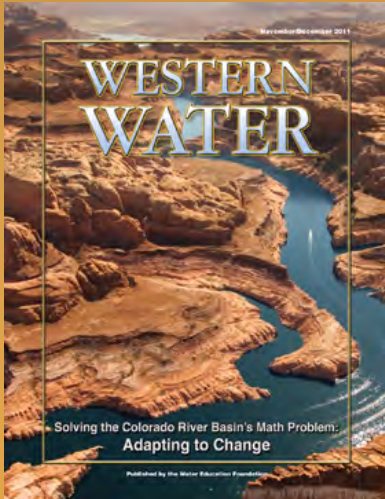
## Lower Basin states:

- Arizona
- California
- Nevada



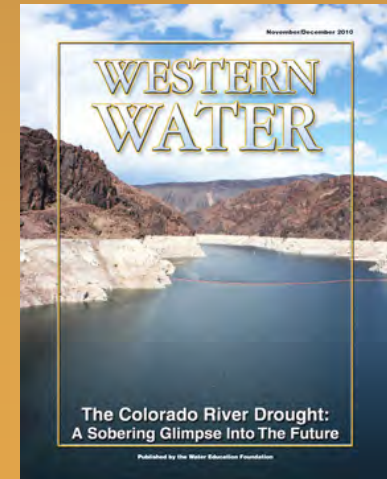
# Law of the River

Since then, numerous compacts, agreements, treaties and court decisions – known collectively as the “Law of the River” – dictate how the Colorado River is managed and how the water is divided.



A Colorado River Compact hearing circa 1922. Delph E. Carpenter, known as the father of the compact system, is in the second row from the top (center).

Source: Colorado State University







The Colorado River Commission, (above) with Secretary of Commerce Herbert Hoover serving as chairman, met in Santa Fe in the Fall of 1922.

Negotiations to strike agreements often have been contentious as each party strives to get the water it needs. Yet, for the most part, compromise and agreement have prevailed.

For more information about the Law of the River, click [here](#) to see the Bureau of Reclamation's website.

Colorado River stakeholders come together during the biennial Colorado River Symposium, sponsored by the Water Education Foundation and held in Santa Fe since 1997, which was the 75<sup>th</sup> anniversary of the Compact.



Today's state representatives are working together to determine how to best use Colorado River water supplies.

# History



Remnants of the Anasazi irrigation systems still exist.  
Source: National Park Service

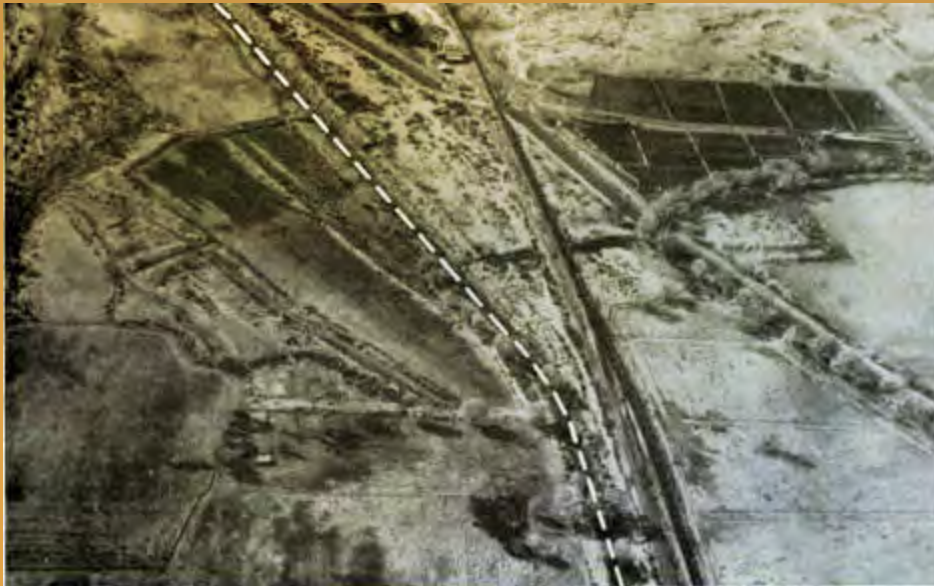


The great kiva in the ruins of Chaco Canyon was used for spiritual rituals.  
Source: National Park Service

As early as 600 A.D. the Anasazi Indians developed a complex distribution system to supply drinking and irrigation water in Chaco Canyon in northwestern New Mexico. It was used until the mid-1100s when they abandoned the region, possibly due to drought.



About the same time, the Hohokam Indians built hundreds of miles of canals to divert water from the Salt and Gila rivers (tributaries of the Colorado) to their settlements located in and near what is today Phoenix.



The white dotted line in this aerial photo shows remains of Hohokam hand-constructed diversion ditch for early irrigation. The square-shaped mound below modern irrigation system (upper right) marks Pueblo Grande ruins which hold many secrets of an ancient civilization.

Source: Bureau of Reclamation



From post holes and other ruins of dwellings and storage houses, archaeologists have found clues to the existence of the Hohokam.

Source: Bureau of Reclamation

Spanish explorers and missionaries arrived in the 1500s and settled areas of Arizona, California and New Mexico. They introduced livestock and built community ditch systems called *acequias*, some of which still exist today.



La Canova Acequia near Velarde, New Mexico



In the mid-1800s, the Church of Jesus Christ of Latter Day Saints (Mormons) settled in Utah. The main irrigation sources as the population grew were Colorado River tributaries, the Green and Virgin rivers.



Green River



Virgin River

# John Wesley Powell



In 1869, geologist John Wesley Powell led a party that became the first to successfully explore and map the Green and Colorado rivers. A one-armed Civil War major, Powell proved the river could be navigated.





Powell became the second director of the U.S. Geological Survey and wrote and spoke about his belief that large-scale settlement of the Colorado River Basin was impractical; that there was not enough water to serve all its arid lands. Irrigation projects were the best means by which the West could sustain population.

# Reclamation Act of 1902

Others pushed ahead to find ways to dam the river to prevent flooding and use water for irrigation and drinking. The 1902 federal Reclamation Act established the Reclamation Service (renamed the Bureau of Reclamation in 1923) to build the projects to put water to extensive use throughout the West.



President Theodore Roosevelt supported the reclamation movement due to his personal experience in the West, and because he believed in homemaking, a key argument for supporters of irrigation projects. Supporters believed reclamation programs would encourage Western settlement, making homes for Americans on family farms.

Source: Library of Congress



# Early Projects

Early projects brought water to the California desert. In the Imperial Valley, farmers initially used a canal that ran partly through Mexico. But the Americans wanted to build a canal that was entirely within the United States – an “All-American” canal – for more control.



A young child stands in an irrigated field of lettuce. Source: Bureau of Reclamation



The All-American Canal – built between 1934 and 1940 – stretches 80 miles through the Colorado Desert to Southern California and is part of the federal irrigation system from the Hoover Dam.

# Salton Sea



Source: Chris Austin



Source: saltonseamuseum.org

In early 1905, massive floods destroyed a canal headwork and the entire flow of the Colorado River flooded the lower Imperial Valley for 18 months, creating the Salton Sea in an area of an ancient lakebed.



# Flood Protection on the Grandest Scale

Recurring flooding through the turn of the 20<sup>th</sup> century led to calls for more flood protection, including the prospect of a large dam on the Colorado River. Survey parties in 1922 recommended Black Canyon as the site where Hoover Dam was eventually constructed. The dam effectively put an end to Imperial Valley flooding.



Black Canyon before the construction (left) of Hoover Dam and after the dam was built.

# Call for an Agreement



In the 1920s the Upper Basin states, where most of the Colorado River water originates, were concerned that the Lower Basin states were developing their water too quickly. To protect their water for the future, the Upper Basin states favored an agreement to establish water allotments.



Fast-growing California wanted an agreement, too, to build dams for flood control, generate hydroelectric power and provide a reliable water source.

Los Angeles, in particular, was a strong proponent of a large dam on the Lower Colorado River and an aqueduct to bring water 300 miles west across the desert.



In 1890 about 50,000 residents lived in Los Angeles. In 1900, the population was 100,000. In 1920 it was nearly 577,000 and by 1930, more than 1.2 million people lived in the city.

Source: Destination Southern California

# The Colorado River Compact: Monumental 1922 Agreement

In 1922, representatives from the seven states signed the monumental agreement.

The Compact:

- Apportioned “in perpetuity” 7.5 million acre-feet annually to each of the basins
- Allowed each basin to develop water as needed without fear of losing it through non-use.



