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## VIEWPOINT

### Minute 319: a cooperative approach to Mexico–US hydro-relations on the Colorado River

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Minute 319 is the most recent amendment to the 1944 treaty governing the Colorado River, shared between Mexico and the United States. The amendment was adopted, in part, as a continuing response to the 2010 Mexicali earthquake, which severely damaged Mexican irrigation infrastructure, as well as ongoing objectives to address dwindling water supplies in the basin. By implementing measures to share both shortages and surpluses, and by facilitating long-term collaborative efforts that engender interdependencies, the amendment commits the parties to cooperate and may serve as a model for other regions sharing limited transboundary freshwater resources.

**Keywords:** water governance; international; transboundary river; cooperation; Colorado River; United States-Mexico

#### Introduction

Since the mid-1800s, the United States and Mexico have engaged one another over the management and allocation of the rivers they share. In the twenty-first century, much of the focus continues to be on the Colorado River, which runs through the states of Colorado, Utah, Arizona, Nevada and California in the United States and the states of Baja California and Sonora in Mexico. Each country's allocation of water from the river was set in 1944 by the Treaty between the United States of America and Mexico Respecting Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande (the 1944 Water Treaty). The treaty is generally viewed positively, as having served as a basis for decades of peaceful and successful cooperation.

In the 70 years since the 1944 Water Treaty was adopted, however, rapidly expanding populations and economies, sustained diversions, and the effects of climate change have seriously strained the resources of the Colorado River. As a result, the two riparians have had to implement changes to the agreement to address evolving needs and new realities. One of these changes came in response to the 2010 Mexicali earthquake, which damaged irrigation infrastructure in the Mexicali Valley area of Baja California, Mexico, and severely diminished Mexico's ability to use Colorado River water efficiently. Known as Minute 318, the treaty modifications allowed Mexico to delay delivery of Colorado River water that the US was obligated to send down the river's channel into Mexico until Mexico had had time to repair its irrigation canals (IBWC, 2010). The treaty was amended again in November 2012 to add Minute 319, which expanded on the objectives and

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implementation of Minute 318 (IBWC, 2012). More importantly, Minute 319 introduced new and creative mechanisms for the coordinated management of the Colorado River.

By implementing measures to share both shortages and surpluses, and by facilitating long-term collaborative efforts that engender interdependencies, the amendment commits the parties to cooperate and may serve as a model for other regions sharing limited transboundary freshwater resources.

This article focuses on Minute 319 and its innovative approach to transboundary water cooperation on the Colorado River. The following section of this article briefly surveys the geologic and hydrologic context of the Colorado River, summarizes the relevant international agreements that have governed the river, and reviews certain elements in the evolution of the agreements. The third section reviews some of the literature regarding collaborative efforts between Mexico and the US, considers the issues and challenges facing the region and river today, and examines the context for the negotiation of Minute 319, including the history and current status of cooperative efforts by parties in both countries. The fourth section outlines the provisions of the newly adopted Minute 319, and the fifth considers the practical implications of the amendment for the people and institutions that depend on the Colorado River, as well as the political and legal implications it may have for future administration of the river.

### **Geographic context and binational regulatory history of the Colorado River**

The Colorado River ([Figure 1](#)) flows approximately 2334 km from its origins in La Poudre Pass Lake in Rocky Mountain National Park in Colorado to its delta in Mexico's Gulf of California. In total, it drains an area of about 637,000 km<sup>2</sup>, nearly an 11th of the entire landmass of the contiguous United States. Over the past 500 years, the river carried an annual average of 18 billion m<sup>3</sup> of water down its course and into the Gulf of California (Woodhouse, Gray, & Meko 2006). More recently, however, agricultural, municipal, and other diversions; rising temperatures and evaporation rates; and declines in precipitation have taken a significant toll on the river. Of the fraction of the river that reaches the Mexican border – about a 10th of its former flow – the vast majority is diverted for municipal and agricultural uses south of the border (Howard, n.d.; Postel, 2013a). The result is that less than 1% of the water that historically reached the mouth of the river now makes it to the delta. What once was an expansive wetlands region spanning 6000 km<sup>2</sup> is now a patchwork of marshes and shallow ponds that survives on accidental releases, agricultural return flows, municipal effluent discharges, and leaks in the system (Gerlak et al., 2013).

