



Rethinking How the United States and Mexico Share the Colorado River

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Eric Kuhn,¹ Anne Castle,² Carlos de la Parra,³ John Fleck,⁴ Jack Schmidt,⁵ Kathryn Sorensen,⁶ Katherine Tara⁷

ABSTRACT

Since 1945, the United States and Mexico have managed common interests on their two largest shared rivers systems, the Colorado and the Rio Bravo/Rio Grande, under the terms of the 1944 international treaty that was designed from the beginning with tools to adapt to changing hydrologic and societal conditions.

A recent emergency agreement on the Rio Bravo/Rio Grande illustrates what is possible, and with old river management rules on the Colorado both within the United States and between the United States and Mexico about to expire, we are at a moment of opportunity for meaningful change.

The core problem on the Colorado River, which we address in the analysis that follows, arose from decisions made in the first half of the 20th century to allocate fixed volumes of water. As usage patterns and hydrology change in the 21st century, fixed volumes no longer work. A shift to a percentage-based split between the United States and Mexico on the Colorado River, based on the river's actual natural flow, would provide a solid foundation for the two countries' joint management of the Colorado in the decades to come.

¹ Retired General Manager, Colorado River Water Conservation District.

² Senior Fellow, Getches-Wilkinson Center, University of Colorado Law School; former US Commissioner, Upper Colorado River Commission; former Assistant Secretary for Water and Science, US Dept. of the Interior.

³ Founder and Managing Partner, Centro Luken de Estrategias en Agua y Medio Ambiente, Tijuana, Mexico.

⁴ Writer in Residence, Utton Transboundary Resources Center, University of New Mexico.

⁵ Director, Center for Colorado River Studies, Utah State University; former Chief, Grand Canyon Monitoring and Research Center.

⁶ Director of Research, Kyl Center for Water Policy, Arizona State University; former Director, Phoenix Water Services.

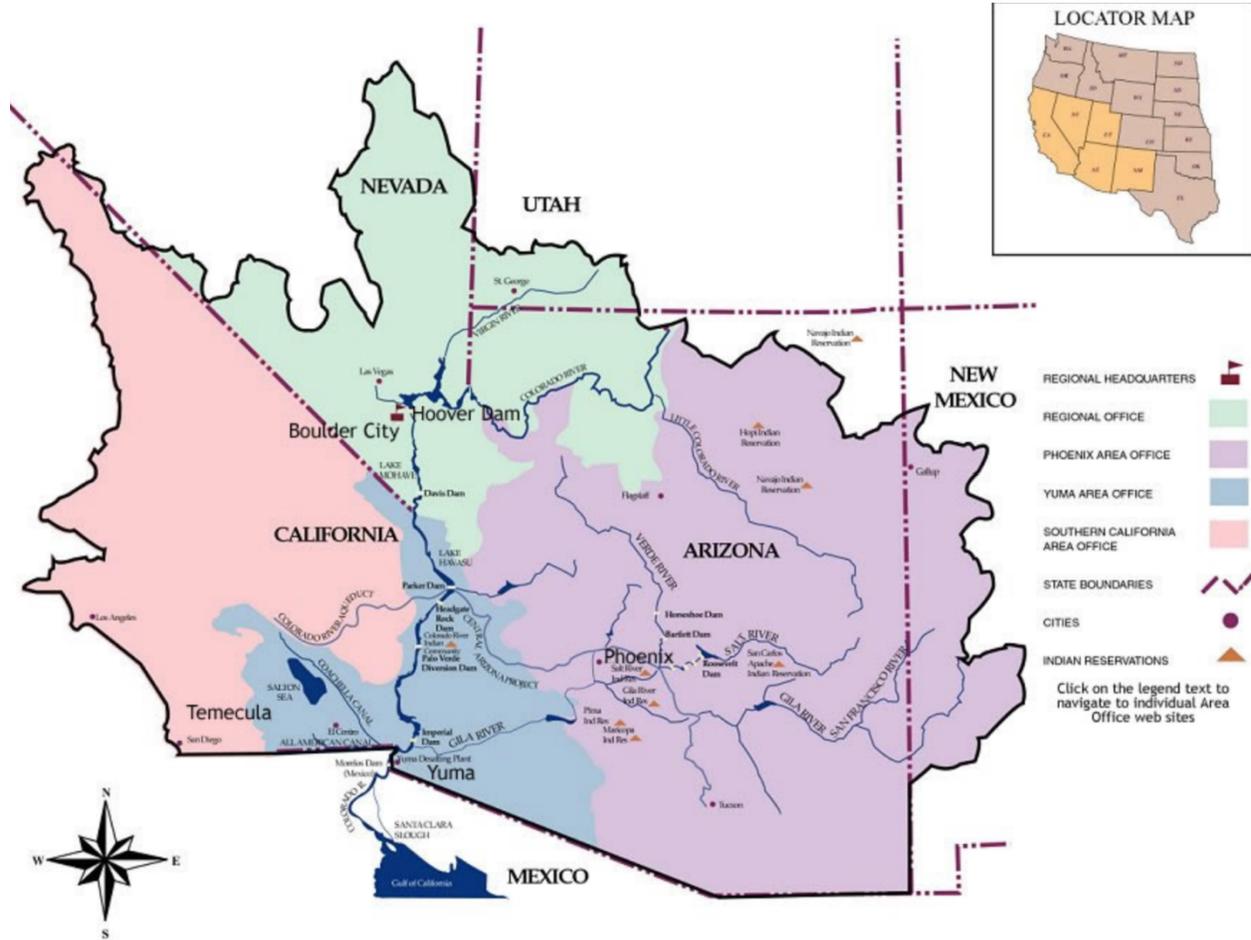
⁷ Staff Attorney, Utton Transboundary Resources Center, University of New Mexico.

Author note

This paper is intended to supplement and complement a series of related papers written in the last year by the authors (or subset of the authors) addressing the critical problems facing the Colorado River Basin, including:

- Eric Kuhn, Anne Castle, & John Fleck, *Royce Tipton and the Hydrology of the 1944 Treaty with Mexico*, (May 2025). Available at: [Kuhn-et-al-2025-Royce-Tipton-Mexico-Hydrology.pdf](#).
- Anne Castle, John Fleck, Jack Schmidt, Kathryn Sorensen, and Katherine Tara, *Essential Pillars for the Post-2026 Colorado River Guidelines*, (April 2025). Available at: [2025-04-25 Principles](#).
- Jack Schmidt, Anne Castle, Eric Kuhn, John Fleck, Kathryn Sorensen, and Katherine Tara, *Analysis of Colorado River Basin Storage Suggests Need for Immediate Action*, (September 2025). Available at: [670](#).
- Kathryn Sorensen, Sarah Porter, Anne Castle, John Fleck, Eric Kuhn, Jack Schmidt, and Katherine Tara, *Consideration for Assigned Water after Expiration of the 2007 Guidelines* (January 2026). Available at: https://issuu.com/asuwattcollege/docs/full_considerations_for_assigned_water_.

Lower Colorado River Basin



Source: US Bureau of Reclamation

INTRODUCTION

On February 3, 1944, the United States (US) and Mexico signed an international water treaty covering their two major shared rivers, the Colorado River and the Rio Grande⁸ (called the Rio Bravo in Mexico) and a smaller coastal stream, the Tijuana River.⁹ Since 1945 when the treaty was ratified, the hydrology of the two major rivers has

⁸ The Rio Grande portion of the 1944 Treaty only covers the river downstream of Ft. Quitman, TX. Upstream of this point, the Rio Grande is covered by a separate treaty, the 1906 Convention. This paper does not concern the 1906 Convention nor the water allocation and use issues on the river upstream from Ft. Quitman.

⁹ Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, Treaty between the United States of American and Mexico, Feb. 3, 1944 (1944 Treaty). The Tijuana River is a small intermittent coastal stream that drains the coastal mountains east of San Diego, California and Tijuana, Mexico. The river's estimated annual flow in 1944 was about 26,000 acre-feet per year. The river's drainage area is 1679 square miles, about 2/3 is in Mexico and 1/3 in the US. Most of the river channel is in Mexico, but the river's mouth is located about 1.5 miles north of the international boundary. Tipton, *infra* note 17, pages 111-113. The river's major issues are pollution and flood control. This paper does not address issues on the Tijuana River.

profoundly changed. Simply put, the hydrologic assumptions the treaty negotiators made more than 80 years ago are no longer valid.

In response to these changing hydrologic conditions, the US and Mexico have recently completed an emergency agreement concerning the Rio Grande that addresses Mexico's inability to comply with treaty-required water deliveries to the US.¹⁰ It is likely that additional emergency agreements will be needed in the future. On the Colorado River, the US and Mexico have agreed to a series of treaty minutes¹¹ to address river management issues of mutual concern, including declining flows and reservoir levels, but these treaty minutes expire at the end of 2026. These current treaty minutes were designed to complement similar agreements that reduce consumptive use within the US. The US Basin States (Basin States) have, to date, been unable to reach a consensus agreement on post-2026 operating guidelines. A new interim agreement appears unlikely. The most likely outcomes are either a very short-term stopgap agreement among the Basin States, or the US Secretary of the Interior (Secretary) will unilaterally impose operating rules for Glen Canyon and Hoover Dams, including shortages, upon the Lower Basin states. Therefore, how the system will be operated within the US in the future is uncertain. Interstate litigation among the Basin States is a distinct possibility.

