

SCIENCE BE
DAMMED
HOW IGNORING
INCONVENIENT SCIENCE
DRAINED THE COLORADO
RIVER
UNIVERSITY OF ARIZONA PRESS

Eric Kuhn and John Fleck
May 12, 2022

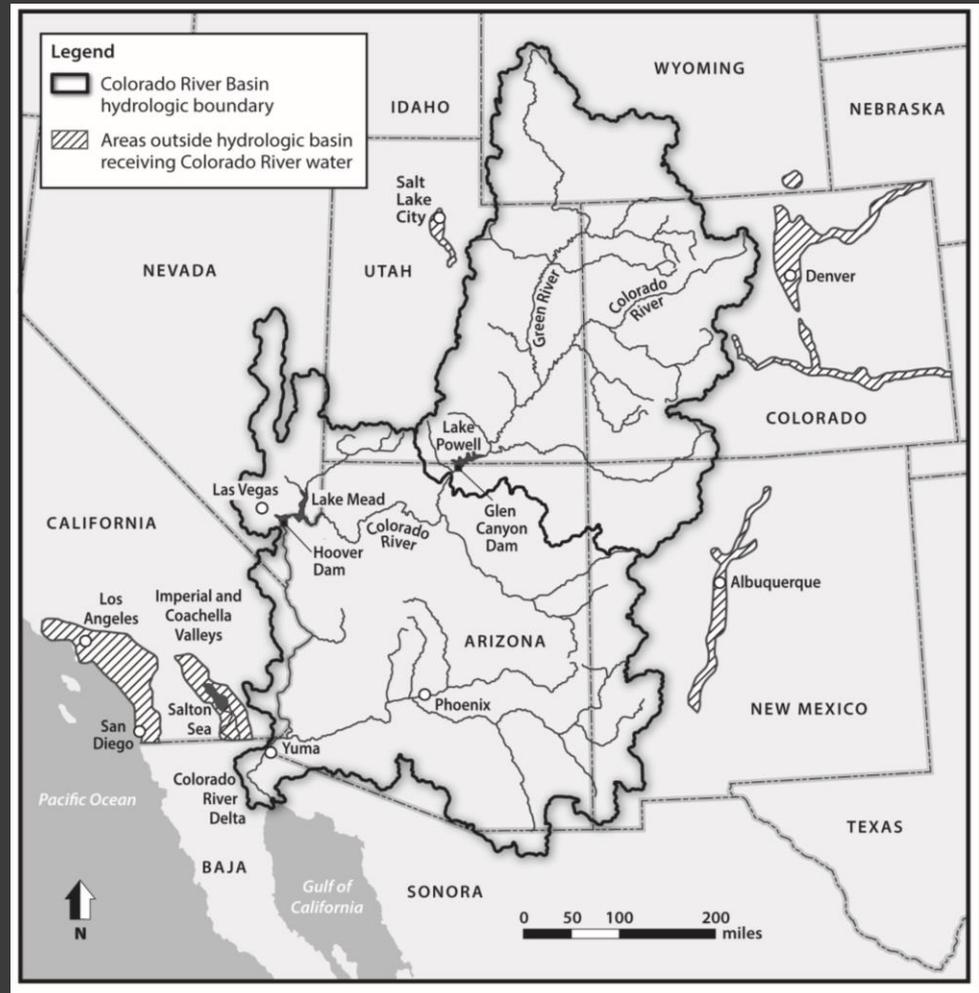
ERIC KUHN AND JOHN FLECK

SCIENCE BE DAMMED

How Ignoring Inconvenient Science
Drained the Colorado River



- Two nations
- Nine states
 - Seven US
 - Two in Mexico
- 30 Indian Tribes
- 5+ million acres of irrigated farmland
- 40-ish million people