Governance of the river is today the responsibility of the International Boundary and Water Commission (“IBWC” or “Commission”). Composed of independent American and Mexican sections, the IBWC is a binational body responsible for applying the boundary and water treaties of the United States and Mexico and for settling differences that may arise in their application.<sup>1</sup> The Commission's roots are found in the 1848 Treaty of Guadalupe Hidalgo, which established the international border between the United States and Mexico, and the Gadsden Purchase Treaty of 1853, which established temporary joint commissions to survey, map and mark the boundary between the two countries. The joint commissions evolved over the decades, culminating in the creation of the International Boundary Commission (“IBC”) in 1889. Following its creation, the IBC was involved in the negotiation and implementation of a number of agreements, including the 1944 Water Treaty.

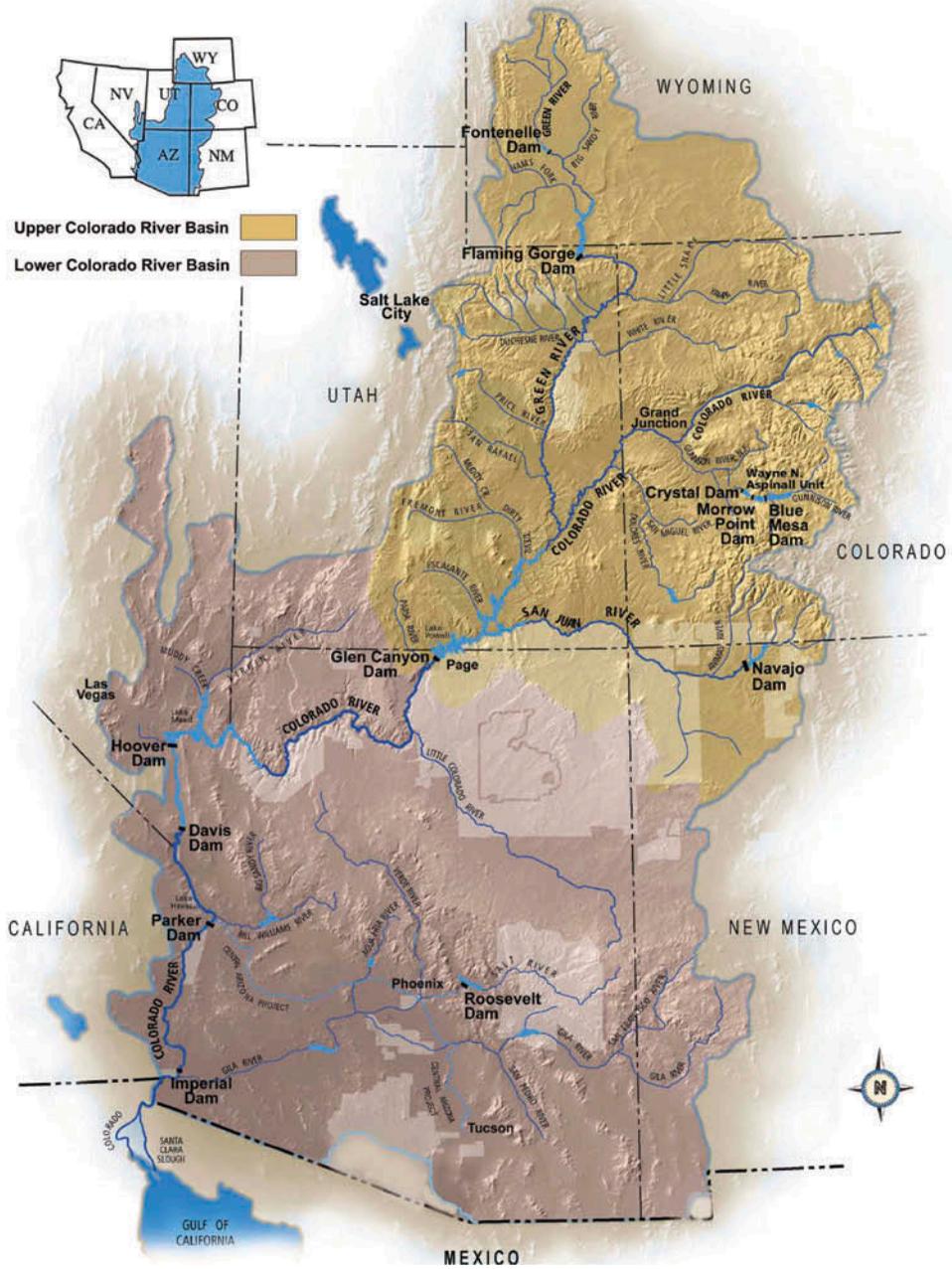


Figure 1. Map of the Colorado River basin showing the locations of major dams and reservoirs (U. S. Bureau of Reclamation, 2013). Courtesy of the Bureau of Reclamation.