Because the Colorado River system's major reservoirs are at critically low levels and the projected spring, 2026, runoff into Lake Powell nearing a record low,¹² it is important that the two countries continue their cooperative efforts by negotiating a new treaty minute in the next few months under which Mexico would continue to agree to share the impacts of declining natural flow. Such a treaty minute could also continue to allow the US and Mexico to agree on adjustments to annual deliveries of Mexican water, both up and down, in effect, allowing Mexico to store deferred

¹⁰ The agreement was reported in the press, but as of 3/26/2026, it was not documented in a treaty minute. See Joint press release from Secretary of State Rubio and Secretary of Agriculture Rollins dated February 3, 2026, [Joint Statement by Secretary of State Marco Rubio and Secretary of Agriculture Brooke Rollins: Securing Critical Water Resources for South Texas Agriculture - United States Department of State](#). See also Fabio Zerpa and Bloomberg, "U.S., Mexico Strike a Deal to Settle Rio Grande Water Dispute," *Fortune*, December 13, 2025, <https://fortune.com/2025/12/13/us-mexico-water-deal-rio-grande-dispute-texas/>.

¹¹ Minutes are agreements allowed by the treaty and approved by both countries interpreting treaty provisions and implementing operational arrangements. For more information on treaty minutes, see IBWC website [Minutes Archive - IBWC](#).

¹² The Colorado Basin River Forecast Center (CBRFC) mid-March 2026 forecast for April-July unregulated inflow to Lake Powell was 1.75 MAF, the third lowest in the 62-year period of record. See [CBRFC Map](#).

deliveries in US reservoirs.¹³ Such an agreement would send a clear message that the US and Mexico are committed to jointly addressing and managing the problems facing the rivers they share.

Rather than lurch from one short-term agreement or minute to another to address the crises and structural water shortage problems created by watershed aridification and the uncertainty of future conditions, the US and Mexico should consider more fundamental changes that address the water supply, economic, and environmental conditions that exist on the Colorado River today in an equitable and more long-lasting manner. We recommend an approach that is independent of how the river will be managed within the US after the 2007 Interim Guidelines and related agreements expire and are replaced by either a series of very short-term agreements, unilateral decisions by the Secretary, or possibly decisions by a US Court. **It is time to consider transitioning to a percentage-based delivery to Mexico on the Colorado River.**

BACKGROUND

The purpose of this paper is to explore the history, hydrology, hydrography, and problems facing the US and Mexico on the two major rivers that they share under the 1944 Treaty and propose a new approach for dividing the use of the waters of the Colorado River between the two countries: a percentage split. The authors do not make a similar recommendation for the Lower Rio Grande River other than to observe that there are serious structural problems with the treaty provisions that require Mexico to make certain deliveries from its tributaries and that it is time to consider modernizing the treaty requirements to reflect the river as it is today.

The authors have included the Lower Rio Grande in this paper for several reasons:

- Both rivers are covered by the same treaty and are facing similar problems: declining natural flows, systematic overuse of the existing water supply, and degraded watershed health.

¹³ The ability of Mexico to benefit from Lake Mead storage has always been a sensitive issue within the US. The enacting clause of the 1928 Boulder Canyon Project Act (45 Stat 1057) identifies the purposes of Lake Mead as "controlling the floods, improving navigation and regulating the flow of the Colorado River, providing for storage and for the delivery of stored waters thereof for reclamation of public lands and other beneficial uses *exclusively within the United States* [emph. added]. To address this limitation, the 1944 Treaty negotiators used the treaty to require the construction of Davis Dam, which impounds Lake Mojave. Article 12 (b) committed the US to build and "thereafter operate and maintain at its expense, the Davis storage dam and reservoir, a part of the capacity of which shall be used to make possible the regulation at the boundary of the waters to be delivered to Mexico..." As a practical matter, however, the Bureau of Reclamation has always operated Lake Mead and Lake Mojave as components of an integrated project. Which means that, while on paper, Mexico's water is regulated by Lake Mojave, the actual water delivered to Mexico can come from either reservoir.

- There is an obvious geopolitical connection. The 1944 Treaty interpretation and implementation on both river systems are managed by the same international entity, the International Boundary and Water Commission (IBWC).
- On both rivers, the hydrologic assumptions made by treaty negotiators were based on the limited data available at the time and are no longer valid.
- While there are common problems, there are also important differences, primarily the hydrography. On the Colorado River, water uses in Mexico are dependent on the delivery of water from the US. On the Lower Rio Grande, water uses in the US are dependent on the delivery of water from Mexico.

Hydrography and Hydrology

There are significant differences in the hydrography and hydrology of the Colorado River and of the Rio Grande. The Mexican part of the Colorado River watershed is the river's delta that was a sparsely inhabited maze of distributary channels prior to upstream water development.¹⁴ All water entering the delta comes from the US, primarily Rocky Mountain snowmelt, but also from winter and monsoon season rains in the downstream part of the watershed. Large-scale depletion of natural flow that once entered Mexico began in 1901 with the gravity diversion of Colorado River water from the Yuma area via the Alamo Canal, using a route that traversed through Mexico, to irrigate desert lands in what is now named the Imperial Valley.¹⁵ Thereafter, incoming flow to Mexico continued to be depleted as development in the US increased.

The construction of two major upstream reservoirs: Lake Mead (Hoover Dam) and Lake Havasu (Parker Dam), three major irrigation system diversion dams: Laguna, Headgate Rock, and Imperial, and a large municipal supply aqueduct to the Los Angeles area, in the 1930s and 1940s facilitated increased diversions in the US that significantly changed the flow regime of the river that entered Mexico. Average daily discharge at Yuma after completion of Hoover Dam and during the decade when the 1944 Treaty was being negotiated was 67% less than before dam construction.¹⁶ While there was far less total annual flow, the power operation of Hoover Dam also reregulated and stabilized river flows available to Mexico allowing it to increase

¹⁴ Sykes, G., 1937. The Colorado Delta. American Geographical Society Special Publication 19, 193 pp.

¹⁵ See generally, Imperial Irrigation District, "All-American Canal," <https://www.iid.com/water/water-transportation-system/colorado-river-facilities/all-american-canal>.

¹⁶ Mueller, E. R. et al. 2017. Geomorphic change and sediment transport during a small artificial flood in a transformed post-dam delta: the Colorado River delta, United States and Mexico. *Ecological Engineering* 106: 757-775.

irrigated agriculture. The threat that Mexico would further increase its agricultural use was one of the primary reasons the US wanted a treaty.¹⁷

Mexico completed Morelos Dam in 1950,¹⁸ immediately south from the Northerly International Border (NIB), allowing a more efficient diversion of water for delivery to Mexicali Valley farm fields. Colorado River water is also the primary water supply for Tijuana—one of the largest cities in Mexico—Mexicali, and several smaller cities.¹⁹ All water used by Mexicali Valley agriculture and almost all of the water used by these cities in northern Baja California is surface or ground water from the Colorado River.²⁰

Morelos Dam does not create any storage, and stream flow not diverted at the dam passes downstream. These bypassed flows are measured at the Southerly International Border (SIB). Between 1950 and 1963, the average daily discharge at the SIB was approximately 3300 ft³/s and zero flow only occurred on 14 days during those 13 years.²¹ The completion of Glen Canyon Dam and the filling of Lake Powell in the mid-1960s and 1970s and the development of the Central Arizona Project and other major water projects in the 1980s and 1990s allowed for the US to completely utilize its share of the Colorado River in all but very wet years. Thus, after Mexico diverted its share of the river at Morelos Dam, inflows to the delta downstream from the dam were virtually eliminated. The few wet years when stream flow did bypass Morelos Dam were in the mid-1980s, 1993, and in the late 1990s. Pursuant to Minute 319, in March 2014, a special bypass from Morelos Dam with water conserved by

¹⁷ Royce Tipton, The Six States Committee, "Engineering Memorandum on the treaty with Mexico Relating to the Utilization of the Waters of Certain Rivers," pages 16 and 17. Tipton wrote: "[D]uring the past few years. Mexico has been rapidly increasing its use of water in Lower (Baja) California under plans outlined and prepared by its Department of Agriculture.... At present an average of eight to ten million acre-feet of water is flowing into Mexico annually, of which some five million are regulated to a firm dependable flow. The firm flow represents the water released from Lake Mead for the generation of firm energy which is not later used in... the United States." Tipton estimated that in 1943 and 1944 Mexico was using 1.8 MAF per year, thus the treaty supporters argued that the allocation of 1.5 MAF per year was a reduction in use (Tipton, page 17). The legal argument was that if Mexico was allowed to use more water, it could establish a right to that use through international arbitration. During the Senate ratification debate, experts for treaty opposers disputed both Tipton's 1.8 MAF estimate and the arbitration argument. See Hundley, *infra*, note 84, page 151.

¹⁸ Prior to the completion of the construction of the Imperial Diversion Dam and the All-American Canal in the 1940s, Mexico's irrigation water was diverted by two diversion structures on the river below Yuma operated by IID, the Hanlon Heading and the Rockwood Gates, and delivered through the Alamo Canal. The same canal that made water deliveries to the Imperial Valley. To obtain a right-of-way for the canal route through Mexico, the California Development Company, the predecessor of the Imperial Irrigation District (IID) had to agree to deliver up to 50% of the water it diverted from the Colorado River to uses in Mexico. This is one of the several reasons farmers in the IID wanted an All-American Canal. After completion of the Morelos Dam, the Hanlon Heading and the Rockwood gates were abandoned. The water diverted by Morelos Dam still enters the Alamo Canal, but it now only delivers water for uses in Mexico. See generally M. J. Dowd, "IID the First 40 Years" available at <https://www.iid.com/home/showpublisheddocument/6000/635648001335730000>.