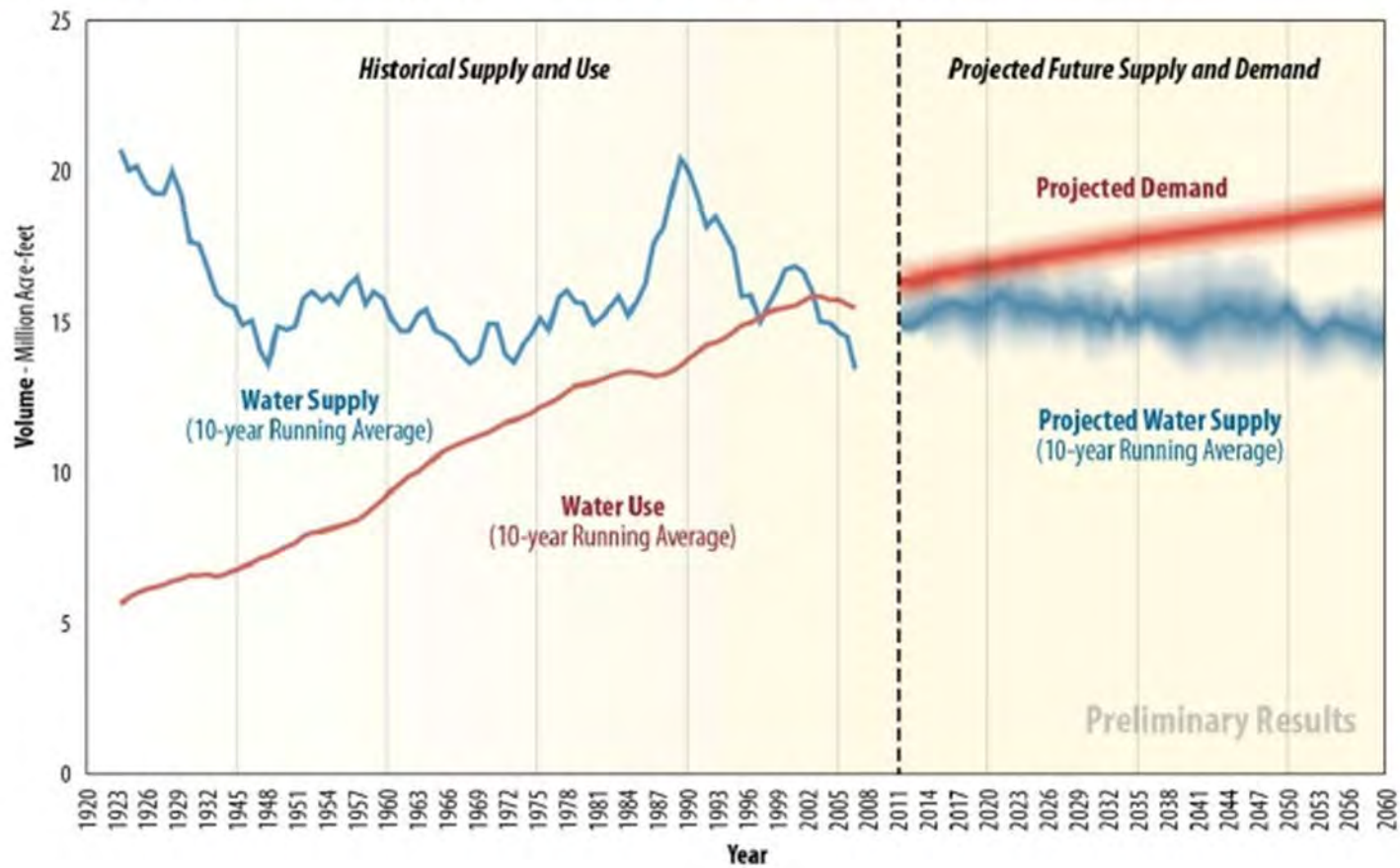
Commerce Secretary Herbert Hoover presides over the signing of the Colorado River Compact, Bishop's Lodge, outside Santa Fe, New Mexico, November 1922.

Source: Bureau of Reclamation.



**FIGURE 2**

**Historical Supply and Use and Projected Future Colorado River Basin Water Supply and Demand**



When the Compact was negotiated, it was believed annual flow was about 18 million acre-feet. In reality, the average is closer to 14.7 million acre-feet. With yearly fluctuations, flows can be as little as 3.8 million acre-feet and as much as 25 million acre-feet.

# Six of Seven States Ratify the Compact



Gila River

In 1923, six Basin states ratified the Colorado River Compact. Arizona did not sign because the Compact did not allocate water to each state. It was most concerned over state rights to tributaries – namely Arizona's Gila River – which were not addressed in the Compact.

For more information, click [here](#) to see Reclamation's website

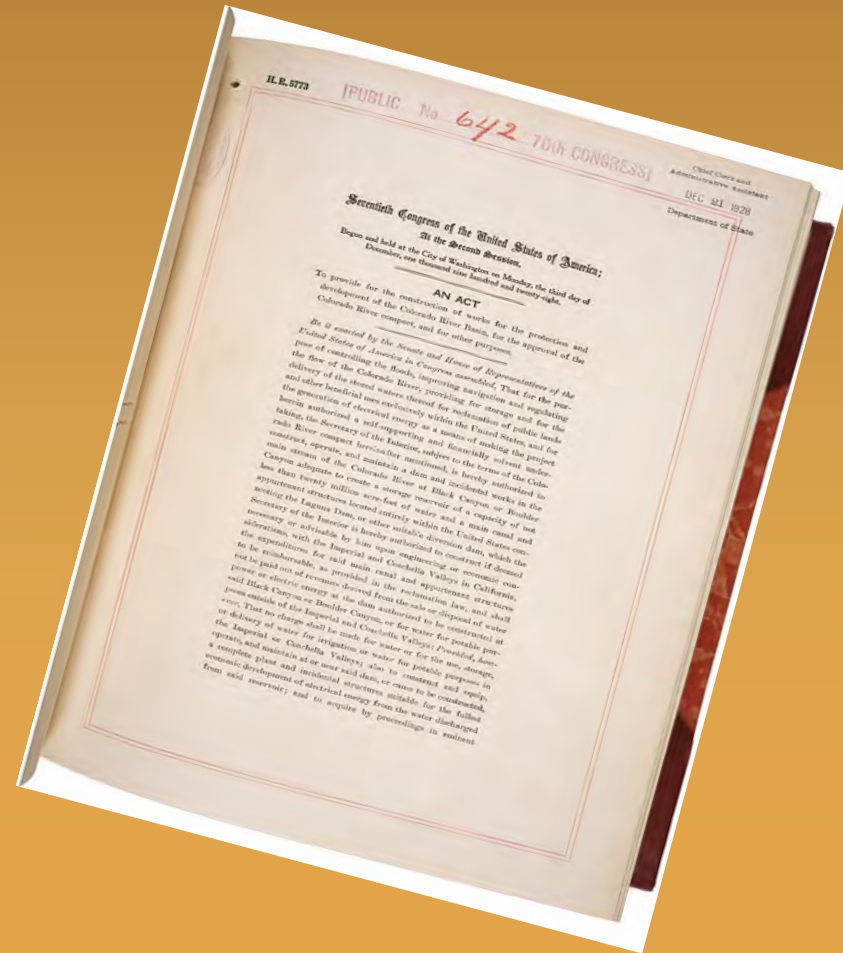


# The Boulder Canyon Project Act



In 1928, the federal Boulder Canyon Project Act authorized construction of Boulder Dam, later renamed Hoover Dam. The agreement was endorsed by the federal government and ratified the 1922 Compact.

For more information, click [here](#) to see Reclamation's website.



Blasting the keyway  
for the Hoover  
Dam.

Source: Bureau of  
Reclamation

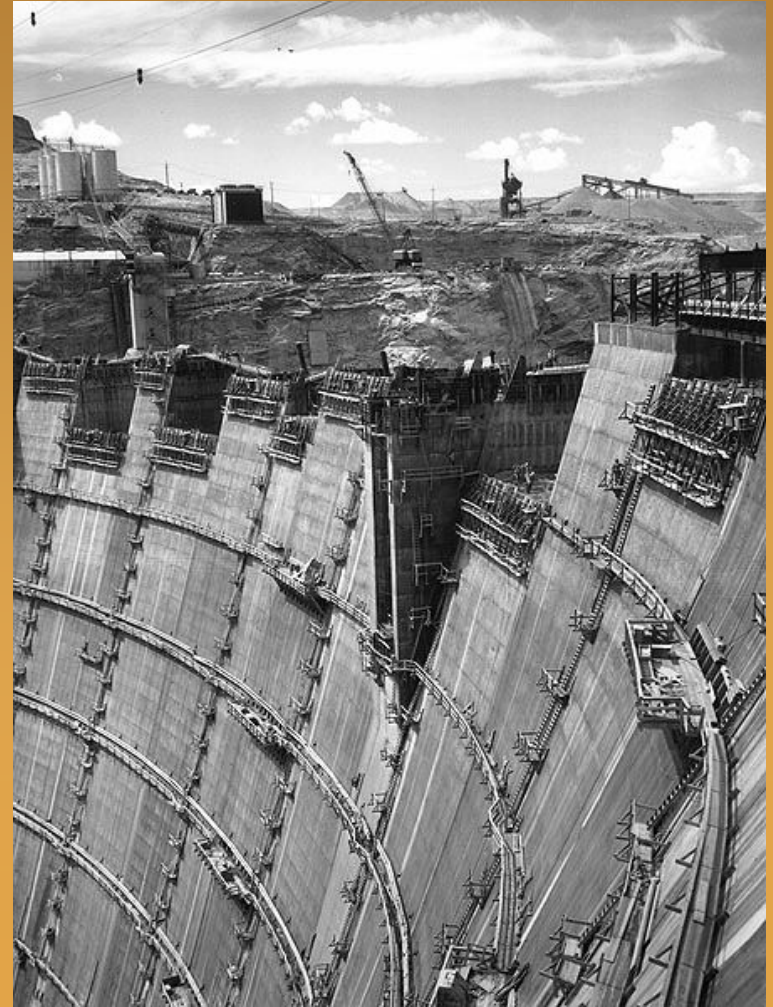
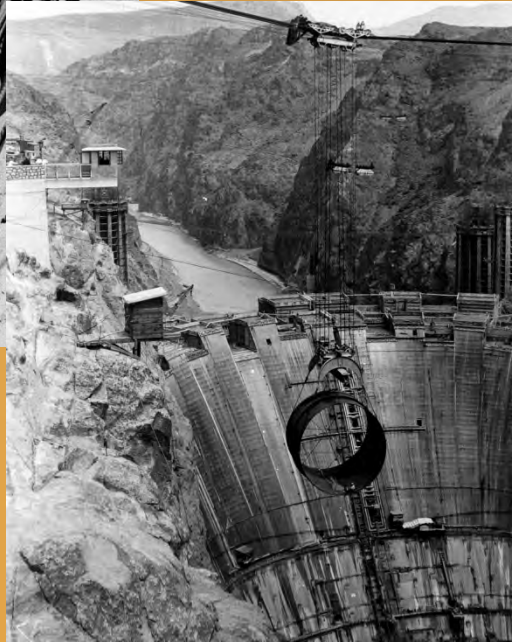
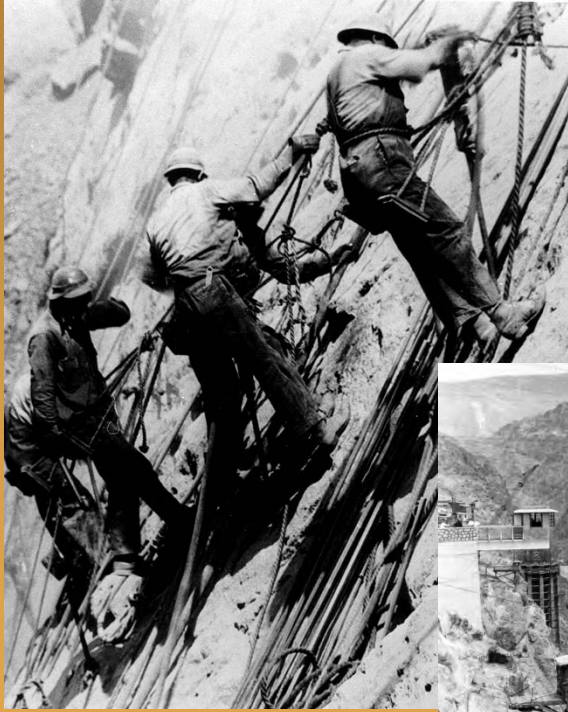