WHERE WE'RE AT IN THE COLORADO RIVER BASIN

Combined Storage, Lakes Mead and Powell

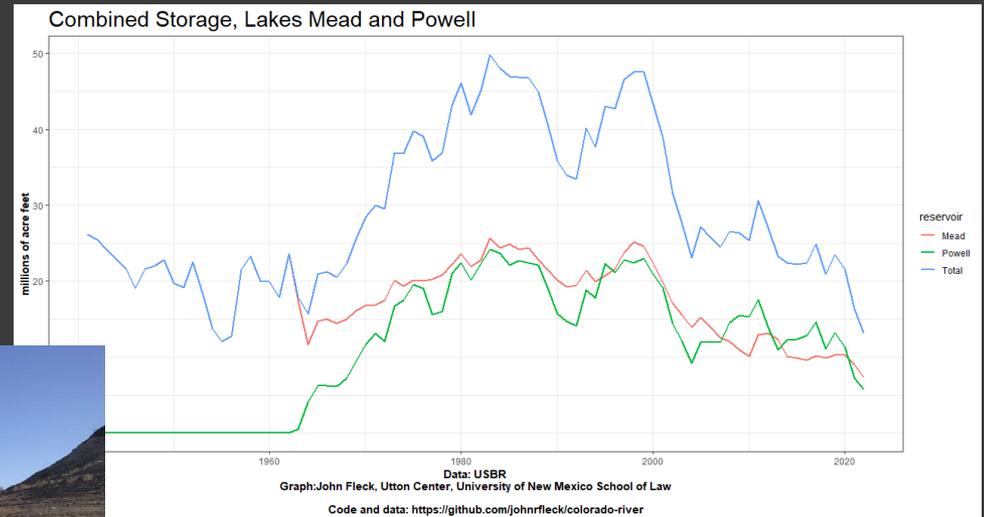


Data: USBR

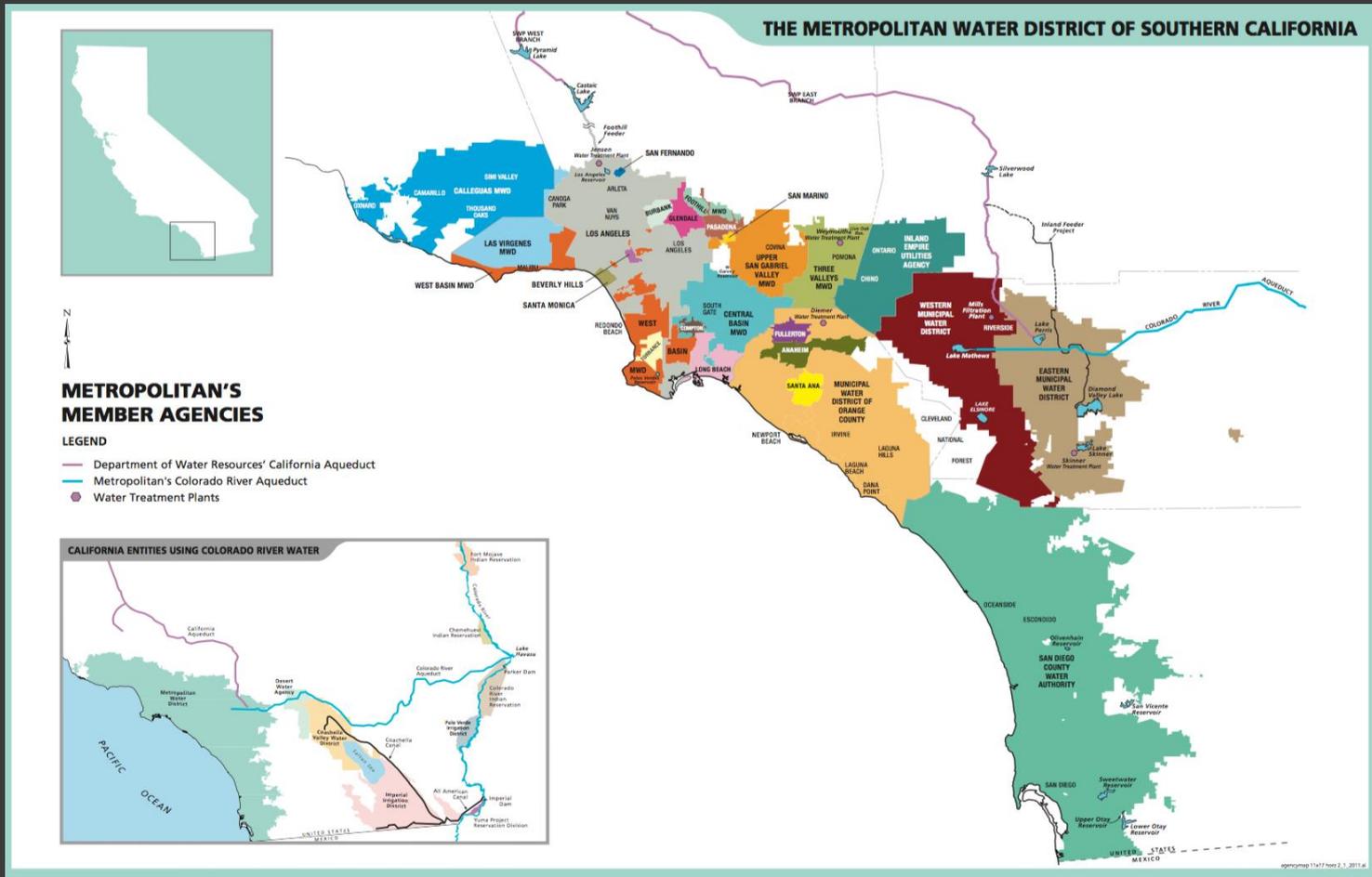
Graph: John Fleck, Utton Center, University of New Mexico School of Law

Code and data: <https://github.com/johnrfleck/colorado-river>

WHERE WE'RE AT IN THE COLORADO RIVER BASIN



WHY THIS MATTERS IN SOUTHERN CALIFORNIA



17.5 maf Webb/Boyer p.46 - Compact Commission
17,500,000 at Boulder Canyon - Fall-Davis 1922 p16 pdf
17,550,000 Fall-Davis p.11 of pdf
17 m @ Yuma - LaRue, 1916, p.23
16.2 m @ Yuma - LaR, 1916 chart @ 192
11.7 - Hill, 1953 - 1930-53 - Roisman p262

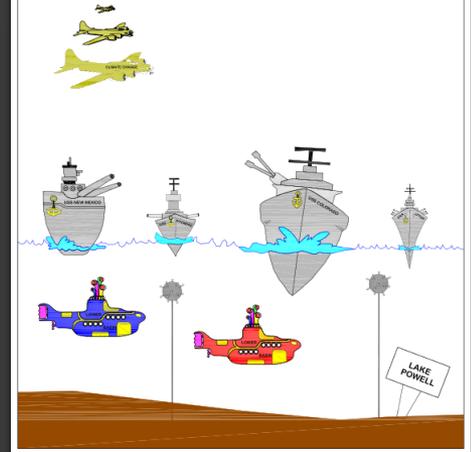


The Colorado River
The Story of a Quest for Certainty on a Diminishing River



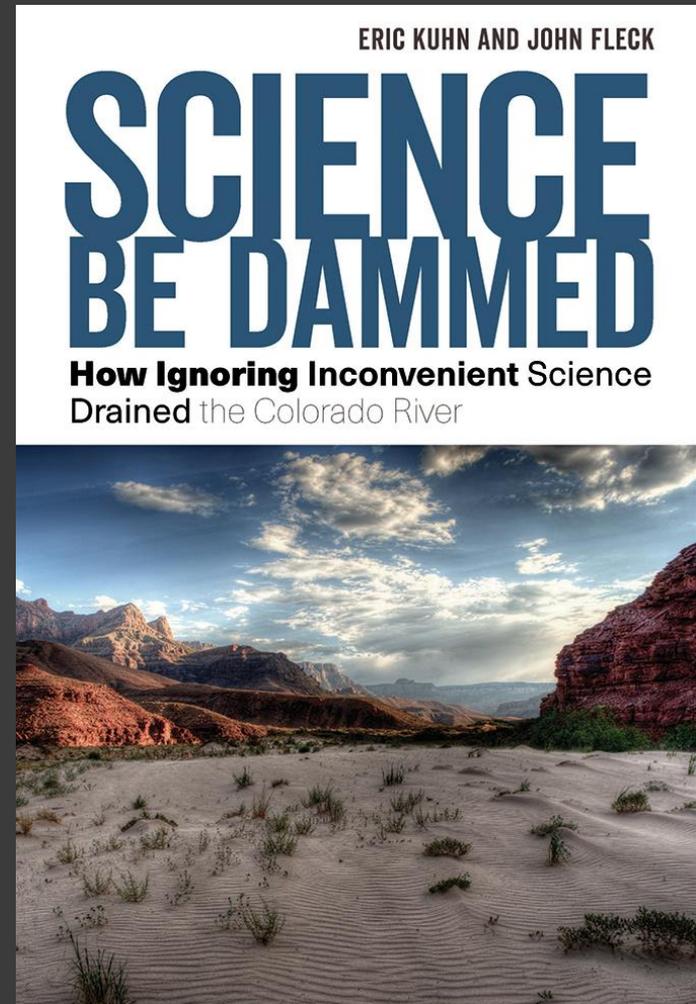
Eric Kuhn
Roundtable Edition
May 8, 2007