¹⁹ The Acueducto Río Colorado-Tijuana (ARCT) was built in the late 1970s. It conveys water under tributary groundwater rights from the San Luis Río Colorado Mesa Arenosa wells that were allocated (Minute 242) for cities in Baja California.

²⁰ Mueller, *supra* note 16.

²¹ *Id.*

Mexico and reregulated by US infrastructure, called the Pulse Flow, occurred for a few weeks and a small amount of that water reached the Gulf of California.²²

The Colorado River is the boundary between Mexico and the US for approximately 21 miles immediately downstream from Morelos Dam in an area called the Limitrophe where the right (west) bank is Mexico (Baja California) and the left (east) bank is the US (Arizona). Downstream from the Limitrophe, the river flows approximately 60 miles to the Gulf of California. Today, the upstream 12 miles of the Limitrophe near Morelos Dam has a small base flow derived from irrigation return flow. Further downstream, the channel is typically dry for approximately 27 miles. Beyond this "dry reach," the channel is wet from ground-water inflow, but the channel is dry where it enters the Gulf of California. The entire floodplain of the Colorado River in Mexico is bordered by levees, and most of the former delta is now farmed and called the Mexicali Valley.²³

The hydrography and hydrology of the Lower Rio Grande that is the subject of the 1944 Treaty, is very different. The Rio Grande has two headwater branches – the Rio Grande itself whose source is the San Juan Mountains of Colorado and the Rio Conchos whose headwaters are the Sierra Madre Occidental in Mexico. These two branches join at the border towns of Ojinaga, Chihuahua, and Presidio, Texas. Some studies refer to the Rio Grande upstream from the Rio Conchos as the northern branch and only apply the name Rio Grande/Rio Bravo to the river downstream from this point. Fort Quitman is on the northern branch, approximately 200 miles upstream from the Rio Conchos, and this downstream part of the northern branch is known as the Forgotten Reach.

The estimated annual natural flow of the northern branch is 23% larger than that of the Rio Conchos, but more than 95% of the annual natural flow of the northern branch is consumed in Colorado, New Mexico, and the El Paso-Juarez Valley of Texas and Chihuahua,²⁴ including the cities of Ciudad Juarez and El Paso. Today, the northern branch is hydrologically disconnected from the river downstream from the Rio Conchos.²⁵

In the earliest 20th century, more than 66% of the Rio Grande's stream flow downstream from Ojinaga/Presidio came from the Rio Conchos between August and February, because the river's floods occur during the North American monsoon

²² Ramirez-Hernandez, J. et al. 2017. Hydrological response to an environmental flood: pulse flow 2014 on the Colorado River delta. *Ecological Engineering* 106" 633-644.

²³ *Id.*

²⁴ Blythe, T. L. and Schmidt, J. C. 2018. Estimating the natural flow regime of rivers with long-standing development: the northern branch of the Rio Grande. *Water Resources Research* 54: 1212-1236.

²⁵ Everitt, B. 1993. Channel responses to declining flow on the Rio-Grande between Ft. Quitman and Presidio, Texas. *Geomorphology* 6 (3), 225-242.

and hurricane seasons. The only months when the Rio Grande's natural flow was dominated by inflow from the northern branch were between April and June during snowmelt from the southern Rocky Mountains.²⁶

The hydrology of the Rio Grande downstream from the Rio Conchos was profoundly changed after completion of La Boquilla Dam on the Rio Conchos in 1915 and Elephant Butte Dam on the northern branch in 1916.²⁷ Other dams were completed in New Mexico and Colorado and on headwater branches of the Rio Conchos that facilitated large increases in consumptive water use. Today, the average annual flow of the Rio Conchos is 63% less than its estimated annual natural flow of 1.7 MAF.²⁸ Nevertheless, more than 90% of the Rio Grande's flow immediately downstream from the Rio Conchos comes from that river.²⁹

The 1944 Treaty lists six Mexican tributaries that are subject to a minimum delivery requirement. These are the Rio Conchos and five others that are further downstream, all which flow into Amistad Reservoir or Falcon International Reservoir.³⁰ The only significant tributaries entering this part of the Rio Grande from the US are the Pecos and Devils Rivers, neither of which have a minimum delivery requirement under the 1944 Treaty. Consumptive water uses on the Rio Grande subject to the 1944 Treaty primarily occur downstream from Falcon International Reservoir. Thus, the distribution of waters of the Rio Grande under the 1944 Treaty is essentially the hydrographic opposite of the situation on the Colorado River in the sense that Mexico is the upstream watershed, and the US is the downstream user of water. In this paper, we refer to the entire length of river downstream from Fort Quitman as the Lower Rio Grande even though 200 miles of the river are part of the northern branch.

At the time that the 1944 Treaty was being negotiated, development of the northern branch had mostly disconnected that river from the hydrology of the river downstream from the Rio Conchos. Mexico had already built large dams in the Rio

²⁶ Schmidt, J.C. et al, 2003. Hydrology and geomorphology of the Rio Grande and implications for river rehabilitation. in: Garret, G.P. and Allan, A.L. (Eds.), *Special Publications* no. 46. Museum of Texas Tech University, Lubbock, TX, pp. 25–45.

²⁷ *Id.*

²⁸ Gonzalez-Escorcia, Y.A. 2017. Determining the natural flow in the transboundary Rio Grande/Rio Bravo basin. Master's Thesis. Instituto Politecnico Nacional, University of California, Davis. Davis, CA.

²⁹ Dean, D. J. and Schmidt, J. C. 2011. The role of feedback mechanisms in historic channel changes of the lower Rio Grande in the Big Bend region. *Geomorphology* 126:333–349.

³⁰ These five tributaries are Arroyo Las Vacas, Rio San Diego, Rio San Rodrigo, Rio Escondido, and Rio Salado. Rio Salado is the most downstream of these tributaries and flows directly into Falcon International Reservoir on the Lower Rio Grande. The 1944 Treaty authorized construction of two main stem international reservoirs. Falcon International Reservoir, with an active capacity of 2.6 MAF is the lower reservoir, located about 160 miles from the river's mouth. It was finished in 1953. Amistad Reservoir, completed in 1969, has an active capacity of 3.1 MAF. Amistad Dam is about 300 river miles upstream of Falcon Dam. For more information on both reservoirs see: <https://www.ibwc.gov/power-plants-dams/>.

Conchos watershed.³¹ During the treaty negotiations, Royce Tipton, the engineering advisor to the US State Department, estimated that users of the Lower Rio Grande in the US were about 70% reliant on flows that originated in Mexico.³² Since the treaty was signed, agricultural consumptive uses in the Mexican state of Chihuahua, especially near Delicias, have steadily increased;³³ the city of Chihuahua has a current population of approximately 1 million.³⁴

Lower Rio Grande Basin



Source: US Bureau of Reclamation, Lower Rio Grande Basin Study

The Treaty

The 1944 Treaty was negotiated at a time when decisionmakers had a limited and incomplete understanding of the hydrology of both major river systems. On the Colorado River, the measurement gage at Lees Ferry, the river's most recognized measuring point, was not installed until summer 1921. Subsequent tree-ring-based

³¹ Mary E. Kelly, "The Rio Conchos, a Preliminary Overview" January 2001, pages 5-10. Available at: [Rio Conchos Report](#).

³² Royce Tipton, *supra* note 17 pages 20 and 21. For additional information on Tipton, see Eric Kuhn, et. al. "Royce Tipton and hydrology of the 1944 Treaty with Mexico," <https://www.inkstain.net/wp-content/uploads/Kuhn-et-al-2025-Royce-Tipton-Mexico-Hydrology.pdf>.

³³ Héctor Sanvicente-Sánchez, Saúl Arciniega, Yolanda Solis-Alvarado, et al. Monitoring the Evolution of Agricultural Growth in an Arid Area in Northwest Mexico Using Free Tools in the Cloud. *Authorea*. November 11, 2021.

³⁴ Mexico 2020 Census, available at: https://www.inegi.org.mx/programas/ccpv/2020/#Datos_abiertos.

reconstructions of natural flows at Lees Ferry would show us that the three decades prior to 1930 were one of the wettest multidecadal periods in the previous 500 years and is now referred to as the Early Twentieth Century Pluvial Period.³⁵ The 1944 Treaty was signed at a time when the concept of “stationarity”—the idea that future river flows will be within the same statistical range as past flows—was deeply ingrained in the culture of water management. It was not well understood that there are long cycles of relative wetness or drought, and the concept of aridification due to atmospheric warming was not anticipated.

The 1944 Treaty was approved decades before scientists recognized that rising atmospheric temperatures would dramatically impact river flows and evapotranspiration demands of irrigated croplands in both watersheds, increasing variability in year-to-year runoff, and lengthening and intensifying the periodic droughts that have forever impacted the watersheds in the southwestern US and northern Mexico. Uncertainty in projecting the future has increased greatly. Today the hydrology of both the Colorado River and the Rio Grande is characterized by deep uncertainty and non-stationarity.