The Upper Basin states agreed to support the authorization only if California agreed to limit its use of Colorado River water. The Act set the basis for restricting California's use to 4.4 million acre-feet and no more than half of any surplus water. It also required California to buy all the electricity the dam generated.

The federal government ultimately approved dozens of reclamation projects – dams and hundreds of miles of canals -- along the river. All the reservoirs are capable of holding nearly four times the average annual flow of the river.



# Hoover (Boulder) Dam



The cornerstone of the dam system along the Colorado River, Hoover Dam was constructed from 1931 to 1936 and provided valuable jobs during the Great Depression.

# Hoover Dam Fast Facts:



President Franklin Roosevelt dedicates then-Boulder Dam in 1935.

- The dam is 726.4-feet high
- Lake Mead, behind the dam, is the country's largest artificial lake and can hold 28 million acre-feet
- It generates, on average, about 4 billion kilowatt-hours of hydroelectric power each year for use in Nevada, Arizona, and California – enough to serve 1.3 million people
- From 1939 to 1949, the power plant was the world's largest hydroelectric installation; today, it is still one of the country's largest.



# Water to California

In 1940 Reclamation completed the All-American Canal, the largest irrigation canal in the world. It provides Colorado River water to irrigate about 500,000 acres of farmland in the Imperial and Coachella valleys.



All-American Canal



Parker Dam where water is initially drawn into Colorado Aqueduct

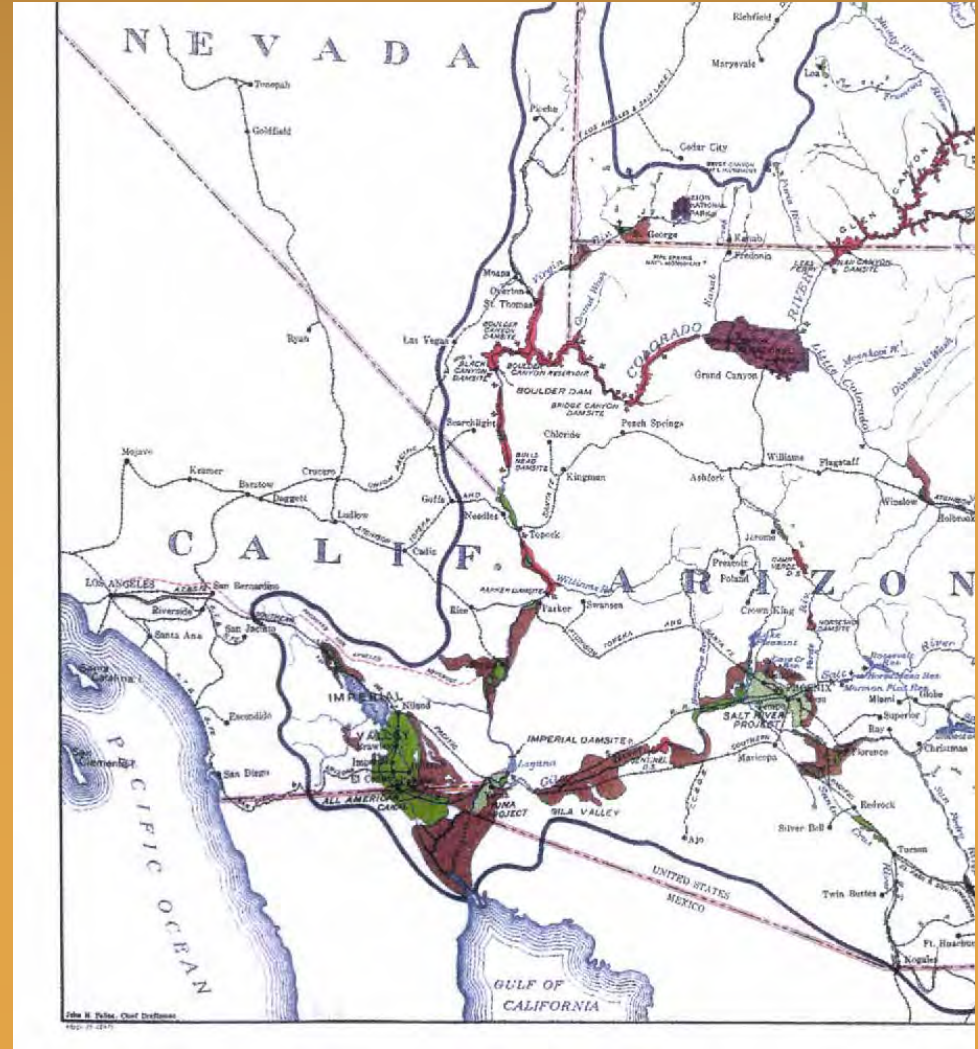
In 1941, the Metropolitan Water District of Southern California (MWD) completed the 242-mile long Colorado River Aqueduct, bringing water to the Los Angeles metropolitan area from near Parker Dam.



# California Seven Party Agreement

In 1931, the California Seven-Party Agreement divided California's 4.4 million acre-feet apportionment, plus any excess, among the seven major water users in the state.

Palo Verde Irrigation District, Yuma Project, Coachella Valley Water District and Imperial Irrigation District had a priority right to use the first 3.85 million acre-feet of California's 4.4 million acre-feet water apportionment.



# Across the Desert

MWD had the next priority, which included 550,000 acre-feet of water within California's basic apportionment, and 662,000 acre-feet of water above the state's apportionment. Through 2002, MWD was able to fill its Colorado River Aqueduct through a combination of its basic apportionment and unused water from other states or surplus water when allotted by the Secretary of the Interior.



The Metropolitan Water District of Southern California was created by the California Legislature in 1928, primarily to build and operate the Colorado River Aqueduct, which stretches 242 miles from Lake Havasu in Arizona to the east side of the Santa Ana Mountains in California.

Source: Metropolitan Water District of Southern California



# The Mexican Water Treaty of 1944

Mexico was not included in the 1922 Compact agreement. Under the 1944 treaty between the United States and Mexico, Mexico receives 1.5 million acre-feet of water annually, plus an additional 200,000 acre-feet under when there exists Colorado River water in excess of the amount necessary to supply uses in the United States and the guaranteed quantity of 1.5 million acre-feet to Mexico.



A Mexican farmer directs water to irrigate crops.

Source: Food and Agriculture  
Organization of the United Nations

# Water in the Upper Basin

In the 1940s, attention turned to the Upper Basin. The 1948 Upper Colorado River Compact apportioned Colorado River water among these four states and paved the way for new water projects in the Upper Basin.

## **Upper Basin's 7.5 million acre-feet apportions:**

- Colorado - 51.75 percent
- New Mexico - 11.25 percent
- Utah - 23 percent
- Wyoming - 14 percent
- Arizona (Upper Basin portion) - 50,000 acre-feet annually.

For more information, click [here](#) to see the Bureau of Reclamation's website.



# California v. Arizona

Arizona's water policies changed in the late 1930s when the state had to purchase Hoover Dam power for the first time. In 1944, Arizona ratified the Compact and began seeking its own federal project to bring Colorado River water to Phoenix and Tucson. But Congress would not approve the Central Arizona Project (CAP) until the state's share of the Colorado River was determined.



Central Arizona Project

In 1964, the U.S. Supreme Court Decree *Arizona v. California* held California to 4.4 million acre-feet, Arizona to 2.8 million acre-feet and Nevada to 300,000 acre-feet annually under normal conditions. The court's decree gave Arizona control over the Gila River and paved the way for the CAP. It was authorized in 1968 and substantially completed in the early 1990s.



President Lyndon  
Johnson authorizes the  
Central Arizona Project.



# Protecting the Colorado River's Environment

In the late 1960s, the public focused on the environment. Many decisions and programs started to promote the well-being of the ecosystem and river habitat.

After one of the biggest environmental battles in history, Congress voted to remove a proposed dam that would have flooded the Grand Canyon before passing the Colorado River Basin Project Act. Read more at The David Brower Center:  
<http://www.browercenter.org/node/179>

The 1973 federal Endangered Species Act provides protection for plants and animals.