Of the waters of the Colorado River, the 1944 Water Treaty provides Mexico with a guaranteed annual quantity of 1.5 million acre-feet (approximately 1.85 billion m<sup>3</sup>) at the Mexico–US border.<sup>2</sup> In the event that the amount of water in the river in a given year

exceeds upstream US water needs, as determined by the US, plus the 1.5 million acre-feet guaranteed to Mexico, Article 10 of the treaty provides Mexico with up to an additional 200,000 acre-feet (approximately 246 million m<sup>3</sup>) of water.

In addition to allocating the Colorado River, the 1944 Water Treaty expanded the responsibilities of the IBC to include water management on the border and imposed an organizational and operational structure on the agency. It also gave the agency its current moniker: the International Boundary and Water Commission (Article 2). The Commission has the status of an international body and consists of a United States section and a Mexican section, each headed by an engineer-commissioner (Article 2). Certain Commission officials are granted diplomatic status by the other nation's government (Article 2). The Commission's jurisdiction extends "to the limitrophe parts of the Rio Grande (Rio Bravo) and the Colorado River, to the land boundary between the two countries, and to works located upon their common boundary" (Article 2).

One of the hallmarks of the 1944 Water Treaty is the unique amendment system implemented by the two nations. Having anticipated changing circumstances and the need for flexibility, the parties adopted an amendment process by which the two IBWC sections were authorized to jointly propose substantive decisions known as 'minutes' that, once approved by both governments, amended the 1944 Water Treaty. This is considered one of the strengths and a chief reason for the success of the treaty. Since its inception, the IBWC has adopted 319 minutes on various border and frontier water-related issues, including border mapping and delimitation, water quality controls and reclamation projects, and coordinated research activities. Minute 319, the latest of these amendments, is one of two dozen minutes to address water deliveries on the Colorado River.<sup>3</sup>

### **Challenges facing the Colorado River**

Entire books have been written on the challenges facing the western United States and the Colorado River.<sup>4</sup> Rising population and economic growth over the last century have taken a significant toll on the river and its man-made water infrastructure. Booming populations in Arizona, California and Nevada have greatly increased the demand for water and reduced the amount of water left in the river (Figure 2). As a result, the Colorado has been described as one of the most dammed, diverted and depleted rivers in the United States (American Rivers, 2013). Combined with reductions in runoff from melted snow, periodic but worsening droughts, and losses to evaporation, the unrelenting stress on the river has caused water levels in reservoirs such as Lake Mead and Lake Powell to decline to unprecedented levels, thereby jeopardizing diversion mechanisms and hydroelectric power production.

Regions further down the river are also imperilled. In most years, 90% of the river's flow is gone by the time it reaches the US–Mexico border; flows have not reached the river's lower delta and estuary for most of the last half century (Postel, 2013a). The freshwater and marine wetlands that used to constitute the delta – once one of the world's great desert river deltas and home to dolphins, fish, birds and other wildlife – are now dry and lifeless and have shrunk to a 10th of their historic 6000 km<sup>2</sup> area (Adler, 2007). Today, what little water remains in the river is often polluted or too saline to support the diversity of life that once inhabited the region (Kowalewski et al., 2000). The lack of clean, high-quality water to support the river ecosystem itself has been apparent for decades; scholars have written extensively on the need to provide for environmental flows (Glennon & Culp, 2002; Pitt et al., 2000; Tarlock, 2000, 2002).