Consequently, in the 1940s when the United States and Mexico agreed to deliver to each other fixed quantities of water, there were few major concerns that these treaty commitments would adversely impact existing and future water users.³⁶ Within the US, nevertheless, there was still opposition to the 1944 Treaty. The State of California vehemently opposed ratification of the treaty by the Senate because of fears that the treaty provided Mexico with too much Colorado River water. The delivery of 1.5 MAF per year, California argued, would reduce the amount of unapportioned “surplus” water, as defined by Article III of the Colorado River Compact (1922 Compact) and thus available for future apportionment to users within the US. Since its water agencies had signed contracts for 962,000 acre-feet more than California’s basic 4.4 MAF apportionment under the 1928 Boulder Canyon Project Act,³⁷ protecting access to and keeping the unapportioned surplus as large as possible were critical to California’s interests. The six states that supported treaty ratification (Arizona,

³⁵The period of record used during the treaty negotiations was 1897 to 1943. The early 20th Century pluvial, a prolonged period of above-average precipitation, is generally considered to be 1906-1930. The observation that this period was unusually wet was first made by Charles Stockton and Gordon Jacoby in their 1976 report: “Long-term Surface-Water Supply and Streamflow in the Upper Colorado River Basin Based on Tree-Ring Analyses,” *National Science Foundation Lake Powell Research Project, Bulletin 18* (1976).

³⁶Tipton, *supra* note 17, at 8-9.

³⁷Boulder Canyon Project Act of 1928, Ch. 42, 45 Stat. 1057 (1928) (BCPA). This Act authorized the states of Arizona, California and Nevada to enter into an agreement in which Nevada is apportioned 300,000 af per year, Arizona is apportioned 2.8 MAF per year, and California is limited to 4.4 MAF plus one-half of any unapportioned surplus. BCPA, Sec. 4(a). The US Supreme Court decree in *Arizona v. California*, 376 U.S. 340 (1964), transformed this authorization into law. These allocations are of mainstem water use and do not include tributary uses.

Colorado, New Mexico, Utah, Texas,³⁸ and Wyoming) countered that California had no existing compact right to unapportioned surplus water and that under Article III (f) of the 1922 Compact, any such water was to be apportioned by future negotiations among the states after October 1, 1963. Under the 1922 Compact, any water provided to Mexico by treaty would be deducted from the amount of the water available for future apportionment.³⁹

In the 1940s when the 1944 Treaty was negotiated and approved, the estimated long-term natural flow at Lees Ferry (referred to as "virgin" flow) was approximately 16.3 MAF per year.⁴⁰ Thus, Mexico's 1.5 MAF annual share at the time, was less than 10% (9.22%) of the natural flow (as measured at Lees Ferry). Since the treaty was ratified in 1945, however, the average natural flow has been 13.78 MAF per year, increasing Mexico's share to about 11% (10.88%).⁴¹ Since the beginning of the "Millennium Drought" in 2000, the Lees Ferry natural flow has averaged only 12.27 MAF, meaning that Mexico's fixed 1.5 MAF per year delivery now represents a little more than 12% (12.22%) of the natural flow at Lees Ferry. This upward trend in Mexico's percentage share of the river (an approximate 30% increase) demonstrates the basic problem with a treaty (or compact) that provides a fixed volume to the downstream entity. If future flows fall below the levels assumed by the treaty (or compact) negotiators, the burden of declining hydrology falls on the upstream entity.

Ironically, under the 1922 Colorado River Compact, the States of the Upper Division may be in an identical position to the US on the Colorado River and to Mexico on the Rio Grande. Under the Lower Division States' interpretation of the 1922 Compact, the Upper Division States have a fixed delivery obligation at Lee Ferry.⁴² As the natural

³⁸ During the ratification debate Texas, which strongly supported the Rio Grande portion of the 1944 Treaty, was one of the six states supporting the treaty. The State of Nevada was a nominal ally of California in opposing the treaty.

³⁹ Article III (f) states "Further equitable apportionment of the beneficial uses of the waters of the Colorado River System unapportioned by paragraphs (a), (b), and (c) may be made in the manner provided in paragraph (g) any time after October first, 1963..." Paragraph (c) provides for a treaty with Mexico.

⁴⁰ Tipton, *supra* note 17, page 45. Today we recognize that the 16.3 MAF per year long-term natural flow at Lees Ferry estimated by the Bureau of Reclamation in 1944 was too high. In 1947, only two years after the treaty was ratified, the Upper Colorado River Compact Commission Engineering Committee estimated the average natural flow to be 15.7 MAF per year, Eric Kuhn and John Fleck, *Science Be Dammed: How Ignoring Inconvenient Science Drained the Colorado River*, U of Arizona Press, 2019, Chapter 13. The difference is that the USBR estimate uses data from the years 1897 – 1943. The UCRC Engineering Committee rejected using years before 1914 because it had no confidence in the flow data before that date. The period of record used by the Engineering Committee was 1914-1945. Based on current day (2024) natural flow estimates, the 1906-2024 long-term average natural flow at Lee Ferry is 14.58 MAF per year. Since the installation of the Lees Ferry gage, the 1922 -2024 long-term average natural flow is 14.05 MAF per year. The source for natural flow data on the Colorado River is the USBR's natural flow database, August 2024 version, <https://www.usbr.gov/lc/region/g4000/NaturalFlow/index.html>.

⁴¹*Id.* Natural flow database.

⁴² See 1922 Compact, Article III (d) – "The States of the Upper Division shall not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years."

flow at Lees Ferry declines, the burden of this decline falls on the Upper Division States, reducing the amount remaining for their consumptive use.⁴³

Under the 1944 Treaty, Mexico and the US agreed to fixed volume delivery requirements. On the Colorado River, the US must deliver to Mexico 1.5 MAF annually in normal years. Deliveries can be reduced during an extraordinary drought and increased to 1.7 MAF per year when "surplus"⁴⁴ conditions exist.⁴⁵ The issue of delivery did not become a significant issue until completion of Glen Canyon Dam when flows passing the SIB dropped to zero. Since that time, the US has met its delivery requirements. In fact, the US still delivers more water than required each year. Because water users within the US regularly order water that they subsequently cannot physically divert or localized storm events create flows that cannot be recaptured in the US, the extra water flows into Mexico.⁴⁶ In addition, on the order of 100,000 to 150,000 acre-feet per year of water that is too saline for irrigation purposes is delivered via a canal into the Cienega de Santa Clara in Mexico and not counted as a treaty delivery pursuant to Treaty Minute 242.⁴⁷

On the Lower Rio Grande, the negotiators of the 1944 Treaty used a percentage-based approach, but with a minimum delivery requirement from the six Mexican

⁴³ Eric Kuhn, "On the Colorado River There are no Simple Disputes," <https://www.inkstain.net/2024/02/on-the-colorado-river-there-are-no-simple-disputes/>. Under the Lower Division States' interpretation, the Upper Division States' compact obligation is assumed to average 8.25 MAF per year (82.5 MAF every 10 years), accounting for an average of 7.5 MAF to achieve the 10-year average, and an additional 750,000 acre-feet annually as half of the obligation to Mexico. In the 1940s when the natural flow at Lee Ferry was thought to average about 15.7 MAF per year, the Upper Division States' downstream obligation would have been 52.5% of the total water available. Using the Millennium Drought average natural flow at Lee Ferry of 12.27 MAF, this obligation would be 67%. The Upper Division States strongly disagree with the Lower Division States' interpretation.

⁴⁴ Both the 1944 Treaty in Article 10b and the 1922 Compact in Article III (c) use the term "surplus," but they have different meanings. A "Treaty surplus" as defined in the 1944 Treaty represents "waters of the Colorado River in excess of the amount necessary to supply uses in the United States and the guaranteed quantity of 1,500,000 acre-feet ... annually to Mexico." Article III (c) of the 1922 Compact defines a compact surplus as the amount of water "over and above the aggregate of the quantities specified in paragraphs (a) and (b)" or 16 MAF. The interpretation of Article III (c) is a significant matter of dispute among the Basin States.

⁴⁵ 1944 Treaty, Article 10(b). The treaty language also allows for a reduction of deliveries to Mexico in the event of a major irrigation system accident in the US. The treaty, however, does not define "extraordinary drought." In the negotiations of Minute 319 and 323, both nations made it clear that they were not attempting to define the term "extraordinary drought."

⁴⁶ Since the completion of Brock Reservoir on the All-American Canal system in 2010, inadvertent overruns have been dramatically reduced. For more information on Brock reservoir, see <https://www.iid.com/water/water-transportation-system/colorado-river-facilities/brock-reservoir>.

⁴⁷ Water quality is addressed through a series of minutes, beginning with Minute 218, March 22, 1965. Under Minute 218 the US agreed to bypass and not deliver to the Colorado River, highly saline groundwater that had to be pumped from lands irrigated by the Welton-Mohawk Irrigation District to manage salinity levels in the root zone. Treaty Minute 242 finalized salinity standard for the delivery of water to Mexico at Morelos Dam. It was approved on September 30, 1973. Minute 242 superseded Minute 241 dated July 14, 1972.

tributaries.⁴⁸ The intent of the negotiators was to give Mexico the use of 2/3 of water from the six Mexican tributaries and the United States 1/3 of that water. The treaty, however, also included a minimum five-year delivery of 1.75 MAF from Mexico to the US, an average of 350,000 acre-feet per year. This minimum fixed delivery, not the 2/3-1/3 treaty split, is now the controlling factor for water supply and treaty compliance on the Lower Rio Grande. Because the hydrology of the six Mexican tributaries is determined by highly variable annual rainfall, especially occasional remnants of tropical storms whose runoff overwhelms the capacity of Mexico's reservoirs, water deliveries from Mexico are much more variable than is the delivery from the US of snowmelt-derived runoff on the Colorado River. Mexico has struggled to meet its Rio Grande delivery requirement. In contrast to the minimum delivery requirement on the six Mexican tributaries, the treaty includes no minimum delivery requirements for the Pecos, Devils, or smaller US tributaries.⁴⁹