**RISK MANAGEMENT STRATEGIES
FOR THE
UPPER COLORADO RIVER BASIN**
ERIC KUHN



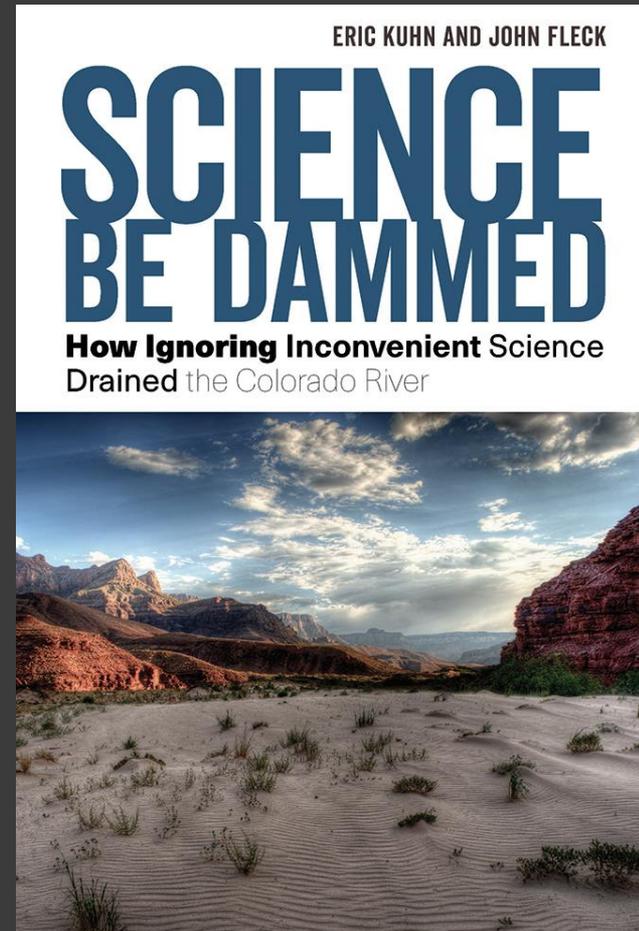
BOOK'S BASIC MESSAGES

- The river's flow – what did we know, when did we know it, and how did we use it?



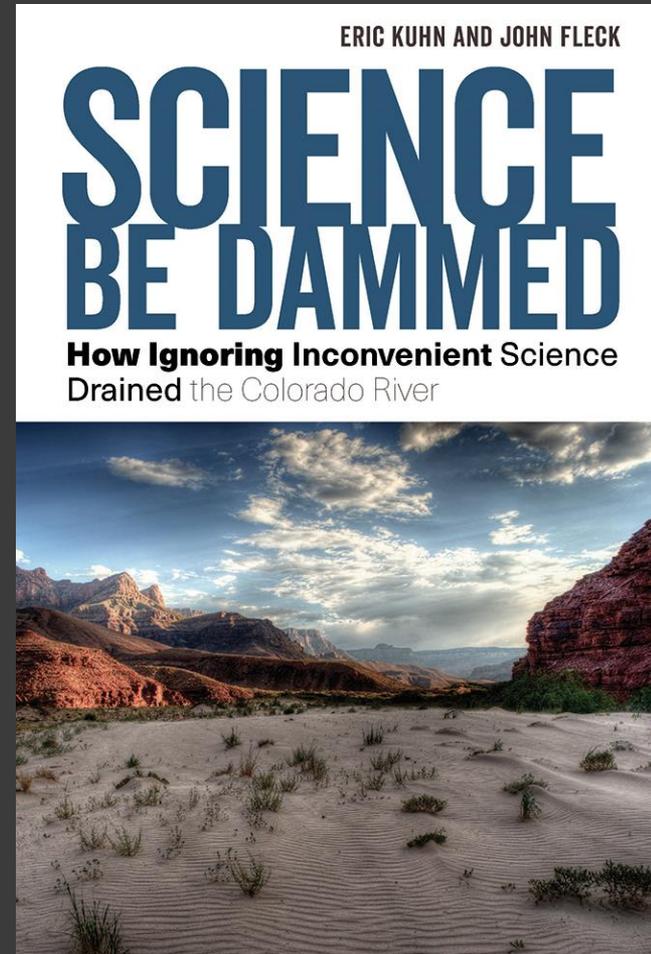
BOOK'S BASIC MESSAGES

- That the compact negotiators did the best they could with a limited but wet record (1899 - 1920) is a largely a myth.



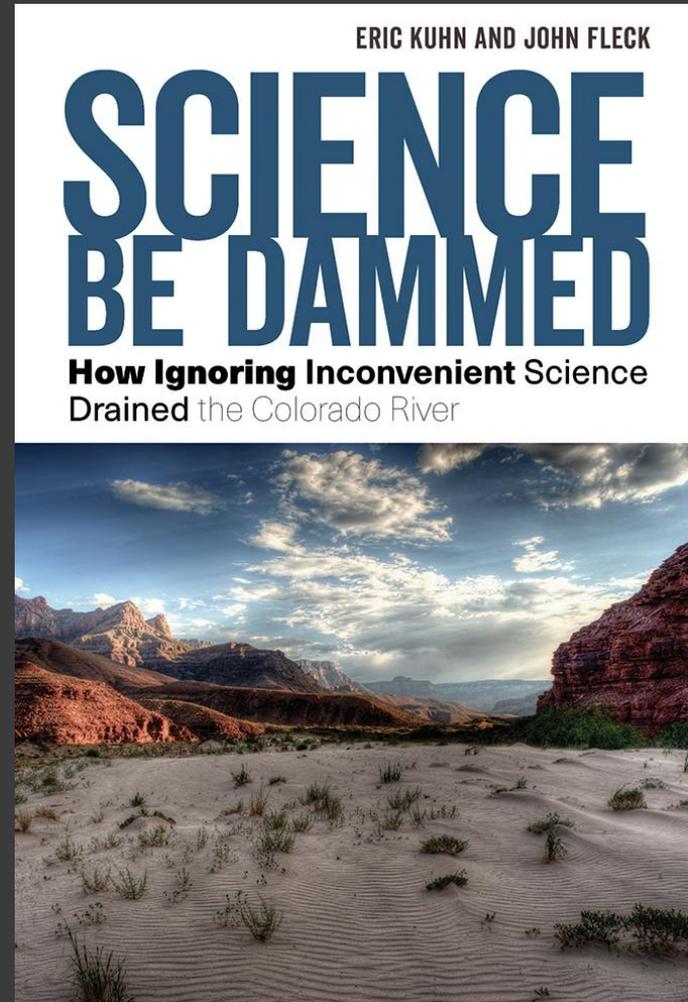
BOOK'S BASIC MESSAGES

- When the foundations of the river allocation laws were developed -1922 Compact, 1928 Boulder Canyon Project Act, and the 1944 Mexican Treaty – available science suggested a smaller river (about 15 MAF/Year @ Lee Ferry).



BOOK'S BASIC MESSAGES

- Decisions about supply were too often driven by politics and the “marketing” of projects NOT the available data.



What happens next?