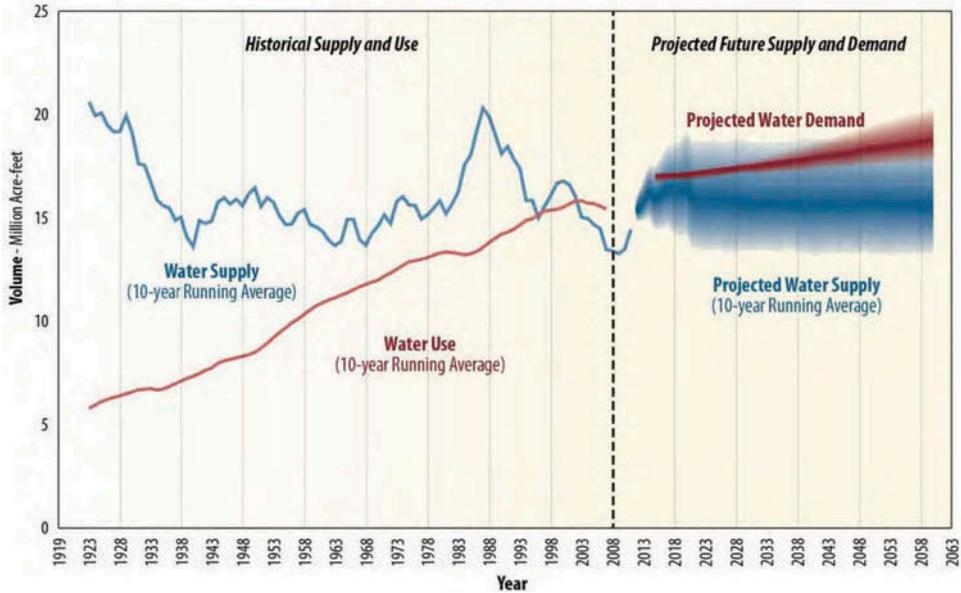


Figure 2. Historical supply and use (including Mexico's allotment and losses) and projected future Colorado River basin water supply and demand (U.S. Bureau of Reclamation, 2012). Courtesy of the Bureau of Reclamation.

Perhaps the most ominous threats facing the region are the effects expected from climate change. Various climate models project a more arid environment, in which surface runoff in the border area will decline and the river's flow will be reduced 10–30% by 2050 (American Rivers, 2013; National Water Commission of Mexico [NWCN], 2010). Projected impacts vary between the lower and upper basins of the river, but temperatures in both regions are expected to rise 2.8–3.3°C, with slightly larger increases projected in the upper Colorado Basin (U.S. Bureau of Reclamation, 2011). The US Bureau of Reclamation predicts that by 2050, precipitation will increase 2.1% in the upper basin but decline 1.6% in the lower basin. That rainfall, however, is expected to arrive as increased torrential rains (NWCN, 2010), because warmer conditions are likely to mean more rainfall and less snowfall for the region, resulting in more December–March runoff and less April–July runoff (USBOR, 2011). Particularly worrying, mean annual runoff for the entire river basin is projected to decrease 8.5% by 2050 (USBOR, 2011). Taken together, these projections point to a substantial increase in uncertainty and risk for communities, industries and ecosystems dependent on the waters of the Colorado River.

These and other challenges confronting the Colorado River basin have been debated for decades within an evolving political context populated by national and subnational governmental entities and, increasingly, non-governmental organizations and industry associations of many stripes on both sides of the border. This proliferation of actors, as well as growing societal awareness of the ecological consequences of poor water management and the need to provide water for the environment, have resulted in new collaborative processes and partnerships intended to benefit the river and its delta. The effectiveness of collaborative efforts along the border has received mixed evaluations. While some scholars and stakeholders applaud the initiatives, others voice concerns that these new approaches are inadequate and ineffective for protecting the environment and other, weaker interests in the face of powerful factions.

Birdsong (2008), for example, has expressed reservations about the ability of collaboration – though important for the allocation of water resources – to adequately provide for the delta “without structuring the legal and economic framework for policymaking to provide specifically for [that] goal” (p. 853). In his view, the decisions reached by collaboration “merely reflect the priorities of entrenched economic interests and legal frameworks that value those economic interests” (p. 854). Conversely, Zamora-Arroyo et al. (2008) argue that the existence of a collaborative process actually “*promoted* the development of innovative legal and economic frameworks to advance the conservation and sustainable development of the Delta” (p. 872, emphasis added).

Grant and Zellmer have both addressed collaborative agreements or structures that offer possible solutions to address issues in the basin. Grant (2008) examined a 2007 proposal by the seven US states to coordinate the management of reservoirs on the Colorado River under low-water conditions, concluding that the collaborative effort held the potential to help the states deal with future water shortages. And Zellmer (2008) considered market-based collaborative options such as water banking or forbearance agreements in light of the traditional doctrine of anti-speculation in water law, finding that water market transactions were a useful tool to reallocate water but urging continued oversight by the government to curb potential abuses and guard the interests of water users. Variations on each of these ideas can be seen in the collaborative substance of Minute 319.

### **Minute 319: the nuts and bolts of the agreement**

In April 2010, a 7.2-magnitude earthquake in the Mexicali area of Baja California devastated water infrastructure in Mexico’s Irrigation District 014. In particular, the disaster severely damaged the concrete-lined Nuevo Delta Canal, as well as the Reforma Canal, which diverts water from the Colorado River into the Nuevo Delta Canal at Morelos Dam (Dennis Gracia et al., 2011; Isackson, 2010, 2011). As a result of the damage, Mexico was unable to fully and effectively utilize water running down the Colorado River and had to allow much of the flow to continue past its broken irrigation channels and withering crops. While the quake was widely felt in the United States, water infrastructure north of the border did not suffer the same damage as experienced in Mexico.