On the Lower Rio Grande, there was less reliable hydrologic data available to the US treaty negotiators than on the Colorado River.⁵⁰ The largest US tributary is the Pecos River which originates in the mountains north of Santa Fe, New Mexico, and from there flows south entering Texas and then southeast to where it reaches the Rio Grande at Amistad Reservoir. The Pecos River is heavily used for irrigation in both New Mexico and Texas.⁵¹ During the negotiation of the treaty, the US State Department's engineering advisor was Royce Tipton, a consulting engineer from Denver, Colorado.⁵² In a report prepared for use by the states supporting the treaty during the ratification hearings, Tipton wrote; "At the present time the Pecos River contributes slightly over 300,000 acre-feet to the main stream. It is estimated that this flow will not be materially depleted by additional development in the Pecos

⁴⁸ The 1944 Treaty apportions the use of the waters of Rio Grande in Articles 4. A. (to Mexico) and 4.B. (to the US). Article 4.B.(c) apportions to the US (in addition to other named tributaries) "one-third of the flow reaching the main channel of the Rio Grande (Bravo) from the Conchos, San Diego, San Rodrigo, Escondido and Salado Rivers and the Las Vegas Arroyo *provided that this third shall not be less, as an average amount in cycles of five years, than 350,000 acre-feet annually*" (emph. added). The Treaty establishes a mechanism if there is an under-delivery of the 1.75 MAF. Art. 4(d) states: "any deficiencies existing at the end, of the aforesaid five-year cycle shall be made up in the following five-year cycle with water from the said measured tributaries." The 1944 Treaty authorized construction of two main stem international reservoirs. Falcon International Reservoir, with an active capacity of 2.6 MAF is the lower reservoir, located about 160 miles from the river's mouth. It was finished in 1953. Amistad Reservoir, completed in 1969, has an active capacity of 3.1 MAF. Amistad Dam is about 300 river miles upstream of Falcon Dam.

⁴⁹ A fact that the 1944 Treaty supporters within the US pointed to during the ratification debate, Tipton, *supra* note 17, pages 20 and 21.

⁵⁰ Tipton, *supra* note 17. The hydrologic data used by Tipton for the Rio Grande only goes back to 1932. On the Colorado River, the data goes back to 1897. The 1928 Boulder Canyon Act, *supra* note 13, authorized and provided funding for a comprehensive study of the Colorado River Basin, allowing the US agencies to install numerous gaging stations on the Colorado River system.

⁵¹ The use of Pecos River water within the US is governed by the Pecos River Compact between the States of Texas and New Mexico. The Pecos River Compact was signed by New Mexico and Texas in 1948. It was approved by Congress the following year. The Pecos River Compact has been the subject of extensive litigation. For more information see: <https://www.tceq.texas.gov/permitting/compacts/pecos.html>.

⁵² Kuhn, *supra* note 32.

River basin."⁵³ Today, we believe the long-term flow of the Pecos River into Amistad Reservoir is about 197,000 acre-feet per year⁵⁴ and since 2007, only about 100,000 acre-feet per year.⁵⁵ The second largest US tributary, the Devils River has seen a similar reduction in flow.⁵⁶ Thus, the flow contribution into Amistad Reservoir by US tributaries is ~75% less, (or over 700,000 acre-feet per year), than what was assumed by the treaty negotiators.

Minutes 319, 323, and 330

For several reasons, including litigation over the All-American Canal Lining Project, the United States did not formally approach Mexico on potential shortage-sharing negotiations until domestic agreements were reached and ultimately adopted by the Secretary of the Interior as the 2007 Interim Guidelines. As part of the 2007 Interim Guidelines process, and with the support of the Basin States, the hydrologic modeling assumed that Mexico would be responsible for 1/6th of the shortage levels analyzed in the environmental impact statement process and, with Minute 319, that is essentially what happened.⁵⁷ The 1/6 figure is based on math: Mexico's 1.5 MAF normal delivery is 1/6 of the total normal year delivery obligation from Lake Mead of 9.0 MAF (7.5 MAF for the Lower Division States plus 1.5 MAF for Mexico). Under Minute 319, signed by the IBWC in November 2012, Mexico agreed to take reduced deliveries based on the projected elevation tiers at Lake Mead set forth in the 2007 Interim Guidelines.⁵⁸

Minute 319 went beyond setting reduced deliveries; it also addressed potential enhanced deliveries under high reservoir conditions, U.S. investments in Mexican infrastructure to improve efficiency, environmental issues including what became the

⁵³ Tipton, *supra* note 17, page 78.

⁵⁴ Ronald T. Green, et.al. "Pecos/Devils River Watershed Projects, Part II" Southwest Research Institute, presentation to the 71st Texas Water use Conference (2014). Also, Wikipedia, https://en.wikipedia.org/wiki/Pecos_River.

⁵⁵ The USGS river gage at Brotherton, Texas is the source of the data since 2007, <https://waterdata.usgs.gov/monitoring-location/USGS-08447300/#dataTypeld=continuous-00065-0&period=P7D&showFieldMeasurements=true>.

⁵⁶ Tipton, *supra* note 17, page 79. Tipton assumed that the Devils River contribution to the Rio Grande would be 463,000 af per year. He added "Most of the Devils River Basin consists of canyon with no valleys that are susceptible to irrigation. It is probable, therefore, that there will be little depletion of the Devils River water by additional development within its basin." Today our best estimate of the recent contribution of the Devils River since 2005 is about 120,000 af per year, see: Hunt, Brian; McKinney, Tyson, 2025, "Hydrologic Monitoring in the Devils River, Val Verde County, Texas (2015-2023)" <https://doi.org/10.18738/T8/VAOG8R>.

⁵⁷ See generally Peter W. Culp, et. al. "Getting to the Right Side of the River: Lessons for International Diplomacy on the Road to Minute 319," *Denver University Water Law Review*, 2014.

⁵⁸ Under Minute 319, when the Secretary declares a Tier I shortage at Lake Mead, the annual delivery to Mexico is reduced by 50,000 af to 1.45 MAF. Under a Tier II shortage, the delivery is reduced by 70,000 af, and under a Tier III shortage the reduction is 125,000 af. These same reductions were carried forward in Minute 323.

2014 Delta pulse flow, and provided Mexico with access to Lake Mead to in-effect store its water by creating an account for use at a later date (later designated as Mexico's Water Reserve).⁵⁹ As often mentioned by representatives of the US, including former US Commissioner to the IBWC, Jane Harkins, the goal of Minute 319 (and subsequently Minutes 323 and 330) was to keep both countries in "alignment." If the Lower Basin is in shortage, so is Mexico. If the Lower Basin is in a surplus condition, so is Mexico, and if the Lower Division States can create and utilize intentionally created surplus (assigned water), Mexico can have a similar program.⁶⁰

Minute 319 had a five-year term, expiring at the end of 2017. During the five-year term, there were no shortages imposed on Lower Basin mainstem users within the US and there were no reductions in treaty deliveries to Mexico. During that period, while there were no formal shortages, the Lower Division states of Arizona, Nevada, and California were making plans for voluntary reductions in their uses.⁶¹

Minute 323, approved in September 2017, succeeded Minute 319. It should be noted that Minute 323 was approved a full two years before the Lower Division States and Upper Division States completed and Congress approved their drought contingency plans.⁶² Like Minute 319, Minute 323 was comprehensive in nature. In addition to extending the mandatory shortages and the provision for Mexico's Water Reserve through the end of 2026, Mexico agreed to leave additional water in Lake Mead for delivery at a future date, in parallel to the measures to which the Lower Division States subsequently agreed under the 2019 Lower Basin Drought Contingency Plan. The Binational Water Scarcity Contingency Plan in Minute 323 provides for Mexico to take conservation actions to help avoid reaching critical reservoir levels at Lake Mead. The amount Mexico contributes varies based on the projected end-of-year elevation of Lake Mead. In theory, like the Lower Division States, these new contributions can be delivered to Mexico at a future date if the storage in Lake Mead exceeds certain levels.⁶³

Minute 330, signed in March 2024, provides that in addition to the measures provided for in Minute 323, Mexico will conserve an additional 400,000 acre-feet during the

⁵⁹ Because of the topography and geology of the delta, there are no suitable surface reservoir sites in the Colorado River Basin within Mexico. Minute 318 first gave Mexico access to US storage to allow it to, in effect, store water that it could not use because of earthquake damage to its water delivery systems in 2010.

⁶⁰ Culp, *supra*, note 57. Also see presentation at the 2019 Colorado River Water Users Association Meeting by Roberto Salmon and Jane Harkins, video available at: [2019 CRWUA Annual Conference - U.S. & Mexico Conversations](#).

⁶¹ An example of this is the 500+ plan, for more details see: [500+ Plan - Central Arizona Project](#).

⁶² Minute 323 included language making Mexico's additional conservation measures contingent upon implementation of the US drought contingency plans. For details of the drought contingency plans, see: [Drought Contingency Plans | Bureau of Reclamation](#).

⁶³ For the details of the when Mexico's water can be recovered see: <https://www.ibwc.gov/wp-content/uploads/2023/03/Min323.pdf>.

three-year period 2024-2026. Mexico agreed to contribute 250,000 acre-feet of the savings to system water.⁶⁴ The remaining 150,000 acre-feet will go to Mexico's Water Reserve account and will be available for delivery at a future date when Lake Mead's elevation is above 1,075.⁶⁵ The package included a US payment of \$65 million to Mexico to offset the impacts of higher salinity levels caused by reduced flows and aid in the financing of the Minute 330 conservation measures.