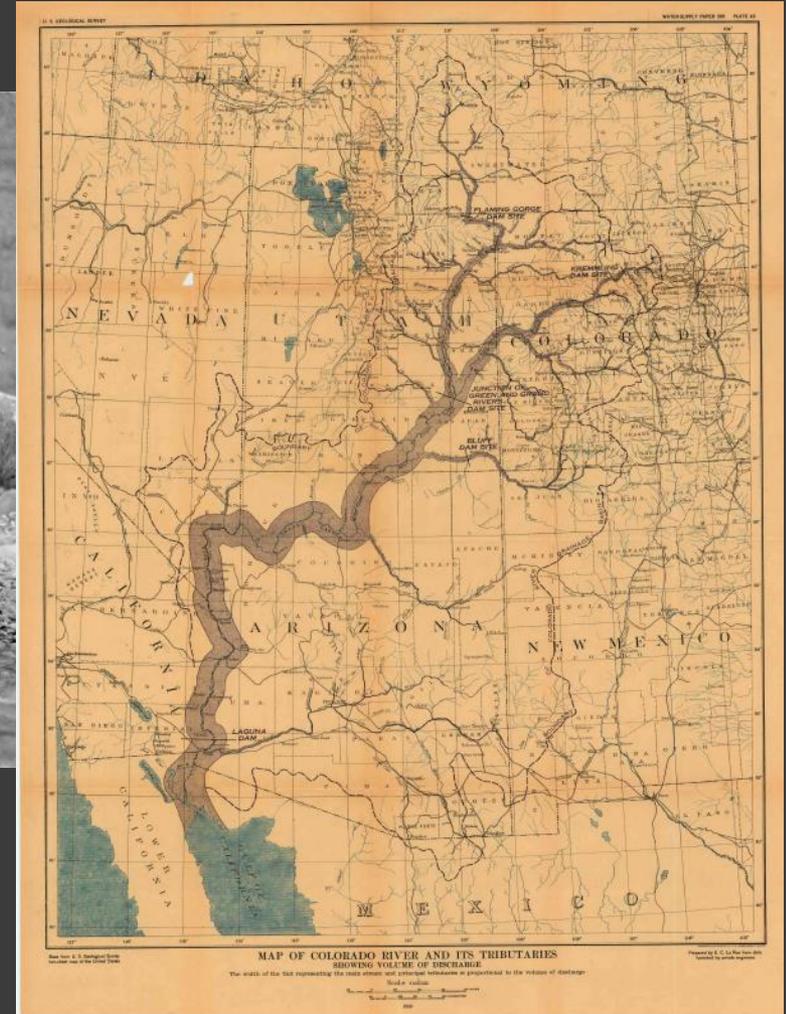
The next 100 years will require Herculean conservation efforts, innovative supply projects, and an expansive interpretation of the 1922 Compact.

E.C. LaRue, the scientist we ignored



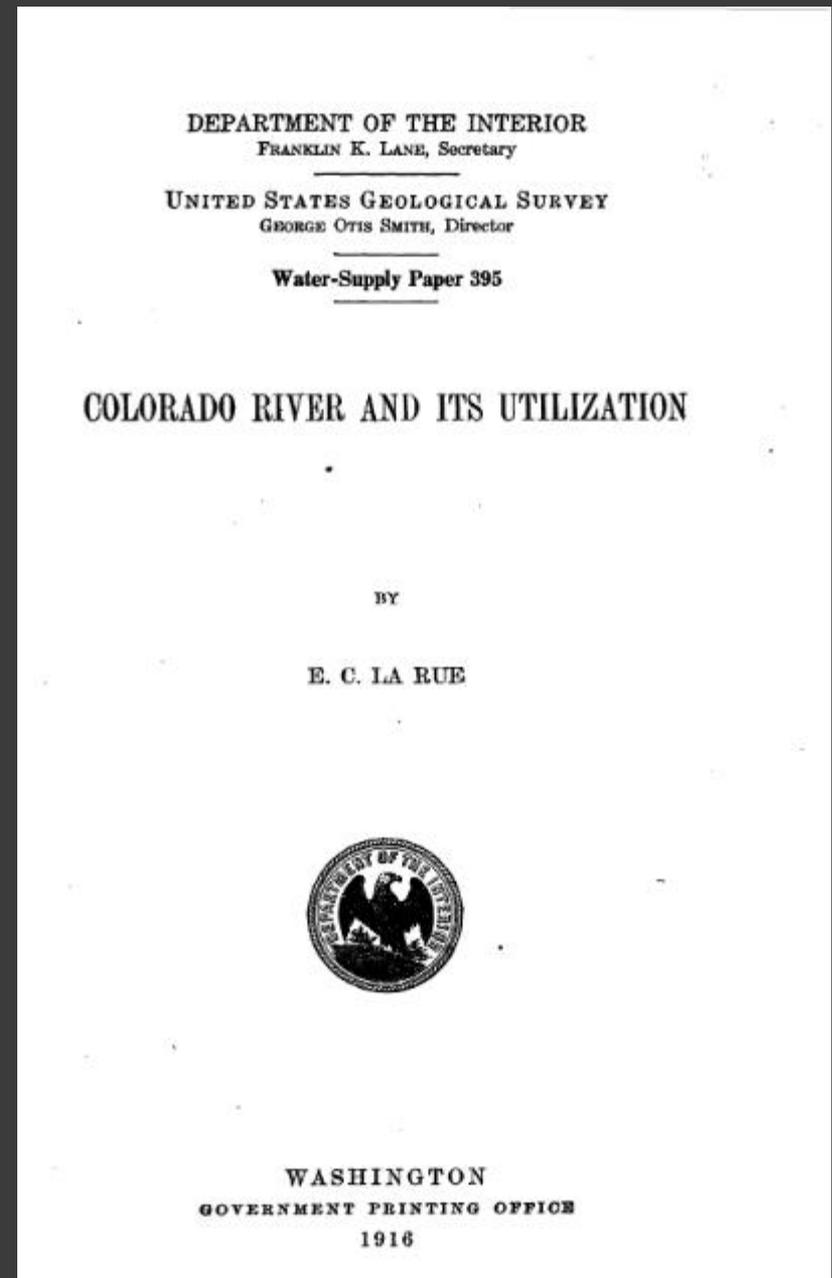
88

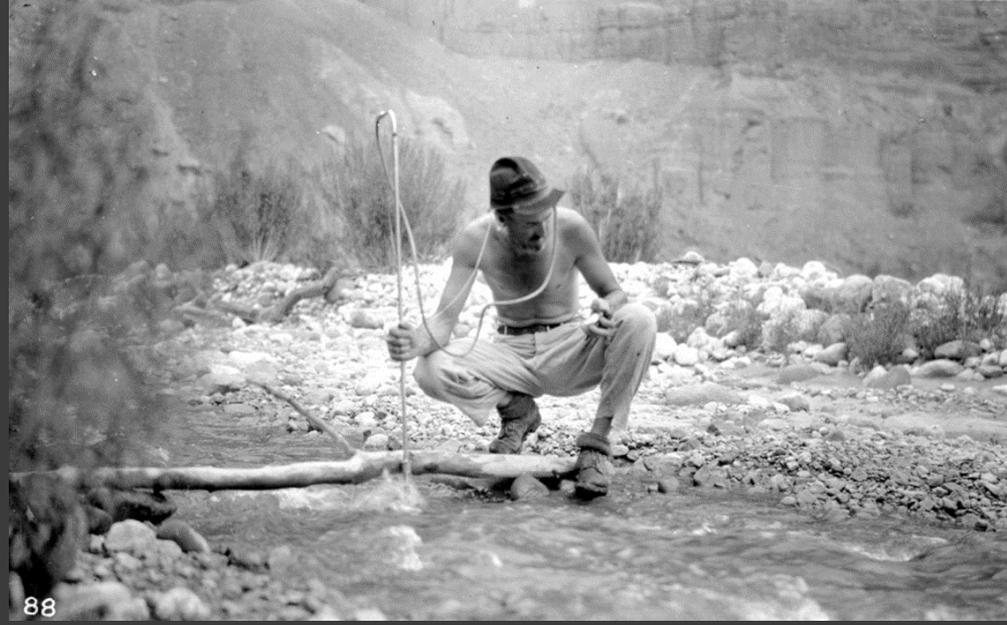
Eugene Clyde LaRue, USGS, measuring the flow of Nankoweap Creek in the Grand Canyon, 1923, USGS photo



1916 – six years
before the
Compact

E.C. LaRue's first
attempt to go
beyond the
gauge record





“The flow of the Colorado River and its tributaries is not sufficient to irrigate all the irrigable lands lying within the basin.”