President Richard Nixon signs the Endangered Species Act.



# “Too thick to drink, too thin to plow”



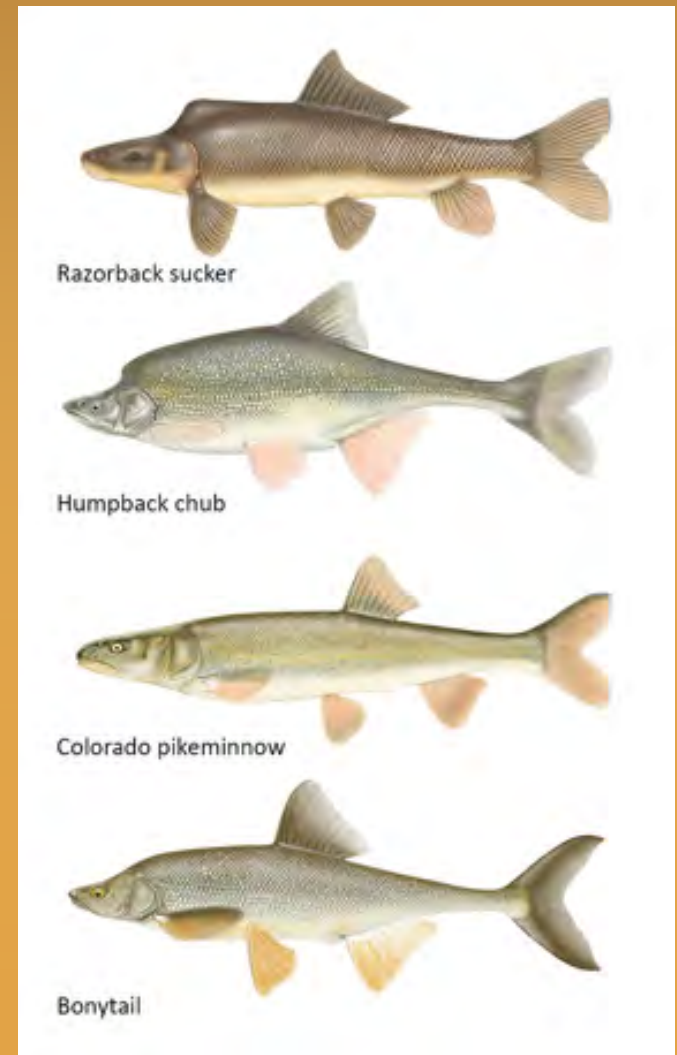
The Colorado River was originally a muddy, brown and seasonally warm river. But the dams have trapped the sediment and made portions of the river cold and clear. Unfortunately, these changes are detrimental to native fish populations.

# Endangered Fish

Four different species of native fish are listed as endangered by the U.S. Fish and Wildlife Service: The Colorado pikeminnow, razorback sucker, bonytail and the humpback chub.



Razorback Sucker



Razorback sucker

Humpback chub

Colorado pikeminnow

Bonytail



# Endangered Fish

The fish, which evolved more than 3 million years ago, have been significantly impacted by projects that altered seasonal flow patterns, changed water temperatures, captured sediment and created physical barriers.



# Non-native Fish

Non-native fish -- pike, catfish and smallmouth bass -- thrive in the Colorado River and are threatening native fish. Efforts are underway to protect and restore native species and vital habitat. Click for more information from [The U.S. Fish and Wildlife Service.](#)



Smallmouth bass were extremely rare in the upper Colorado River prior to 2000 but dramatically have increased in number since then. The invasive fish prey on native fishes and threaten endangered fish recovery efforts.

Source: B. Burdick, Fish and Wildlife Service

# Upper Colorado Endangered Fish Recovery Program



Source: Colorado University, John Piklick

In 1984, the Upper Basin began developing a recovery program for the four endangered fish – a cooperative agreement among the secretary of the Interior, the governors of Colorado, Utah and Wyoming and the Department of Energy.



# Upper Colorado Endangered Fish Recovery Program

The recovery program's dual goals are endangered species recovery and water development. It has been heralded because of the broad contingent involved – federal and state agencies, water development interests, power customers and environmental groups.

Click for more information from the [Upper Colorado Endangered Fish Recovery Program](#).



A fish passage at the Grand Valley Project Diversion Dam on the Colorado River provides endangered fish with access to critical habitat in western Colorado. Source: Bureau of Reclamation



The fish ladder installed in 1996 at the Redlands Diversion Dam near the mouth of the Gunnison River allows upstream passage of native fishes and aids in recovery of endangered Colorado pikeminnow and razorback sucker populations. Source: Bureau of Reclamation

# Lower Colorado River Multi-Species Conservation Program (MSCP)



Endangered fish gained 80 acres of new habitat at the Imperial National Wildlife Refuge northeast of Yuma. In late 2007, officials dedicated six large ponds including Imperial Pond (left).

The goal of the Multi-Species Conservation Program is the recovery of about 26 endangered and threatened species along more than 400 miles from Lake Mead to the Mexican border, including lakes Mead, Mojave and Havasu and the historic 100-year floodplain.



# Lower Colorado River Multi-Species Conservation Program (MSCP)

The program calls for the creation of over 8,100 acres of habitat for fish and wildlife species and the production of over 1.2 million native fish to augment existing populations.

The Bureau of Reclamation is the implementing agency, and nearly 60 other state and federal agencies, water and power users, municipalities, Tribes and conservation organizations provide input and oversight.



The Arizona delegation and other officials sign the implementation agreement for the Lower Colorado River Multi-Species Conservation Program at Hoover Dam.



Jerry Zimmerman, Lorri Gray-Lee and Bill Werner were leaders in establishing the MSCP.

<http://govinfo.library.unt.edu/whccc/lower-colorado.html>



# Colorado River Delta



Efforts are underway to restore habitat in the Colorado River Delta, where the river meets the Sea of Cortez in Mexico. The Delta has not seen regular flows for more than a decade.

Both public and private dollars from the U.S. are helping Mexican non-profit organizations, in partnership with Mexican federal agencies, to revive native habitat that comprises a critical link in the Pacific Flyway.

# The Surplus Agreement

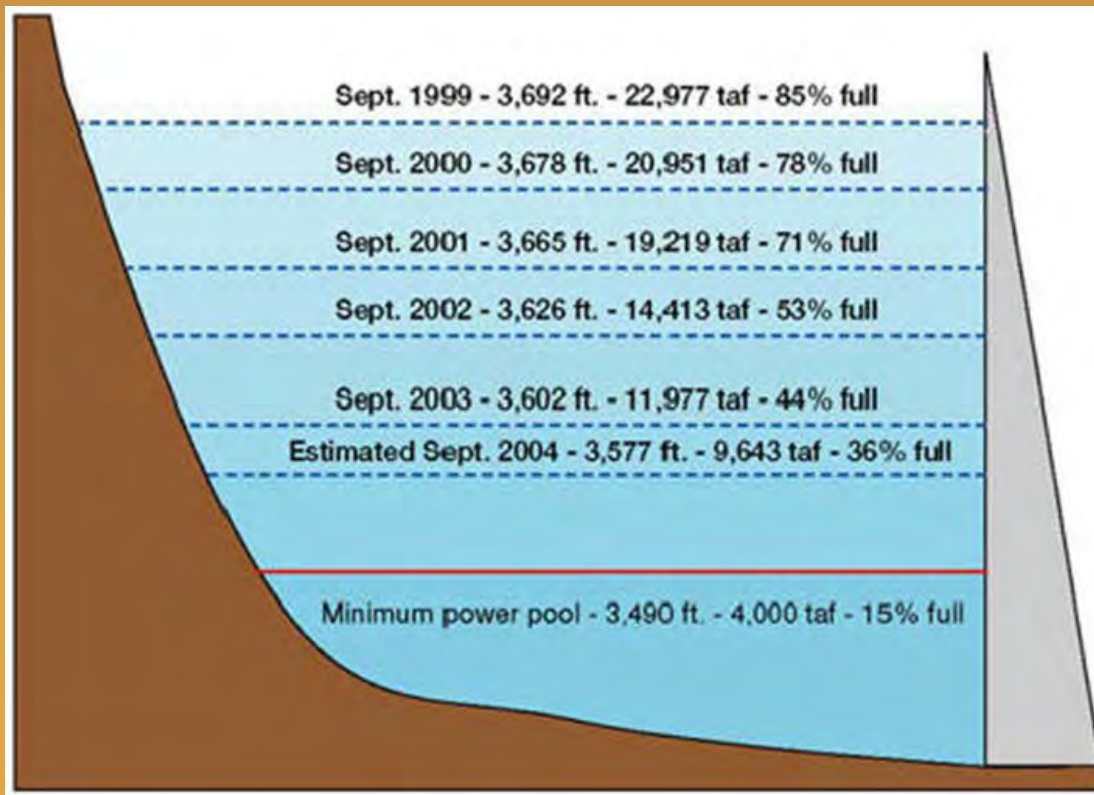
In the 1990s California continued to depend on surplus water each year at the discretion of the Interior Secretary. Yet years after CAP was completed, Arizona could take its full apportionment of water every year by using groundwater banking.



In 1983, the Hoover Dam spillways were open to release some of Lake Mead's water (left).  
By contrast in 2003, water levels significantly dropped due to drought conditions (right).  
Source: SNWA

# The Surplus Agreement

The 1990s were wet years and by the end of the decade storage in Mead and Powell was the highest ever. The 2001 Interim Surplus Guidelines set rules by which surplus water would be available to California and Nevada through 2016.