With the various provisions of Minutes 323 and 330, accounting for water deliveries to Mexico is complex. Reclamation, in consultation with the IBWC, accounts for deliveries to Mexico in its annual Colorado River Accounting and Water Use Reports.⁶⁶ In 2024, 2025, and, again in 2026, the basic treaty delivery under the Tier 1 shortage is 1,450,000 acre-feet, a reduction of 50,000 acre-feet from the normal delivery. In 2024, the physical delivery, however, was only 1,357,582 acre-feet⁶⁷ and Mexico created 129,403 acre-feet of system water under Minute 330. The 2025 Accounting Final Report will not be available until later in 2026. Based on provisional data, the physical delivery was 1,297,706 acre-feet and Mexico created 120,596 acre-feet of system water. The USBR's 24-Month Studies suggest that the delivery to Mexico in 2026 will be about the same as 2025.⁶⁸ Since Minutes 323 and 330 expire at the end 2026, there is no way to estimate a projected delivery to Mexico in 2027.

At the December 2025 Colorado River Water Users Association (CRWUA) conference, representatives of both countries stated that negotiations to replace expiring treaty Minutes 323 and 330 are expected to begin in early 2026. Because negotiations among the Basin States have been unsuccessful, absent a last-minute agreement among the Basin States, the Secretary of the Interior may have no choice but to unilaterally determine the operating regime for the Colorado River system reservoirs beginning with water year 2027 (October 1, 2026). Many details of the Secretary's decision are currently unknown, but it is anticipated that the Secretary's

⁶⁴ Here the term "system water" means stored water in Lake Mead available for the Secretary of the Interior to deliver to water users in and below Lake Mead in accordance with the 1964 Decree in *Arizona v. California* and the existing operating rules (e.g. the 2007 Interim Guidelines).

⁶⁵ Beginning January 1, 2027.

⁶⁶ The Accounting Reports published by the USBR are available at <https://www.usbr.gov/lc/region/g4000/wtracct.html>.

⁶⁷ This does not include deliveries in excess of treaty requirements of 18,555 acre-feet and other deposits to Mexico's Water Reserve account. See Colorado River Water Use Report, 2024, page 31, available at <https://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2024/2024.pdf>.

⁶⁸ In Water Year 2024 the delivery to Mexico from Parker Dam was 1,362 MAF; for WY 2025, it was 1,286 MAF. For WY 2026, the projected delivery is 1,293 MAF. Note that deliveries to Mexico under the treaty are measured by calendar year, not water year. Releases from Parker Dam make up 90+% of the water delivered to Mexico; return flows make up the remainder.

decision will impose major cuts to Lower Basin mainstem water uses within the US.⁶⁹ The amount of the annual delivery to Mexico under the treaty is a critical component of the overall operation of the river. Accordingly, and particularly since levels in the major Colorado River reservoirs are critically low,⁷⁰ the US and Mexico must begin these discussions immediately and bring them to conclusion soon.

MOVING TOWARD A SUSTAINABLE TREATY ANNUAL DELIVERY

At CRWUA, Mexican diplomat Africa Zepeda told the audience that living with the 20th Century hydrology is not compatible with the realities of our 21st Century climate, adding that the two countries need to “move from crisis management to long-term sustainability.”⁷¹ To accomplish this on the Colorado River, the United States and Mexico should consider a fundamental change to how annual deliveries are determined in the next treaty minute. Rather than continuing with the Minute 319/323 “alignment” model, which sets the annual delivery to Mexico based on an approach using projected storage levels in Lake Mead and the levels of shortages incurred by water users within the US, the annual delivery to Mexico should be based on a percentage of the natural flow at Lees Ferry.⁷²

Given the extremely short timeframe available to initiate and conclude negotiations between the US and Mexico before 2027 Treaty operations begin on January 1, 2027, the strawman recommendations for the Colorado River in this paper are limited to transitioning from a fixed volumetric delivery to a percentage-based allocation tied to the natural flow of the Colorado River. However, the authors recognize that a much broader dialogue is needed and needed soon. A shift to percentage-based allocation addresses fairness, but Colorado River resilience will require institutional innovation and a realistic acknowledgement of the risks facing the Basin. While progress on Colorado River binational cooperation since 2010 has been both extraordinary and laudable, a broader suite of issues must be addressed by all those that rely on the Colorado River to move the Basin to focus on the broader question of

⁶⁹ Under the Post-2026 Operating Criteria Draft Environmental Impact Statement (DEIS), five action alternatives were analyzed. The Basic Coordination Alternative assumes no agreement among the states. Under this alternative: “Lower Basin shortages up to 1.48 MAF would be triggered based on Lake Mead elevation.” Based on comments to the DEIS, this alternative could be modified, see: [P26-DEIS-Exec-Summary.pdf](#) page Es-11.

⁷⁰ Under the March 2026 24-Month study “most probable” projection, Lake Powell will drop below elevation 3500 feet by September 2026. Under its 2024 Record-of Decision, the Bureau of Reclamation is committed to take actions to keep the reservoir above elevation 3500 feet. See https://www.usbr.gov/uc/water/crsp/studies/24Month_03.pdf.

⁷¹ The presentation can be viewed here: <https://www.youtube.com/watch?v=nL0KnDnd7vA>.

⁷² Lees Ferry is the location of the USGS river gage near the historic settlement with the same name. It is located just upstream of the confluence of the Paria and Colorado Rivers. Lee Ferry is located one mile downstream of that confluence. Under the 1922 Compact, Lee Ferry is the dividing between the Upper and Lower Basins. The USBR’s natural flow data base estimates the natural flow at the Lees Ferry gage, not at Lee Ferry.

how the two countries might jointly improve the management and resilience of the Colorado River System.

The authors anticipate addressing these broader topics in future papers. As a preliminary matter, however, formal acknowledgement and a commitment to a binational dialogue should, at a minimum, be included in any upcoming binational Colorado River minute:

- First, the issue of salinity management. The institutional framework established under Minute 242 has been remarkably durable, but it is also widely recognized that the arrangements governing salinity are now several decades old and could potentially be improved considering current scientific understanding and operational experience.
- Second, the broader question of basin resilience. While this article understandably focuses on allocation rules between governments, the long-term sustainability of the Colorado River will inevitably involve the irrigated agricultural industry that dominates water use throughout the basin. Even a brief acknowledgment of this structural dimension in an upcoming Minute might help - in parallel with the allocation proposal - initiate discussions between the countries within the larger challenge of reducing basin-wide water demand.
- Third, and perhaps more fundamentally, much of the history of the 1944 Treaty has revolved around reciprocal commitments between the two countries— which nation delivers what, and under what conditions. It may be worth exploring whether the next phase of binational cooperation could also include joint mechanisms aimed at improving efficiency, resilience, and river and ecosystem management across the basin, regardless of which side of the border specific actions are taken.

The details of such an agreement (new minute), of course, will have to be carefully analyzed and worked out by IBWC. The following is a “strawman” proposal to demonstrate and analyze the concept of how a percentage-based delivery approach for the Colorado River might work.

Colorado River Strawman Proposal

The annual delivery to Mexico would be a percentage of the average natural flow at Lees Ferry over the five previous years. To re-regulate the changes in annual deliveries, Mexico would be given access to system storage in Lake Mojave/Lake Mead (perhaps in the future to include Lake Powell). To demonstrate the concept, we use 11% of the 5-year average natural flow as Mexico's apportionment, subject to a total annual cap of 1,700,000 acre-feet, including deliveries of Mexican stored

water, which could be as high as 200,000 acre-feet per year. Water stored in the US for the benefit of Mexico would be subject to evaporation losses and transit losses from Lake Mojave to the international boundary. The provisions addressing the details of when Mexico's stored water would spill would have to be negotiated.⁷³

Our 11% figure is slightly higher than the percentage the treaty negotiators thought Mexico would be receiving when the treaty was signed in 1944, but slightly lower than the percentage Mexico has received since the advent of the Millennium Drought in 2000. The suggested five-year period is somewhat arbitrary. A longer period reduces the annual variability in deliveries to Mexico and provides more certainty to both US and Mexican water users. A shorter period is more responsive to droughts and wet cycles. Another advantage to a five-year period over a shorter period is that it usually takes Reclamation one year or more to release its estimates of natural flow. With a five-year period, the calculation is less reliant on provisional data.⁷⁴

Had this 11 percent/five-year criterion been in place beginning with the ratification of the treaty in 1945, the average annual delivery to Mexico would have been 1.53 MAF per year over the period of 1945-2024, about the same as the historical deliveries.⁷⁵

Had the 11 percent/five-year criterion been in place beginning in 2001, the average annual delivery would have been 1.425 MAF per year, about 3% less than the actual deliveries, which averaged 1.474 MAF per year. Finally, had the 11 percent/five-year criteria been in place over the 2020-2025 period (the first formal shortage to Lower Basin States was in 2022), the average annual delivery to Mexico would have been about 1.35 MAF, only slightly less than actual deliveries, 1.364 MAF, over the six-year period.⁷⁶

Colorado River Discussion

In our view there are sound reasons for the United States and Mexico to consider transitioning to an approach that calculates the annual delivery to Mexico based on actual hydrologic conditions in the Colorado River Basin and not be chained to the hydrologic assumptions made by the treaty negotiators more than 80 years ago. The

⁷³ Although there is little likelihood that Lake Mojave/Lake Mead "system" will spill in the foreseeable future, the order in which Mexico's water "spills" is likely to be a sensitive issue within the US.