- E.C. LaRue, USGS Water Supply Paper 395, 1916



Note:
Similar to the Basin Study, the scope of the Moving Forward effort is limited to the portion of the Basin and adjacent areas that receive Colorado River water within the U.S.

The Great Salt Lake as a climate proxy

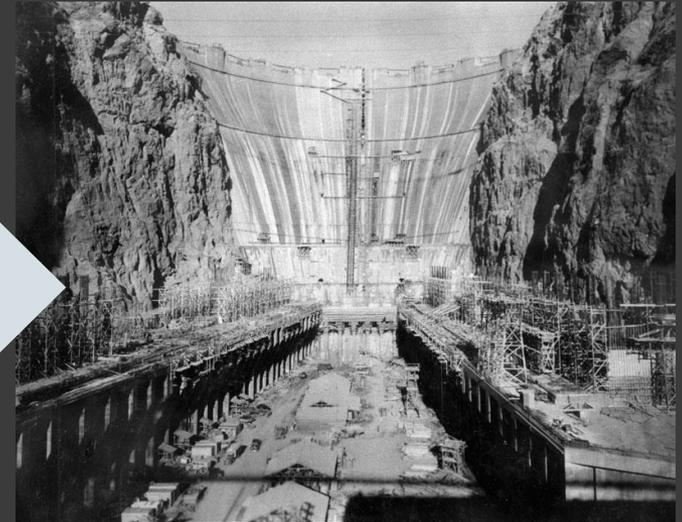


1916
LaRue's
first
warning

1925
LaRue's
second
warning

1922
Colorado
Compact
negotiated

1929
Colorado
River
Compact
ratified



**“sufficient water for the irrigation of
all the lands”**

– A.P. Davis, 1922



investigations had reached a point where I felt confident that with proper and sufficient conservation which was thought advisable there would be sufficient water for the irrigation of all the lands that could be favorably reached from the standpoint of economics within or adjacent to the Colorado Basin, not only by gravity but by reason-

**Arthur Powell Davis, director, U.S.
Reclamation Service, first meeting of the
Colorado River Compact Commission, Jan.
26, 1922**

“a twenty-year record ... is adequate”

- Delphus Carpenter,
Colorado River Compact
negotiations
- Carpenter's water budget
- Total water 20.5 MAF
- Above Lee Ferry 17.5 MAF
- LB incl tribs 3 MAF
- Compact allocations
- To the LB 8.5 MAF
- To the UB 7.5 MAF
- Surplus 4.5 MAF