The guidelines were intended to give California a 15-year transition period to expand agricultural conservation and transfer programs to reduce its use from 5.2 million acre-feet to 4.4 million acre-feet.



# 2003 California Quantification Settlement (QSA)

The Surplus Agreement helped facilitate the 2003 Quantification Settlement Agreement (QSA).

The QSA established provisions for:

- Quantified priority rights for California agricultural agencies
- 75-year agreement to voluntarily transfer 200,000 acre-feet of farm water annually from Imperial Irrigation District (IID) to San Diego County
- Gradual reduction of California use of Colorado River water to 4.4 million acre-feet
- Committed the state to restore the Salton Sea.



San Diego

# Salton Sea

The Salton Sea is California's largest lake, encompassing 378 square miles. Its source of water is salty agricultural return flows from Imperial, Coachella and Mexicali valleys.

The Sea has no outlet and loses water only through evaporation, increasing salinity. As a result, the Sea is about 25% saltier than the Pacific Ocean.





# Salton Sea



Pelican

The Salton Sea National Wildlife Refuge is an important stop on the Pacific Flyway for more than 380 species of birds.



Salt, excessive nutrients, deoxygenation and other issues have contributed to massive fish and bird die-offs.



Great White Heron



# QSA Challenged



The QSA has been challenged in court. A California Superior Court ruled in 2010 the QSA was invalid because it required the state to sign a “blank check” to pay mitigation costs for the Salton Sea. The Appellate Court overturned that decision saying it is up to the state Legislature to appropriate funds. The case was sent back to the Superior Court for further proceedings.

## QSA links:

[San Diego County Water Authority](#) [Coachella Valley Water District \(CVWD\)](#)

[Imperial Irrigation District \(IID\)](#)

[Metropolitan Water District of Southern California \(MWD\)](#)

[State of California](#)

[U.S. Department of the Interior](#)

# Multi-year Drought

A record drought beginning in late 1999 had a severe impact on the Lower Colorado River Basin. Lakes Mead and Powell dropped to 50% capacity, affecting the entire basin.



Lake Mead's "bathtub ring" is a thick band when water levels severely drop during drought conditions.

# Multi-year Drought

In September 1999, Lake Powell was 95% full. In 2005 before the spring run-off, the lake reached its lowest level, only 33% full. Some “normal” and wet years helped; in 2011 summer runoff was among the greatest since the closure of Glen Canyon Dam, and the reservoir was 72% full. But 2012 was another dry year.



Lake Powell was showing its “bathtub ring” in 2002 (left) and continued to decline in 2003 (right).



# The 2007 Interim Guidelines

## Seven States' Shortage Agreement



The multi-year drought and fears of continued water shortages brought the seven states to the table in the mid-2000s, and the decisions were even more difficult. The question was: When drought years triggered a shortage of water, what cutbacks would be forced?

# The 2007 Interim Guidelines



Interior Secretary Dirk Kempthorne holding up the 2007 agreement.

The 2007 Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead established guidelines for which states will take water reductions and for how much in a shortage.

This agreement was signed by the seven states of the Colorado Basin and the federal government and lasts until 2026.

# The 2007 Interim Guidelines

An important aspect was it improves the efficiency of the system by allowing the river's two huge reservoirs, Lake Powell and Lake Mead, to rise and fall in tandem.



Lake Powell



Lake Mead



# Intentionally Created Surplus

Another critical innovation in the 2007 agreement is Intentionally Created Surplus, a mechanism by which water users can store conserved water in Lake Mead for later use.

This program both increases lake elevations at Mead, helping to avoid shortages, and also gives water users access to stored water when it would otherwise be unavailable.

# Tribes



The Colorado River remains an important irrigation supply for tribes.

Source: Bureau of Reclamation

The 300,000-acre Colorado River Indian Tribe Reservation was created in 1865 by the federal government for “Indians of the Colorado River and its tributaries.” Located in Arizona and California, the reservation originally was formed for the Mojave and Chemehuevi. The Hopi and Navajo Tribes were relocated to the reservation in later years.

Find out more about the Colorado River Indian Tribes at <http://www.crit-nsn.gov/index.shtml>

# Tribes



In 1908, U.S. courts established that Indian water rights exist whether or not water was actually being used by the tribe (*Winters v. United States*), yet Indian water rights were not quantified in the 1922 Compact. In 1964 the U.S. Supreme Court again asserted Tribal water rights (*Arizona v. California*), ruling that five lower Colorado River reservations “were not limited to land, but included waters as well.”

Federal legislation and court decisions have granted tribes nearly 1 million acre-feet in the Upper Basin and nearly 1 million acre-feet of diversion rights in the Lower Basin. Yet, less than half this water is actually being used by Indians. Some tribes want to lease their water to off-reservation users.



The Navajo-Hopi Little Colorado River Water Rights Settlement Act of 2012 was protested by Navajo and Hopi communities in April 2012 because they feared the settlement could diminish the tribes' sovereignty when it related to maintaining a safe and sufficient future water supply.



The settlement pertained to water rights claims of the Navajo Nation, the Hopi Tribe, and the state of Arizona. It authorized construction of municipal water projects and resolved litigation against the United States concerning Colorado River operations.

# Navajo Gallup Water Supply Project

The Navajo Gallup Water Supply Project is the cornerstone of the Navajo Nation water rights settlement in the San Juan River Basin in New Mexico.

The project will connect to existing infrastructure and deliver water to some Navajo communities that do not currently have water. An estimated 40 percent of Navajo Nation residents are dependent upon hauling water for use in their homes.



Secretary of the Interior Ken Salazar and Miss Navajo Nation Crystalyne Curley share the microphone during the ground-breaking ceremony in 2012. Source: Bureau of Reclamation

# Navajo Gallup Water Supply Project



Gallup Project officials participate in a ground-breaking ceremony in 2012.

The project broke ground in June 2012 and will include two water treatment plants, 280 miles of pipeline, 24 pumping plants and numerous storage facilities.

Click [here](#) for more information about the project.



# Reducing Salinity



Increasing salinity along the river has been a problem since the 1950s and 1960s. The United States began diverting significant amounts of water from the river to irrigate new agricultural areas, and the salty return flows from the farmland increased salinity in the river.

# Wellton-Mohawk Irrigation and Drainage District Project



Wellton-Mohawk Main Canal  
Source: Wellton-Mohawk Irrigation and Drainage District

Arizona pumped highly saline drainage from the Wellton-Mohawk Irrigation and Drainage District Project back into the Colorado River near Mexico. In 1961 Mexico formally protested the salty water it was receiving was not suitable for irrigation, and farms in the Mexicali Valley were being impacted.

In 1972, the United States and Mexico found a "permanent and definitive solution" to the salinity problem. The United States would build a desalting plant in Arizona to desalinate the water from the Wellton-Mohawk diversion.

# Yuma Desalting Plant

The Yuma Desalting Plant, the world's largest reverse osmosis desalting plant, was completed in 1992 to take salty irrigation runoff, desalt it and deliver it to Mexico.





# Yuma Desalting Plant

A flood on the Gila River damaged the plant in 2003, and it only has operated on occasion – a 90-day trial run in 2007 at 10% capacity and a yearlong trial in 2010 – but it is maintained even while not operating.



The Gila River flooded and damaged the desalting plant in 2003.

# Yuma Desalting Plant

During the 2010 pilot run, the plant operated effectively with no substantial equipment problems or accidents. The pilot run conserved 30,486 acre-feet.



# Yuma Desalting Plant

A major factor in operating the plant is the impact on the largest remaining wetland in the Colorado River Delta, the Cienega de Santa Clara. When the plant is not operating, agricultural runoff is delivered through a channel.

During the pilot operation, an agreement between the United States and Mexico resulted in replacing water supply for the marsh, ensuring that the wetland would not be harmed.

A report, released in June 2012 concluded that the wetlands were not adversely impacted during the one-year operation of the desalting plant.