⁷⁴ Reclamation's provisional natural flow data are still pretty good. There is a strong correlation between natural flow at Lees Ferry and unregulated inflow to Powell. A nuance here is that treaty deliveries are based on a calendar year. The natural flows at Lees Ferry are normally reported based on a water year (10/1/- 9/30), but CY data are available. Using water year data for the 5-year calculation would provide an extra three-month cushion for correction of the provisional data.

⁷⁵ The average is greater than 1.5 MAF because there were many years before 2001 that were treaty surplus years—when flood control releases were made from Lake Mead that resulted in treaty deliveries of 1.7 MAF to Mexico.

⁷⁶ This factors in the contributions Mexico made to the system under Minutes 323 and 330 that are not recoverable and assumes all of Mexico's recoverable water is eventually delivered.

advantages to using a percentage-based delivery approach such as the “strawman” proposal described above include:

- Mexico and the United States would more equitably share the burden of the impacts of aridification on Colorado River flows. If natural flows continue to decline, the annual delivery to Mexico would decline but Mexico's percentage of the available water would remain the same.
- The amount of water that Mexico receives under the treaty would not depend on and would be independent of water use rules within the US. The approach of keeping Mexico's water use in “alignment” with the Lower Division States was effective while there was consensus among the US Basin States (the 2007 Interim Guidelines). Now, however, consensus within the US has been replaced with uncertainty. The most likely outcomes are either a series of very short-term stopgap agreements,⁷⁷ or interstate litigation with major operational decisions being imposed on the Basin States by the Secretary or perhaps a court. It is now in both nations' interests to replace alignment with an approach that provides more long-term certainty concerning annual deliveries.
- The Basin States and the Department of the Interior would not be put in the position of having to make assumptions concerning future water use by Mexico before consulting with Mexico (through the IBWC). For example, the Lower Division States have publicly offered to take the first 1.5 MAF per year of cuts required by post -2026 operating rules, but they have also stated publicly that the Lower Division States will only be taking the first 1.25 MAF per year of necessary cuts and they expect Mexico will take the remaining 250,000 acre-feet per year. This has yet to be negotiated. For future negotiations among the Basin States, Mexico's uses would be known.
- Since the US Basin States have, to date, failed to reach a consensus agreement, the chance of future litigation over the interpretation of the 1922 Compact and/or other provisions of the Law of the River has increased exponentially. Among the core disputed 1922 Compact issues is the obligation of the Upper Division States for deliveries at Lee Ferry. Upper Basin deliveries and Lower Basin uses are the most critical factors in determining the storage level at Lake Mead. Under the Minute 319/323 “alignment” approach, deliveries to Mexico are a function of the amount of storage in Lake Mead, thus Mexico would have a direct stake in the outcome of future US Supreme Court litigation. Under a percentage-based delivery, Mexico would be less

⁷⁷ The State of Nevada and the Southern Nevada Water Authority proposed a two-year stopgap agreement in their comments on the Post-2026 Operational Guidelines DEIS, dated March 2, 2026.

susceptible to, or dependent upon, the outcome of interstate litigation within the US.

- The 1944 Treaty includes provisions for both the delivery of up to 1.7 MAF per year during surplus years and for a reduction in deliveries during “extraordinary droughts,” but the treaty negotiators chose not to define or set criteria for when these provisions are triggered. Under Minutes 319 and 323, the reduced deliveries and conservation measures are considered “voluntary” and not an interpretation of the extraordinary drought provision. A percentage-based approach would make these treaty provisions moot. Any prolonged drought would automatically result in reduced deliveries. A multi-year wet cycle would result in increased deliveries up to a negotiated annual limit.

There will certainly be challenges with implementing a percentage-based delivery approach. Using a percentage-based delivery requires that both countries have confidence in the underlying flow index to which the percentage is to be applied. Mexico may not be comfortable using an index based on Lees Ferry natural flows calculated by Reclamation. The counter argument is that while calculating natural flows has historically been a slow and tedious process, with the success of Open ET and the adoption of eeMETRIC by the Upper Colorado River Commission and Reclamation for calculating Upper Basin agricultural consumptive uses,⁷⁸ the process of calculating natural flow is now faster and more transparent, although its accuracy is still under evaluation.⁷⁹ While the calculation of natural flows will never be perfect and provisional data will always be subject to revisions, the Lees Ferry natural flow is the best available and has major advantages over other possible indexes.⁸⁰

Reaching agreement on the percentage split that Mexico would receive may be difficult and test the diplomatic skills of the representatives of both countries. In early summer 2025, the negotiators representing the US Basin States were optimistic that a percentage-based delivery approach could break the stalemate between the Upper and Lower Division States over post-2026 operating criteria. Their optimism

⁷⁸ Agricultural consumptive uses make up over 60% of Upper Basin depletions. For general information on eeMETRIC and OpenET, see Upper Colorado River Commission “Consumptive Use Measure in the Upper Colorado River Basin,” June 14, 2022 <http://www.ucrcommission.com/openet-upper-colorado-river-commission-and-bureau-of-reclamation-move-to-satellite-based-et-for-consistent-consumptive-water-use-measurements/ment>.

⁷⁹ As described in the document referenced in note 66, the Upper Division States and the USBR believe there are advantages in transitioning to eeMETRIC, however, individuals within the academic community have raised technical concerns, for example, see: <https://digitalcommons.unLedu/civilengdiss/190/>.

⁸⁰ Another possible index would be the estimated natural flow at Hoover Dam. It would account for the ~800,000 acre-feet per year of inflow between Lee Ferry and Hoover Dam. Reclamation’s Natural Flow Database has a node for natural flow at Hoover Dam. The problem with using the Hoover Dam node is that very little natural flow data currently exists on Lower Basin tributaries, personal communication between authors Kuhn and Schmidt and Dr. James Prairie, USBR.

was very short lived. They failed to reach agreement on the most fundamental question: the percentage of the natural flow that the Upper Division States would have to deliver. The state negotiators quickly abandoned the idea.⁸¹

For the upcoming negotiations for the successor to Minute 323, the US and Mexico have an advantage over the US Basin States in coming to agreement. Through Minutes 319 and 323, Mexico has already voluntarily agreed to delivery reductions in approximately the same percentage as the change in natural flow between the period of record since the treaty was ratified (1945- 2025) and current Millenium Drought period (2000-2025).⁸²

If the US and Mexico were to negotiate a percentage-based delivery, a cautious approach may be to first implement an agreement on an interim basis. This makes such an arrangement appropriate for implementation through a treaty minute, rather than as a treaty amendment. Previous minutes approved by the IBWC have addressed temporary measures to be undertaken designed to allow both countries to better assess long-term opportunities and cooperative measures for water conservation, management and development. Several of the existing minutes are long-standing. Minute 242, for example, which addresses water quality on the Colorado River, was signed in 1973 and is still in effect.⁸³

The Relationship of the Colorado River to the Lower Rio Grande

The most difficult challenge facing transitioning to a percentage-based delivery approach on the Colorado River may be the political connection between the Colorado River and the Lower Rio Grande. Mexico has had a history of problems in meeting its delivery obligations on the Lower Rio Grande, particularly because of the highly variable rainfall-dominated hydrology of the six tributaries and increasing consumptive uses in Mexico. The US has a need to significantly reduce Colorado River water use by all stakeholders. Will either nation agree to significant treaty minutes implementing delivery changes for one river without resolving issues on the other?

The Colorado River and the Lower Rio Grande are covered by the same treaty, but the rivers have very different hydrology that are likely to be affected by aridification differently. In the late 1930s when US State Department decided to engage with

⁸¹ See "Colorado River Insights", 2025: Dancing with Dead Pool, Ch. 3.

<https://www.colorado.edu/center/gwc/2025/12/03/colorado-river-insights-2025-dancing-deadpool>.

⁸² The decline in Lees Ferry natural flow between the 1945-2025 period and the 2000-2025 period is ~11%. The difference between the 1,318 MAF delivered to Mexico in 2024 and the normal delivery of 1.5 MAF is ~12.1% (this ignores a small amount of water that accrued to Mexico's Water Reserve account, which is theoretically recoverable).

⁸³ Minute 242, <https://www.ibwc.gov/wp-content/uploads/2023/05/Min242.pdf>.

Mexico and restart the stalled negotiations for a water treaty that had first begun in the 1920s, the Colorado River Basin States strongly opposed including the Colorado River and the Lower Rio Grande in the same treaty. They did so because they understood the hydrographic differences, even though they did not understand the potential for long-term changes in runoff caused by a warming planet. The Colorado River Basin States were concerned that the US negotiators would trade Colorado River water for more Rio Grande water.⁸⁴ They lost that argument. Mexico and the US, with support of South Texas irrigators that use Lower Rio Grande water that primarily comes from Mexico, decided to move forward with a single treaty covering both streams, as well as the smaller Tijuana River.⁸⁵

For at least the last 30 years, Mexico has struggled to meet its delivery requirements on the Rio Grande under the treaty. According to the IBWC website, for the five-year cycle that ended last October, Mexico failed to deliver more than 800,000 acre-feet.⁸⁶ Mexico's problems have been widely covered by news organizations in both countries. This issue has created significant tensions between the two countries. President Trump has threatened to impose additional tariffs on Mexico if it fails to meet its delivery requirements. Mexico President Claudia Sheinbaum has responded that Mexico cannot deliver water that it does not have.⁸⁷

Despite the fundamentally different hydrology of the two rivers, the hydrologic problem faced on both rivers is the same—declining annual flow. However, the upstream and downstream countries are reversed. Because of the aridification of the watersheds and the limited understanding of the hydrology of both rivers, the hydrologic assumptions made by the negotiators 80 years ago are no longer valid. Both rivers have experienced prolonged drought, causing their major reservoirs to reach critically low levels.⁸⁸ Salinity levels and the health of degraded ecosystems are major concerns on both rivers. The demand for water on both rivers exceeds the available supply and that imbalance has been steadily getting worse.⁸⁹

The Colorado River within the US is shared by seven states and governed by a complex "Law of the River." Litigation among the Basin States is a real possibility and if the alignment approach used to determine the annual delivery adjustments to

⁸⁴ See generally Norris Hundley Jr., *Dividing the Waters: A Century of Controversy between the United States and Mexico*, University of California Press, 1966.