GEORGE NOCK
PHOTOGRAPHER
1007 LYNN ST.
DALLAS, TEXAS

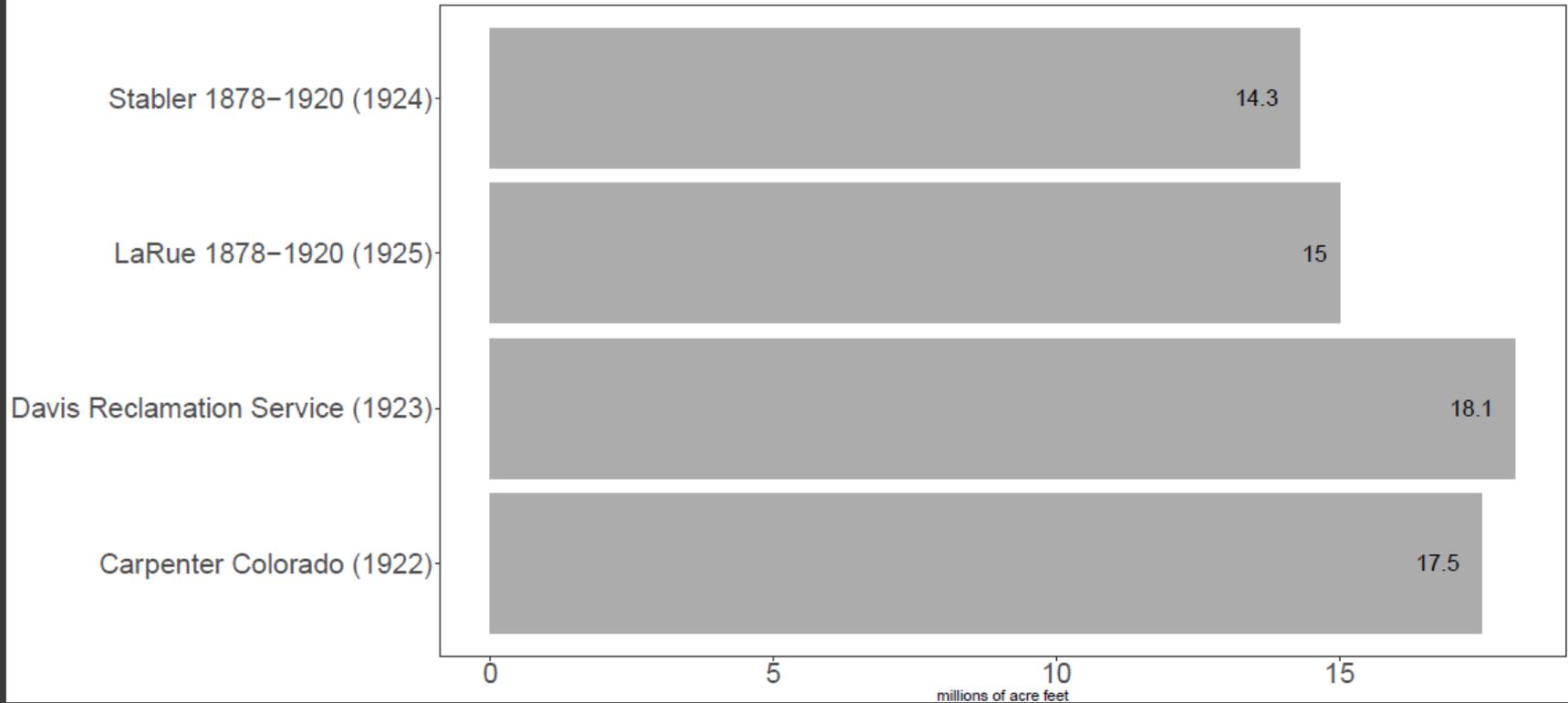
**Herman
Stabler,
USGS, 1923**

**Uses river stage
measurements at
the Yuma
railroad bridge to
estimate flows**

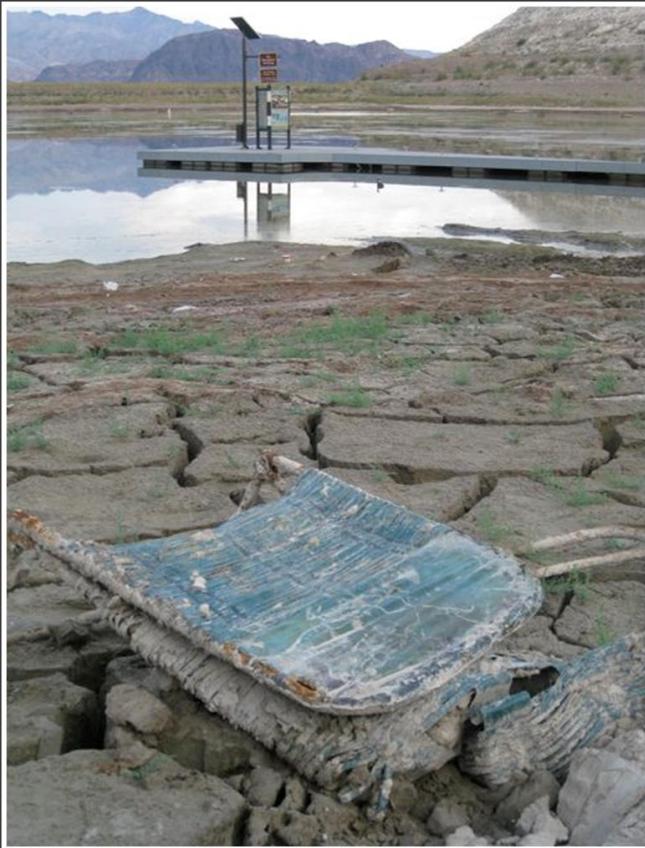
**1878 – 1920
14.3 MAF/yr @
Lees Ferry**



Estimates of Lee Ferry natural flow during the 1920s



Two kinds of risk



Hydrologic



Above are members of the Colorado River Commission. Left to right: Delph Carpenter, Colorado; W.S. Norviel, Arizona; Clarence Stetson, executive secretary of the commission; Herbert Hoover, US Secretary of Commerce; James Scroggum, Nevada; R.E. Caldwell, Utah; W.F. McClure, CA; Stephen B. Davis, Jr., NM; and Frank C. Emerson, Wyoming.

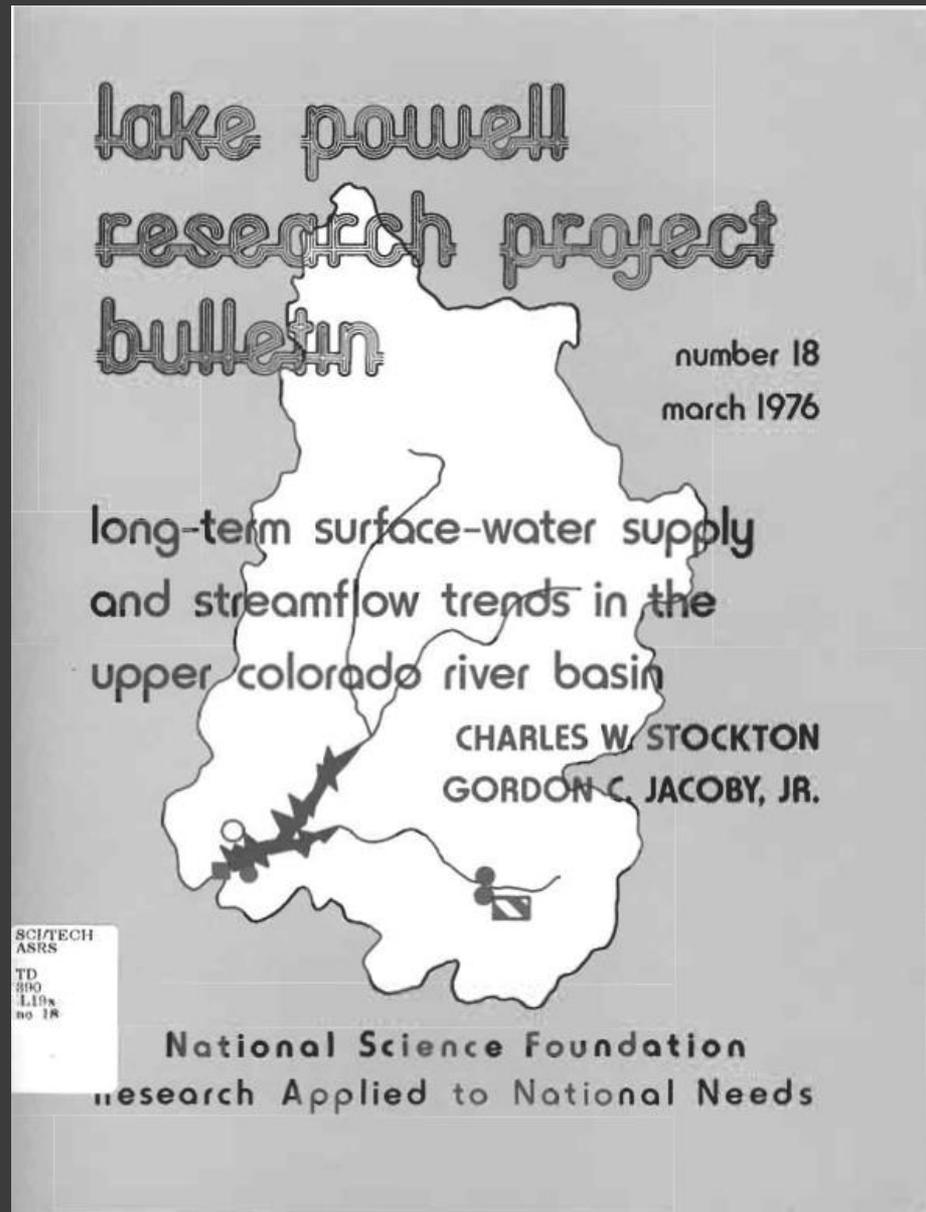
Institutional

WATER AVAILABILITY OVER TIME

- 1922 Colorado River Compact 20+ MAF/yr
- 1928 Boulder Canyon Project Act 20 MAF/yr
- 1944 Treaty with Mexico 18 MAF/yr
- 1948 Upper Colorado River Compact 17 MAF/yr
- 1968 CAP Authorization 16 MAF/yr
- Long-Term paleo-reconstructions 15.5 MAF/yr
- 2000-2021 Estimate 13.0 MAF/yr

Flows are estimated natural flows below Yuma
(not Lees Ferry)

We've known about the demand-supply imbalance for many decades. A 1976 tree ring study suggested a Colorado River ~25 percent smaller than the Colorado River Compact's allocations.