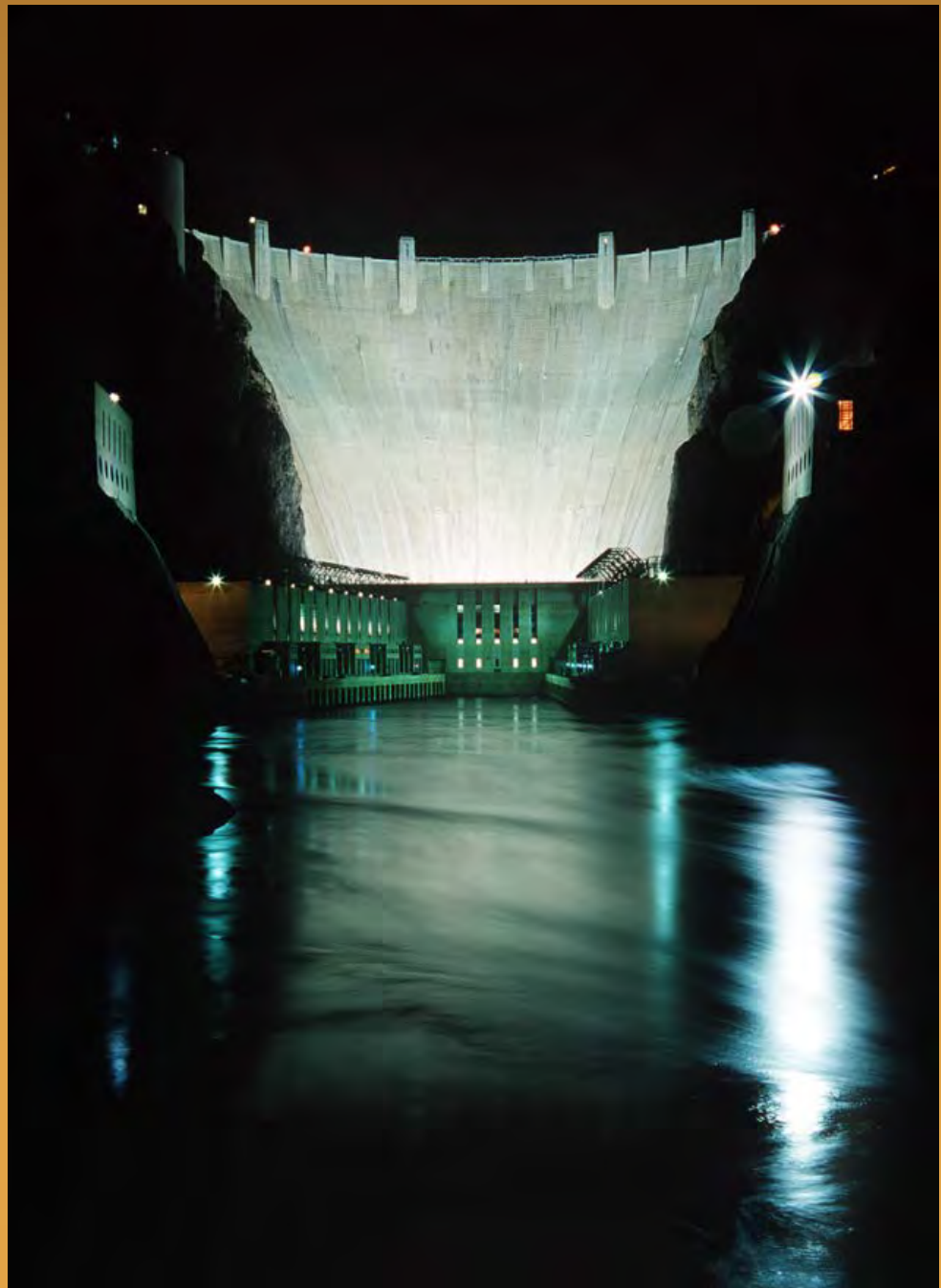
# Yuma Desalting Plant

Operational costs worked out to about \$300 per acre-foot of water for the 30,000 acre-feet produced during the 2010 trial run. Also, major infrastructure upgrades would be needed to move beyond the trial phase into routine operation.

Significantly, the federal government was unable to pay for the pilot operation of the plant which was largely financed by water users including the Central Arizona Project, Southern Nevada Water Authority, and Metropolitan Water District of Southern California.



# THE DAMS



# Upper Basin Dams - Colorado River Storage Project



Flaming Gorge Dam in Utah

The 1956 Colorado River Storage Project Act (CRSP) has had a significant impact on the development and management of water in the Upper Basin. It regulates flows, stores water, provides flood control and generates hydropower. The CRSP also provides for recreation and improves conditions for fish and wildlife.

There are four initial storage units built as part of the CRSP: The Wayne N. Aspinall Unit in Colorado (Blue Mesa, Crystal and Morrow Point dams), Flaming Gorge Unit in Utah, Navajo Unit in New Mexico and Glen Canyon Unit in Arizona.

For more information, visit [Reclamation's website](#).



# The Wayne N. Aspinall Unit



Gunnison River

Source: National Park Service

The project was authorized to provide the water storage and generate hydroelectric power along a 40-mile section of the Gunnison River, a tributary of the Colorado River,

The three Aspinall Unit dams – Blue Mesa, Morrow Point and Crystal dams – are located in the upper part of Black Canyon, one of the longest, narrowest and deepest gorges in the world.

# Blue Mesa Dam



Blue Mesa Dam is located on the Gunnison River about 30 miles below Gunnison. Completed in 1966, the 390-foot tall dam is the largest of the three Aspinall Unit dams. It forms the Blue Mesa Reservoir, the largest body of water in Colorado stretching a distance of 20 miles with 96 miles of shoreline. The reservoir has a capacity of 940,800 acre-feet.

The Blue Mesa Powerplant has a total capacity of 86 megawatts.

# Morrow Point Dam



Morrow Point Dam, completed in 1968, is located 12 miles downstream of Blue Mesa Dam in a narrow reach of Black Canyon. The dam was the first thin-arch, double curvature concrete U.S. dam (double-curvature means that the dam not only curves from left to right, it also curves from top to bottom). Morrow Point stands 468 feet high.



# Morrow Point Dam



The dam stores water for power generation and provides water for irrigation, some recreation and flood control. The powerplant, with a capacity of 165 megawatts, was the first constructed underground by the Bureau of Reclamation.

# Crystal Dam



Located six miles downstream of Morrow Point Dam, Crystal Dam was completed in 1976. The dam stabilizes flows to benefit the environment downstream, especially in the Gunnison National Park. The dam also has a powerplant that can produce up to 32 megawatts of hydroelectric power.

Crystal Reservoir extends six miles to Morrow Point Dam and has a capacity of about 26,000 acre-feet.

# Animas-La Plata



Animas-La Plata construction.  
Source: Bureau of Reclamation

More than 40 years in the making, the Animas-La Plata water project in Colorado is nearing completion and will fulfill the water rights settlement of the two Indian tribes – the Ute Mountain Ute and the Southern Ute Indian Tribes – that have water rights that date back to 1868.

The Animas-La Plata project will provide water for the Tribes, cities and water districts in Colorado and New Mexico. Construction began in 2003; the reservoir was filled in 2011 and the project will be completed in 2013.



# Animas-La Plata



Source: Bureau of Reclamation

The project includes a pumping plant on the Animas River, an underground pipeline to carry water from the pumping plant to the reservoir and an off-stream reservoir, Lake Nighthorse.

The reservoir, named after former U.S. Senator Ben Nighthorse Campbell, has a capacity of 120,000 acre-feet.

# Glen Canyon Dam



First Lady, Mrs. Lyndon B. Johnson, dedicates Glen Canyon Dam in 1966.

Source: Bureau of Reclamation

Glen Canyon Dam is just south of the Arizona/Utah border. Construction began in 1957 and was completed in 1964. The dam created Lake Powell, the second largest reservoir in the United States.

# Glen Canyon Dam and Lake Powell Fast Facts



- Lake Powell was formed by Glen Canyon Dam and named in honor of John Wesley Powell, who led a scientific expedition down the Colorado River through the Grand Canyon in 1869.
- Glen Canyon Dam, a concrete structure rising 710 feet above the Colorado River, was completed in 1963.
- Glen Canyon Dam is the largest facility of the Colorado River Storage Project, which supplies affordable electric power to throughout Utah, Colorado, Arizona and New Mexico.
- Glen Canyon Power plant has eight generators with a maximum combined capacity of close to 1.3 million kilowatts.
- The reservoir has a storage capacity of 24.3 million acre-feet, making it the second largest man-made reservoir in the country.



# Lower Basin Dams

In addition to Hoover, other dams along the Lower Colorado River are Parker, Davis, Palo Verde, Imperial, Laguna and Morelos.

These dams and related aqueducts provide water to many cities, including Phoenix, Tucson, Las Vegas, Los Angeles and San Diego.

To learn more about the Lower Colorado River, visit the [Lower Colorado River Authority](#) website.



Palo Verde Diversion Dam  
Source: Bureau of Reclamation



*Lake Powell*

**Glen Canyon Dam**

*Lake Mead*

**Hoover Dam**

*Lake Mojave*

**Davis Dam**

*Lake Havasu*

**Parker Dam**

*Imperial Reservoir*

**Imperial Dam**

**Laguna Dam**

NASA Terra  
MODIS April 8, 2003

# Hoover Dam



Built during the Depression, the largest dam of its time took less than five years to construct and complete in 1936. Hoover Dam is a National Historic Landmark and has been rated by the American Society of Civil Engineers as one of America's Seven Modern Civil Engineering Wonders.

The dam created Lake Mead, the largest reservoir in the United States in maximum capacity of 28 million acre-feet.



# Davis Dam



About 70 miles downstream from Hoover Dam on the border between Arizona and Nevada is Davis Dam. Completed in 1951, the dam is 200 feet high and is owned and operated by Reclamation. Davis Dam forms Lake Mojave.

# Parker Dam



Parker Dam, built between 1934 and 1938, is 155 miles downstream of Hoover Dam on the border of California and Arizona. It is 320 feet high, of which 235 feet are below the riverbed, making it "the deepest dam in the world." The Metropolitan Water District financed the construction of the dam to create a forebay to pump water through the Colorado River Aqueduct.

The dam forms Lake Havasu, which can store 647,000 acre-feet – more than 210 billion gallons – of water.

# Imperial Dam



Imperial Diversion Dam is 18 miles northeast of Yuma on the California/Arizona border. Completed in 1938, the dam diverts water into the All-American Canal for delivery to the Imperial and Coachella valleys in California, to the Yuma Project in Arizona and California and to the Gila Project in Arizona.



# Laguna Dam



Source: [Aquaformia.com](http://Aquaformia.com)

A rock-filled diversion dam, Laguna Dam was the first dam constructed on the Lower Colorado River Basin. Built between 1903 and 1905 and located 13 miles northeast of Yuma, it ended boat travel.

# Warren H. Brock Reservoir



Brock Reservoir  
construction  
Source: Bureau of Reclamation

The new \$150 million Warren H. Brock Reservoir – in California’s Imperial Valley – is used to capture water historically lost downstream to Mexico when flows in the Colorado River could not be used or stored in the United States – often when weather conditions, such as rainfall events, result in farmers in Arizona and California not being able to take the water they ordered. The reservoir consists of two basins that hold water from the All-American Canal until it can be used for nearby agriculture.

# Warren H. Brock Reservoir

The local storage project was introduced in the 2007 Interim Guidelines. Reclamation estimates the reservoir could save as much as 70,000 acre-feet a year.