⁸⁵ *Id.* at Chapter 4.

⁸⁶ See: https://ibwcsftpstg.blob.core.windows.net/wad/WeeklyReports/Current_Cycle.pdf.

⁸⁷ Elena San Jose, "Water a Ticking Time Bomb for Mexico" *El Pais* December 19, 2025, <https://english.elpais.com/international/2025-12-19/water-a-ticking-time-bomb-for-mexico.html>.

⁸⁸ The two major reservoirs on the Colorado River are Lake Mead, currently at 34% of active capacity, and Lake Powell, currently at 25% of active capacity. On the Rio Grande, the two major reservoirs are Amistad at 21% of active capacity and Falcon Reservoir at 13% of active capacity (3/17/2026).

⁸⁹ USBR, Lower Rio Grande Basin Study, Dec. 2013, <https://www.usbr.gov/watersmart/bsp/docs/finalreport/LowerRioGrande/LowerRioGrandeBasinStudy.pdf>.

Mexico from Minutes 319 and 323 is continued in some form, that litigation will impact Mexico. To date, Mexico has relied on the durability of domestic agreements within the US as a foundation for binational cooperative agreements. Litigation within the US—including the potential for interstate litigation at the US Supreme Court level—could, in turn, complicate and undermine the basis for any US-Mexico successor to Minutes 323 and 330 and eliminate the ability to remain “in alignment.”

The Lower Rio Grande is not covered by an interstate compact in the US; its waters are only used by one US state—Texas. Since the 1944 Treaty required no minimum deliveries from the Northern Branch of the Rio Grande, the Pecos River, and the Devils River, the treaty has legally disconnected water users on the Lower Rio Grande from whatever happens upstream on these US rivers. The only legally reliable source of water to satisfy water demands on the Lower Rio Grande within the US is the 1,750,000 acre-feet minimum average delivery requirement over five years (an average of 350,000) from the six Mexican tributaries under the 1944 Treaty.

The Colorado River has a critical management “pinch point”—Lees Ferry. At this point, Reclamation maintains a sophisticated natural flow database. There is no equivalent management point on the modern Rio Grande downstream from Fort Quitman, nor is there a natural flow database that is maintained and updated on an annual basis.

The basic problem is that the treaty's fixed delivery requirements are not working for either nation on either river. Both rivers are currently impacted by hydrologic assumptions that are no longer valid. Both rivers are overused. Changes must be made, but the solution for each river will have to be crafted to meet its specific needs. The unanswered question is whether the two nations will again, as they did in the 1940s, tie the two rivers together for political reasons or allow solutions to be negotiated and implemented separately?⁹⁰

CONCLUSION

Beginning in 2010 with Minute 318 and continuing through Minute 323 in 2017 and Minute 330 in 2024, Mexico and the US established an effective working relationship to address the impacts of long-term drought and shortages on the Colorado River. Mexico has voluntarily shared efforts designed to reduce Colorado River uses to sustainable levels and arrest the decline in reservoir levels. Reservoir levels, however, continue to decline. More efforts are needed to reduce total consumptive use on the Colorado River. The US Basin States have not reached agreement on a

⁹⁰ The authors recognize that there are valid arguments for both approaches. The relationship between the two neighboring nations is complex and water is just one of many issues.

set of operating rules to replace the 2007 Interim guidelines which expire at the end of Water Year 2026. They may never reach such an agreement; thus, litigation is becoming more likely. The current treaty minutes governing Colorado River relations, Minutes 323 and 330, also expire in 2026 and need to be renegotiated, but there is uncertainty within the US as to how the current imbalance between supply and demand will be addressed, therefore, what might be requested from Mexico.

Although very successful to date, the alignment approach used to determine the annual delivery to Mexico under Minutes 319, and its successor Minutes 323 and 330, effectively treats it as a fourth Lower Division State. Water deliveries to Mexico are a function of Upper Basin deliveries at Lee Ferry, uses within the Lower Division states, and the resulting water levels in Lake Mead. Thus, potential litigation among the Basin States that could impact how much water is delivered by the Upper Division States at Lee Ferry under the 1922 Compact could impact Mexico and become a factor in that litigation.

Perhaps even to a greater degree than the Colorado River, the Lower Rio Grande is also a river in crisis. And like the Colorado River, total consumptive use of water must be reduced to sustainable levels. On the Rio Grande, however, the geography is reversed. Mexico is the upstream nation that provides most of the water. Since both river systems are covered by the same treaty and administered by the IBWC, there is an obvious political connection that must be acknowledged.

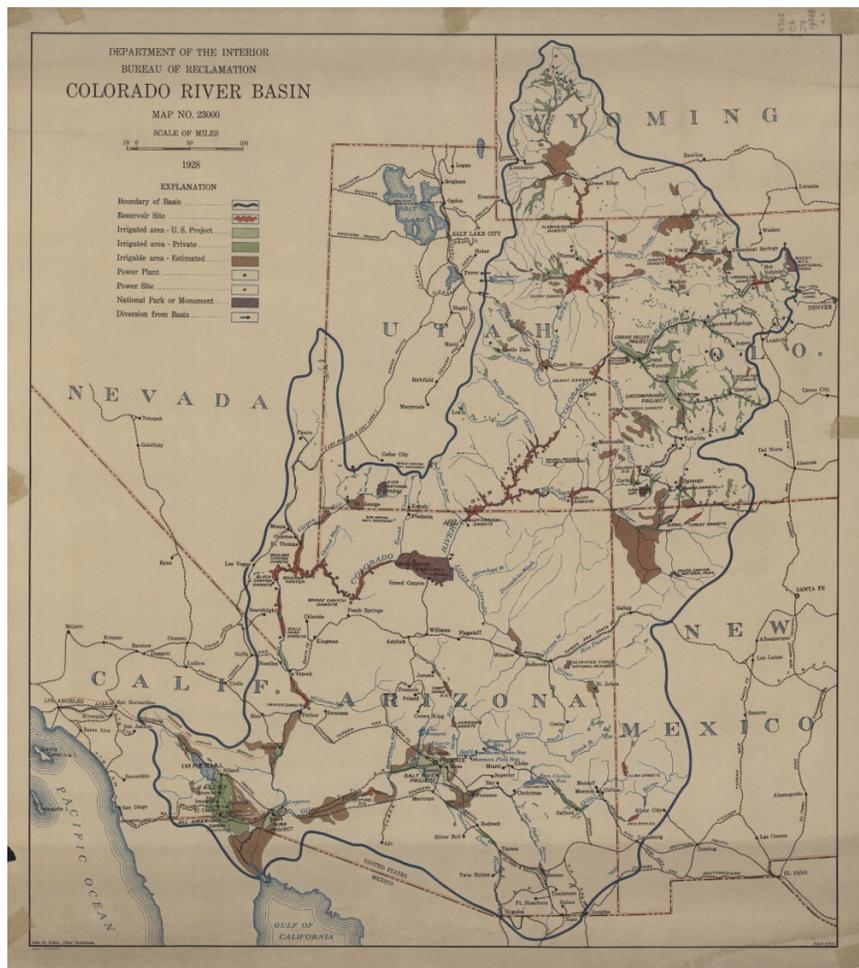
Rather than continue with short-term crisis-driven solutions, both nations should explore arrangements that address watershed aridification, hydrologic uncertainty, and variability. On both rivers, changes are needed. On the Colorado River, replacing the obligation of the US to deliver a fixed volume of water annually with a percentage-based delivery approach would be a positive step toward long-term sustainability and insulate Mexico from interstate legal disputes within the US. On the Lower Rio Grande, hydrography is more complicated and hydrology is more uncertain. While the concept of a percentage split was originally the intent of the treaty negotiators, it was coupled with a minimum delivery obligation that has now become a fixed delivery requirement. Mexico's treaty obligations require further analysis and review with the goal of providing a more long-term certainty for both nations.

Issues of delivery adjustments also point to broader challenges that both countries will need to address. The aridification of the Colorado River and the Lower Rio Grande watersheds not only causes reduced flows, but it also stresses watershed health, including land use, salinity, and ecosystem degradation. Agricultural production, as the dominant water user, plays a central role in shaping these

conditions. While this article focuses on allocation, long-term resilience will depend on improving soil health, reducing salinity, and enhancing water-use efficiency, including through more conservation-oriented and regenerative agricultural practices. More fundamentally, these shared challenges suggest the need to move beyond a framework centered on bilateral delivery commitments toward one that incorporates binational mechanisms to improve overall watershed condition and system performance.

The US-Mexico border spans over two thousand miles. Water resources of our two major shared rivers are under severe strain due to both overuse and aridification of the watersheds. To achieve watershed resiliency and water supply sustainability, both nations must use less water and make more efficient use of the available water. Water management will require a new and sustained level of international collaboration and flexibility.

Colorado River Basin as of 1928



Source: US Bureau of Reclamation