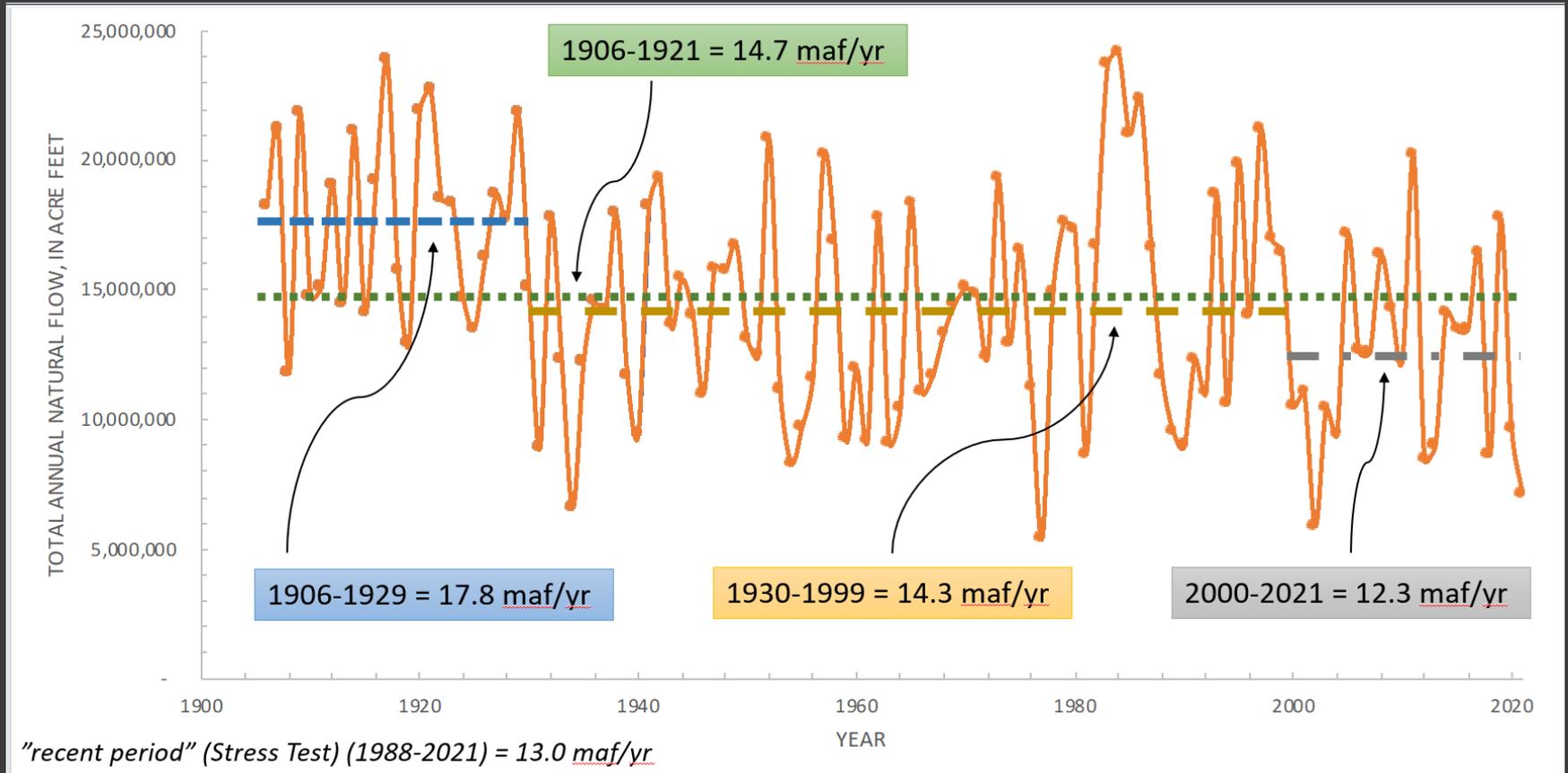
Climate change is already impacting the flow of the Colorado River. “Aridification” is drying out the Colorado River watershed. As temperatures rise, stream flows fall.

How is Climate Change Impacting Colorado River Flow?

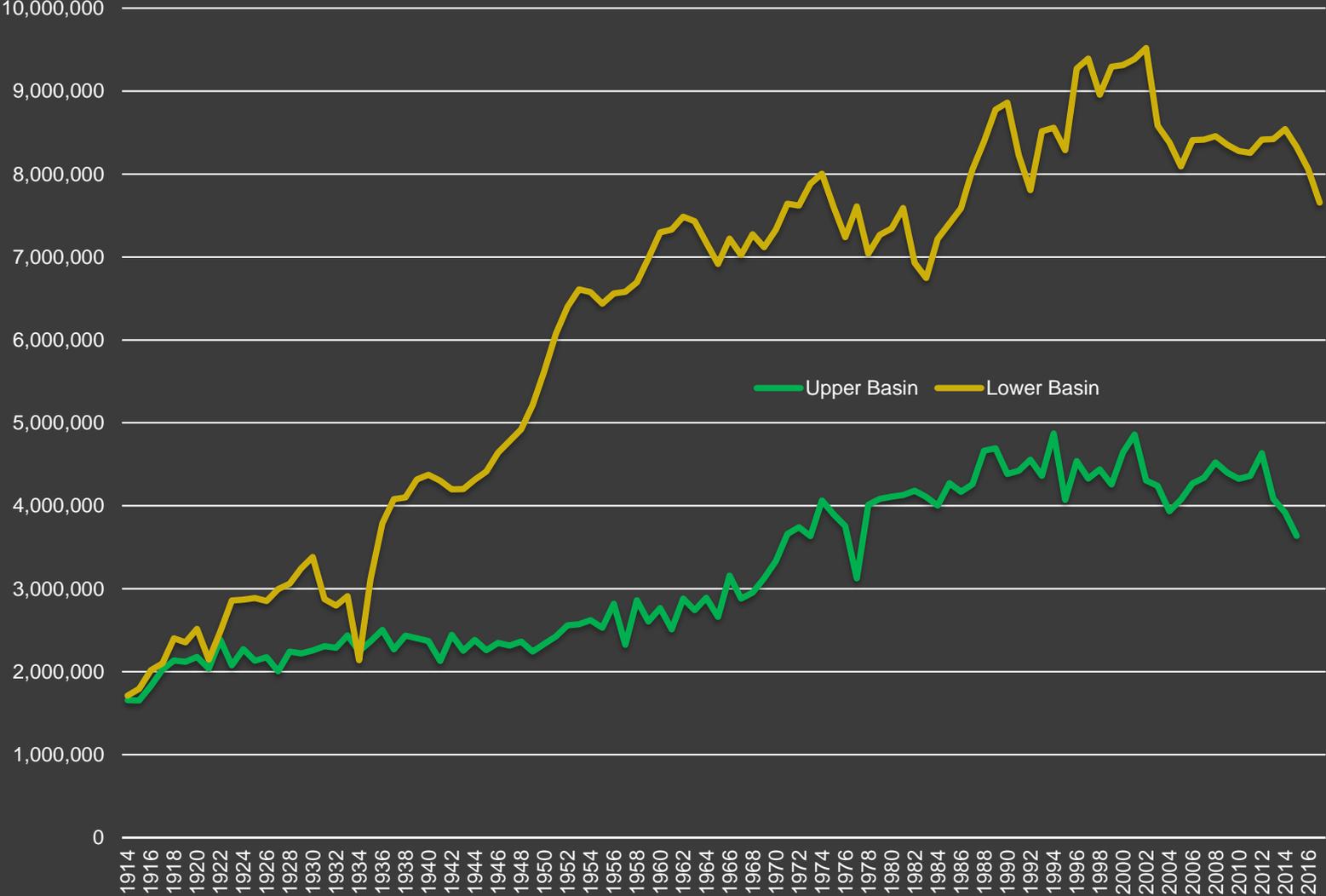
Brad Udall, Climate Scientist and Scholar, Colorado Water Center
Dr. Jonathan Overpeck, Samuel A. Graham Dean and Collegiate Professor,
School of Environment and Sustainability, University of Michigan