# Morelos Dam



Source:  
LACreekFreak.wordpress.com  
by Josh Link

The Morelos Dam is located where the Colorado River meets the Mexican Border in Los Algodones, Baja California, Mexico. The dam is the diversion point for the Alamo Canal waters which flow west to the agricultural fields in Mexicali.

# The Colorado River as an Economic Force



Hoover Dam tours are popular with the public.

Recreational enterprises on the Colorado River are the 19<sup>th</sup> largest employer on the Fortune 500, fueling economies in Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming according to a 2012 study "[Colorado River, Inc.: The \\$26 Billion Recreation Resource Employing a Quarter Million Americans.](#)"

# The Colorado River as an Economic Force

The study released by [Protect the Flows](#) in partnership with [Southwick Associates, Inc.](#) found that 5.36 million adults use the Colorado River and its tributaries for recreational activities each year, contributing significantly to the economic growth in six of the Basin states.

If the Colorado River were a company, it would rank **#155** in the 2011 Fortune 500 ahead of companies like General Mills, US Airways, and Progressive Insurance, and would be the **19th** largest employer in the Fortune 500.



[Protectflows.com](http://Protectflows.com)



# The Colorado River as an Economic Force

## **River-related recreation:**

- Produces \$26 billion in economic output
- Supports 234,000 jobs in six states
- Generates \$17 billion in retail sales
- Creates \$10.4 billion in annual earnings, salaries and wages
- Out-performs regional farming revenues by 14.6% on average
- Contributes \$3.2 billion in federal, state and local tax revenue annually
- Provides enough state and local tax revenues to fund over 29,000 teacher positions

# Challenges: Today and the Future

The Colorado River Basin faces many challenges: Climate change is looming and is expected to decrease the water supply because snowmelt in the Colorado River Basin is occurring earlier, reducing runoff and the amount of crucial water available downstream.

Population is growing; more water projects are planned; species are on the brink of extinction; oil, gas and mineral exploration near the river is increasing, and invasive species are threatening the river habitat.

All combined, these challenges put incredible pressure on the Colorado River system.



# Water Conservation

Water conservation efforts will need to remain at the forefront to permit the river's waters to be used more efficiently for a growing population. Significant savings already have been achieved by conservation.



Cisterns, like in Tucson (above) collect rainwater and can be used for toilet flushing and drip irrigation.



# Water Conservation

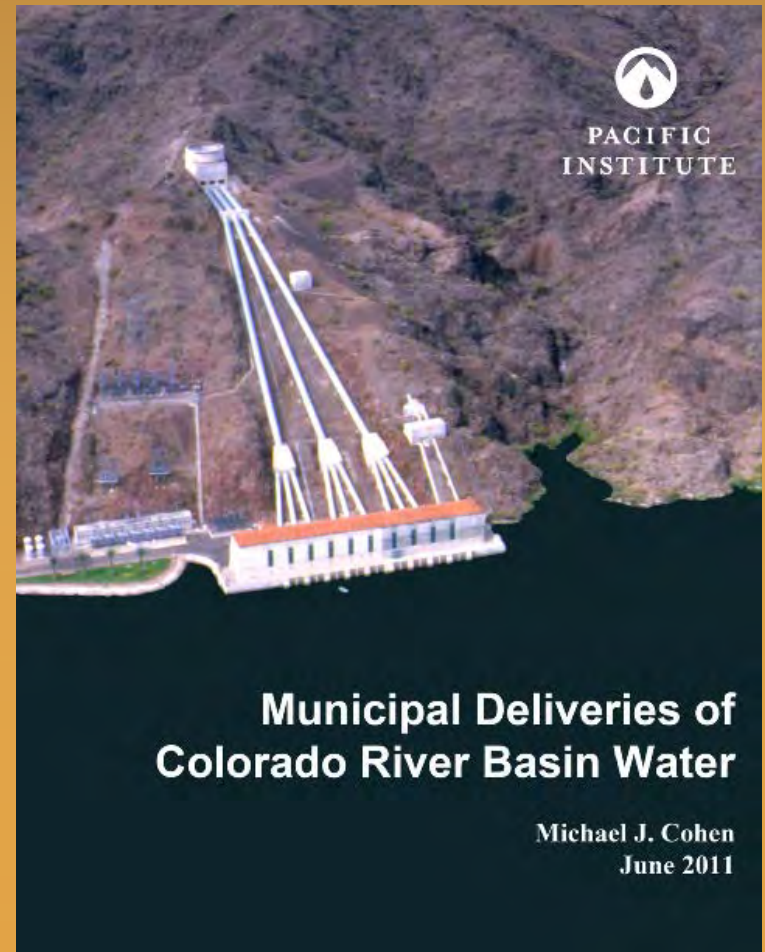


Major communities have reduced per-capita demand on the river an average of 1% or more between 1990 and 2008, according to a 2011 study by the Pacific Institute. In all, that's 2 million acre-feet of water saved – enough to supply Los Angeles for about three years.

# Municipal Deliveries of Colorado River Basin Water Report

But as populations expand, water consumption is still increasing. The volume of water drawn from the Colorado River – by 100 municipal and regional water authorities – grew by 5 percent, according to study statistics.

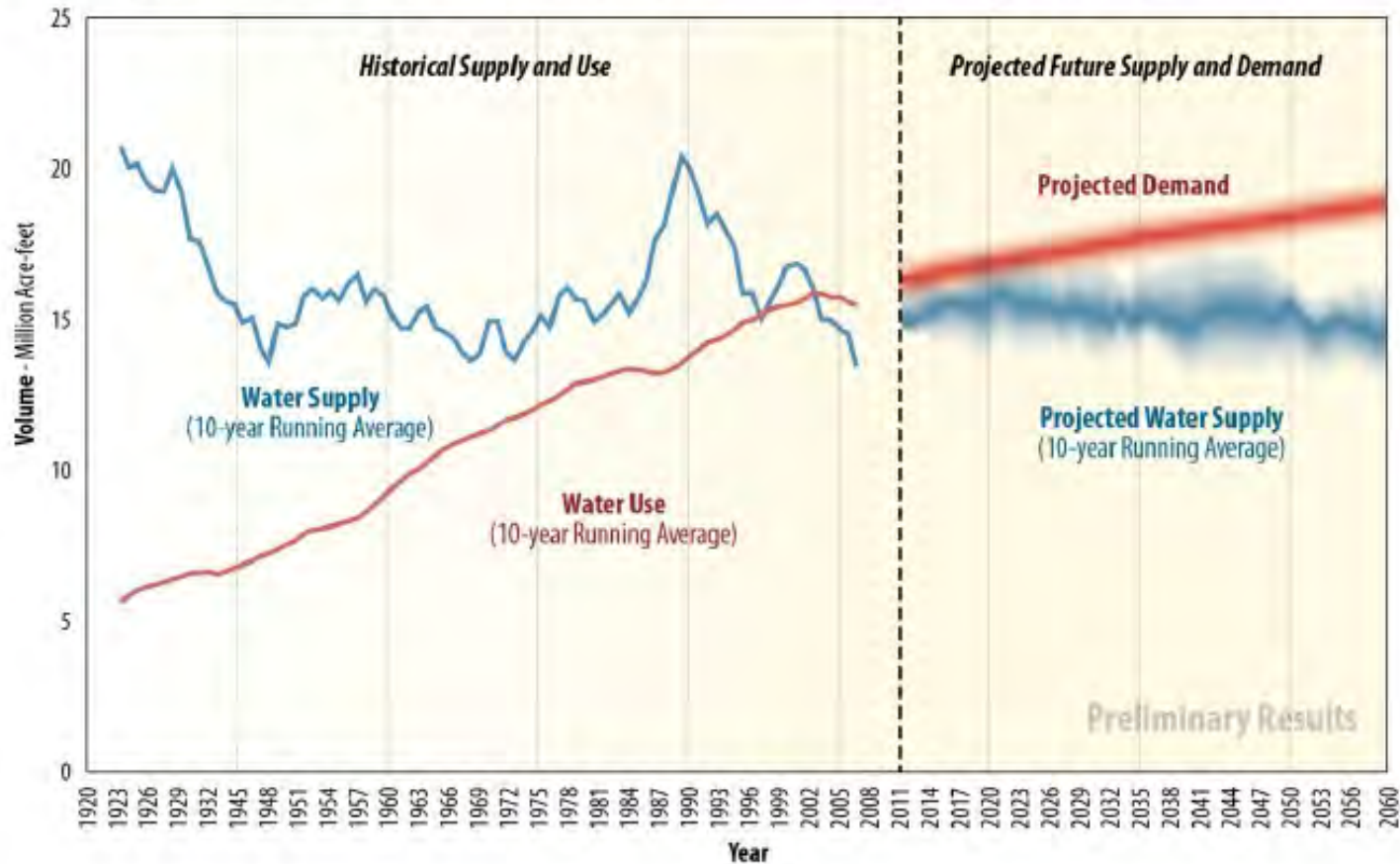
Read the entire [\*Municipal Deliveries of Colorado River Basin Water\*](#) report on the Pacific Institute's website.



# Colorado River Basin Study

**FIGURE 2**

Historical Supply and Use and Projected Future Colorado River Basin Water Supply and Demand



Both Upper and Lower Basin states and Reclamation teamed up to assess supply and demand imbalances in the future with and without possible climate change impacts.