Since the 1970s, scientists have been interested in how runoff in the Colorado River Basin (CR Basin) would change as the climate warms. Many of these studies strongly suggested that the Colorado River (CR) would lose flow with warming, but in the last few years, scientists have been able to analyze a declining 20-year flow record, the ongoing 2000-2021 “Millennium Drought”. Multiple studies since 2016 have now found human fingerprints on the nearly 20% loss in flow since 2000 and attribute up to half of that loss to the approximately 1.2°C or more warming that has occurred during the last century. This article summarizes six key peer-reviewed studies related to the topic of CR flow loss. These studies have found declines in runoff efficiency, investigated the causes of flow loss, and in some cases made projections about future flow declines based on the 21st-century climate model projected temperatures.

THE RIVER THE COMPACT NEGOTIATORS DIVIDED UP NO LONGER EXISTS!



Colorado River Water Use



MESSAGES FOR THE RIVER'S FUTURE

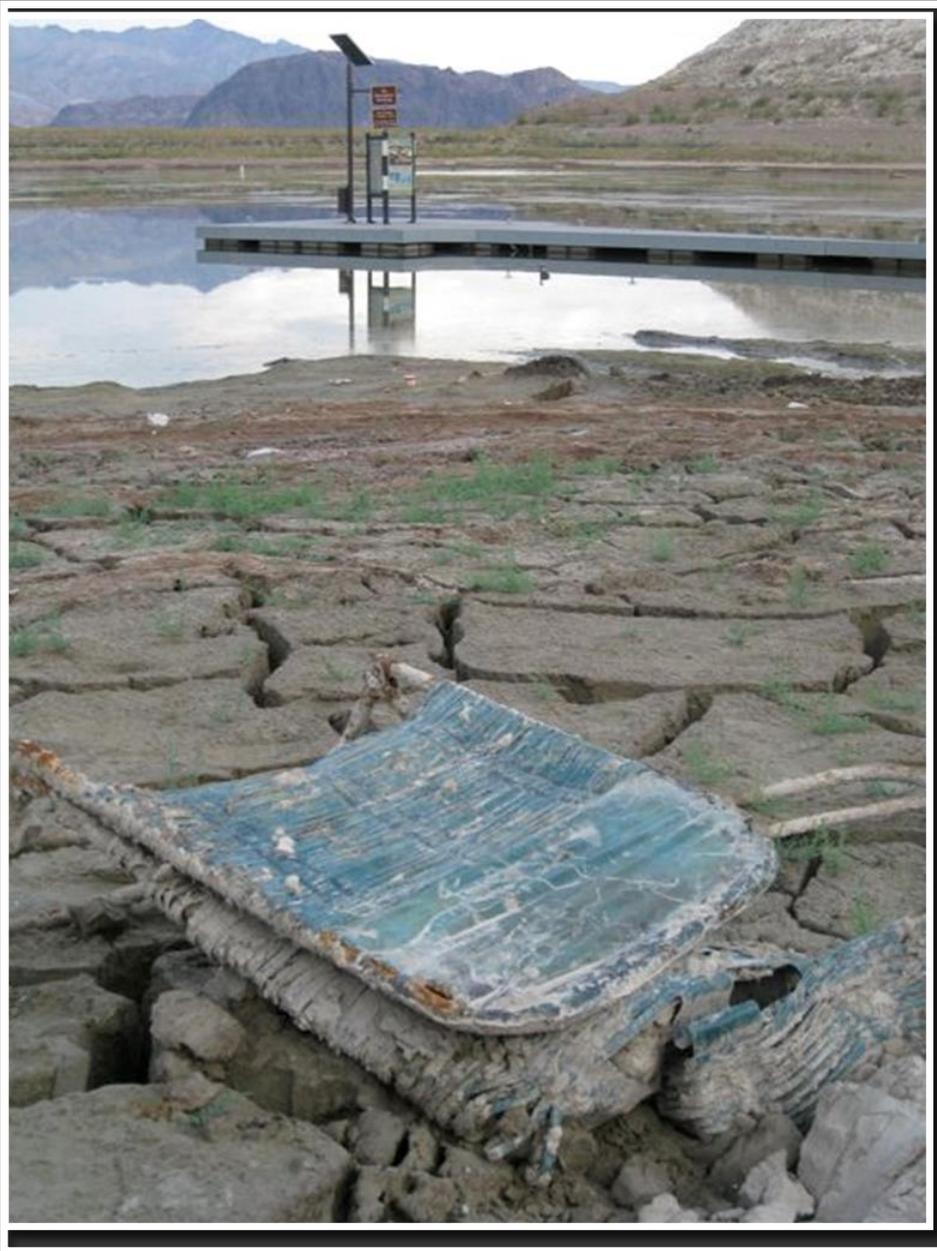
How will decision makers use the available science to inform their decisions?

Many of the disputed Compact issues from the 30s, 40s, 50s, 60s, & 70s have never been resolved – The UB's Mexican Treaty delivery, how apportionments are measured under the compact, the meaning of Articles III(a) & (b), and a LB compact that covers tributaries & res evaporation are a few.

Have they been forgotten? For the post 2026 River Management Guidelines, will these unresolved issues be resolved or ignored?

The concept of “equity” among states and between basins was a political driver, today the UB is using about 4.5 MAF/YR, the LB about 10 -11 MAF/YR

Much of the Law of the River was based on “certainty” – can we continue to have “fixed obligations” on a river plagued with deep uncertainty caused by climate change?



What does the future hold?

We're already in an era of deep hydrologic uncertainty – the climate we have today could be the wettest climate we see in the next hundred years.

Current rules aren't sufficient – they don't move quickly enough to reduce our use. All that conservation we've all done? It's only the start. More will be needed.

There will be less irrigated acreage in the Colorado River Basin in the future.

Our question – How do we do all of that?