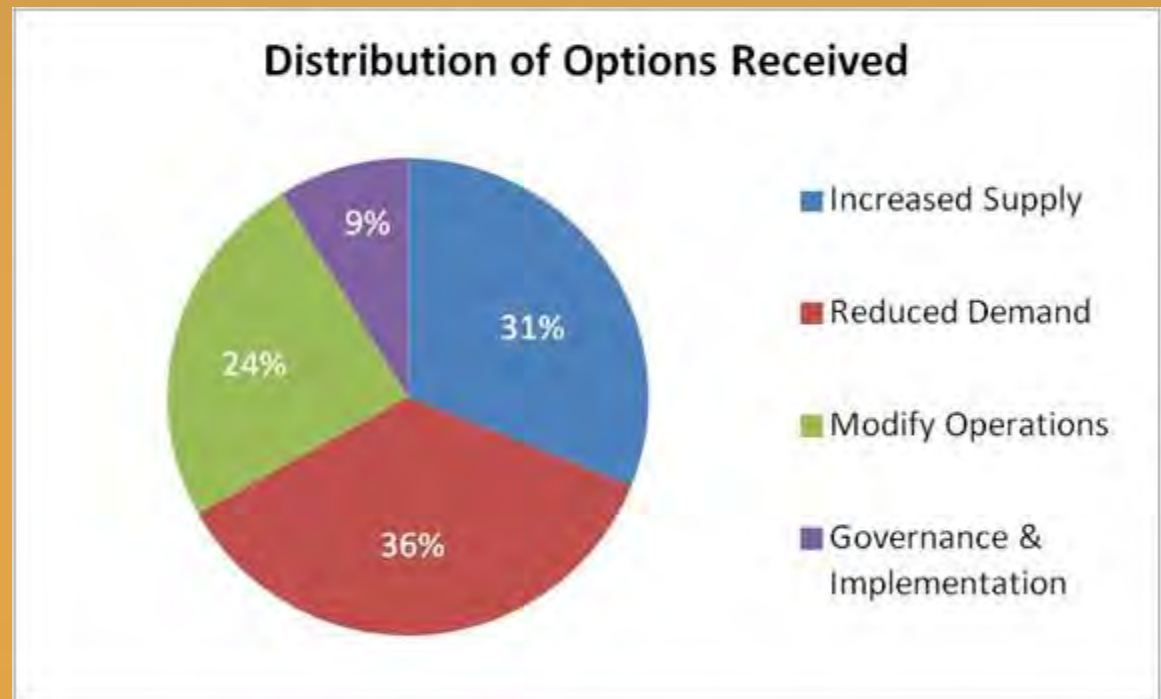
# Colorado River Basin Study

Due out in late 2012, the report will look at current and future conditions for the next 50 years. The report will consider water allocations under the [Law of the River](#); hydroelectric power generation; recreation; fish, wildlife and their habitats; water quality; flow and water-dependent ecological systems and flood control.

Click here to learn more about the [Colorado River Basin Water Supply and Demand Study](#) at the Reclamation website.

Public input was sought for ideas on a broad range of potential options to help resolve projected water supply and demand imbalances in the Basin.

More than 140 ideas were submitted. Options were separated into four main categories based on their approach for resolving the imbalance: Increased Supply, Reduced Demand, Modify Operations, and Governance and Implementation..

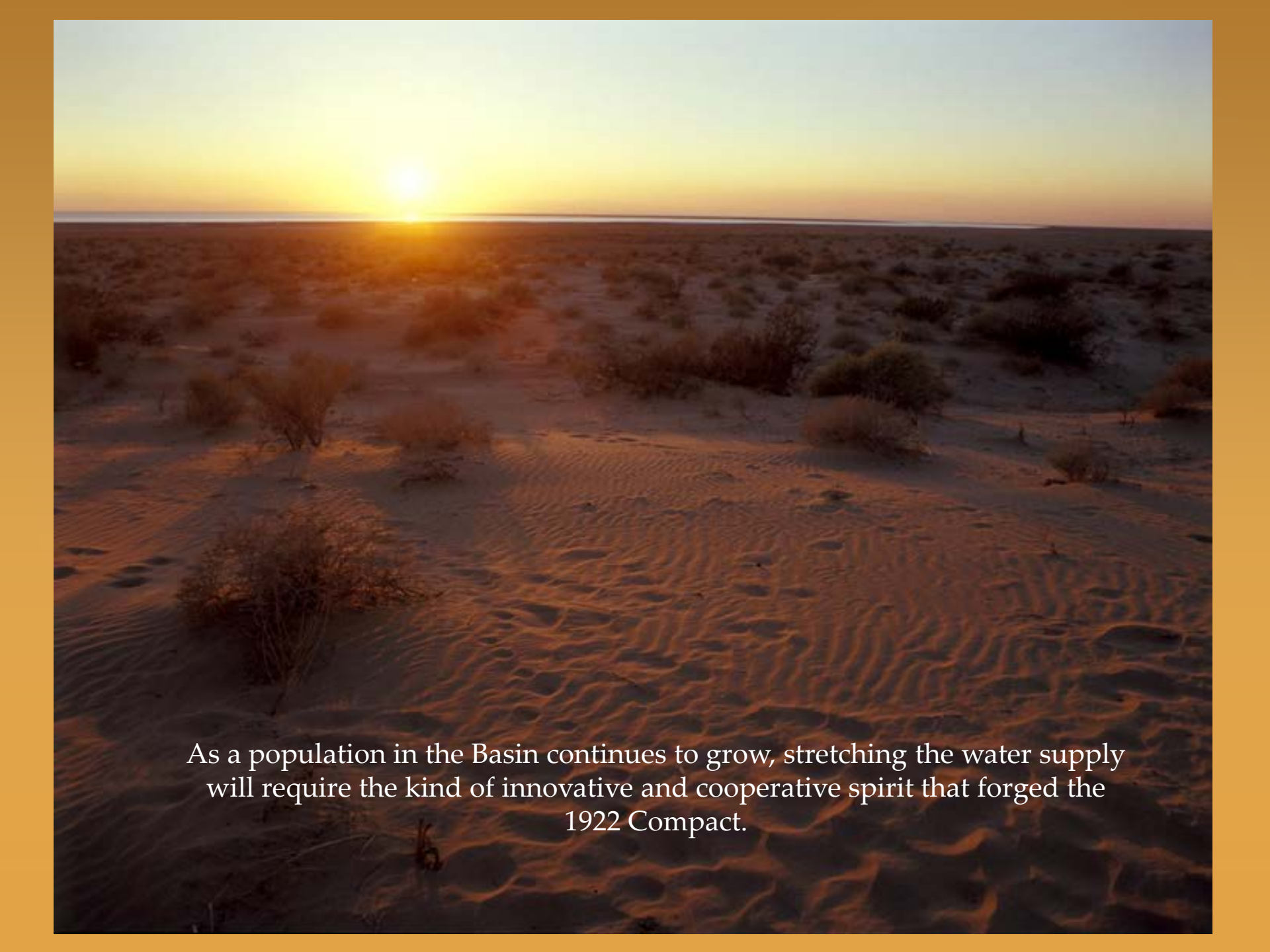


# Options for the Future

The **Augmentation Options Report** is part of a 2007 agreement. Released in 2008, the report provides technical information for water managers to help them base future recommendations.

The report details 12 suggestions to secure water for the future. Among the suggestions were these:

- Brackish water desalination
- Conjunctive use (banked water)
  - Ocean water desalination
    - River basin imports
    - Stormwater storage
  - Vegetation management
    - Water reuse
  - Weather modification



As a population in the Basin continues to grow, stretching the water supply will require the kind of innovative and cooperative spirit that forged the 1922 Compact.



The balance of life and environment in the Southwest depends on how this resource is managed today and in the future. With so much at stake, most people hope the parties will continue to work together and forge agreements rather than resort to litigation.

*“Open and inclusive dialogue, as painful as it is at times, is the best approach to real and, more important, lasting solutions to even the most difficult of water issues.”*

Michael L. Connor, Reclamation Commissioner, June 9, 2011



Michael Connor with the Water Education Foundation's Executive Director Rita Schmidt Sudman during an interview for the Foundation's Fall 2010 *River Report*.

# Who's Involved

- Bureau of Reclamation [www.usbr.gov](http://www.usbr.gov)
- Central Arizona Project [www.cap-az.com](http://www.cap-az.com)
- Coachella Valley Water District [www.cvwd.org](http://www.cvwd.org)
- Colorado River Water Conservation District [www.crwcd.org](http://www.crwcd.org)
- Colorado River Water Users Association [www.crwua.org](http://www.crwua.org)
- Colorado Watershed Assembly [www.coloradowater.org](http://www.coloradowater.org)
- Department of Interior [www.doi.gov](http://www.doi.gov)
- Environmental Defense Fund <http://www.edf.org/>
- Environmental Working Group <http://www.ewg.org/>
- Imperial Irrigation District [www.iid.com](http://www.iid.com)
- International Boundary and Water Commission [www.ibwc.state.gov](http://www.ibwc.state.gov)
- Las Vegas Valley Water District [www.lvvwd.com](http://www.lvvwd.com)
- Lower Colorado Region Website [www.usbr.gov/lc](http://www.usbr.gov/lc)
- Metropolitan Water District of Southern California [www.mwdh2o.com](http://www.mwdh2o.com)
- National Oceanic and Atmospheric Administration: Colorado Basin River Forecast Center [www.cbrfc.noaa.gov/](http://www.cbrfc.noaa.gov/)
- Natural Resources Defense Council [www.nrdc.org/](http://www.nrdc.org/)
- Nature Conservancy [www.nature.org](http://www.nature.org)
- Pacific Institute <http://www.pacinst.org/>
- San Juan Water Commission [www.sjwc.org](http://www.sjwc.org)
- Southeastern Colorado Water Conservancy District [www.secwcd.org](http://www.secwcd.org)
- Southern Nevada Water Authority <http://www.snwa.com/index.html>
- Wellton-Mohawk Irrigation and Drainage District <http://www.wellton-mohawk.org>