In response to the natural disaster, the United States agreed to defer temporarily up to 260,000 acre-feet (approximately 320 million m<sup>3</sup>) of Mexico’s annual allotment of Colorado River water by storing it upstream in various reservoirs. The agreement, known as Minute 318, provided Mexico time to repair and rebuild its irrigation systems and the option to request delivery of the water at a future date. At the time Minute 318 was entered into, the parties recognized a need for a more thorough assessment of the Colorado River’s management scheme and committed to negotiate a more comprehensive regime.

On 20 November 2012, as part of the binational commitment to improve the management of the Colorado River and respond to the changes that have affected the river in recent decades, the IBWC adopted Minute 319. Designed to lay a firmer foundation for shared management of the river in the face of continued population growth, economic development, climate change and other challenges, Minute 319 identifies measures intended to “allow both countries to better assess the long-term opportunities and cooperative measures for water conservation, management and development” (§ I). In particular, the minute introduces innovative mechanisms for sharing water surpluses and

shortages, enhancing benefits through flexible storage and delivery procedures, facilitating investment in Mexico's water infrastructure, and restoring (albeit on an experimental scale) environmental flows in the Colorado River down to the Gulf of California.

As a preliminary matter, Minute 319 extends for an additional four years the cooperative measures established under Minute 318, affording Mexico additional flexibility in receiving its water allotment under the 1944 Water Treaty. As part of the extension, Mexico is permitted to continue accumulating and deferring any water delivery previously postponed under Minute 318. Delivery of water banked under Minute 318 can be requested at any time, including in compensation for any delivery reductions during times of shortage (§ III.1).

Minute 319 further authorizes Mexico to defer delivery of water volumes resulting from conservation projects or new water source projects in order to establish an "intentionally created Mexican allocation" (ICMA), up to an annual maximum volume of 250,000 acre-feet (approximately 308 million m<sup>3</sup>) (§ III.4). The water in the ICMA is then available for subsequent delivery when Mexico wishes to receive it, subject to restrictions relating to the creation, accumulation and delivery of the ICMA. Among these restrictions are a limit on the volume of ICMA that Mexico may create (250,000 acre-feet) and prohibitions on creating ICMA or deferring water under the treaty if flood-control releases are being made from Lake Mead or on taking delivery of deferred water in excess of 200,000 acre-feet in any one year (§ III.4). Further, under Minute 319, Mexico may not take water banked under Minute 318 or accumulate it as part of the ICMA if the elevation of Lake Mead falls below 1025 feet (312.5 m) above mean sea level (§ III.4.d).

Minute 319 also puts into place a cooperative, coordinated approach for the two countries to use in confronting water shortages and surpluses. The agreement allows the US to send less water to Mexico when certain low-reservoir conditions are present. In dry years, Mexico can adjust its requests to offset US reductions with deliveries of deferred water if Mexico has a minimum ICMA or has deferred sufficient water under the infrastructure provisions. Conversely, in years in which Lake Mead is projected to be at or above certain elevations, Mexico may increase its requests for river water in increments correlated to lake levels (§§ III.2.a, b). The authorization to increase its requests, however, does not allow Mexico to exceed the total quantity of 1,700,000 acre-feet (approximately 2.1 billion m<sup>3</sup>) of water set by Article 10(b) of the 1944 Water Treaty (Minute 319, § III.2.d).

Section III.6 carries perhaps the most revolutionary provisions of Minute 319. Entitled Water for the Environment and ICMA/ICS Exchange Pilot Program, the section emphasizes the importance of providing water for the Colorado River delta and other environmental needs. It establishes a cooperative pilot programme to provide water for instream flows down to the river's delta and to advance research on the delta's ecosystem and its response to the renewed flows. Under the pilot programme, the US will contribute through the Commission \$21 million for infrastructure and environmental projects in Mexico. In return for the injection of cash, Mexico will grant the US a one-time allotment of 124,000 acre-feet (approximately 153 million m<sup>3</sup>) of water (§ III.6.e.iii). The money is intended to fund the repair of infrastructure damaged by the 2010 earthquake, with the goal of generating water savings that will benefit all river users and the environment.

Under Section III.6, Mexico and the US will contribute two-thirds of the instream flows, while the Colorado River Delta Water Trust (Delta Water Trust),<sup>5</sup> a binational coalition of non-governmental organizations that has been purchasing water rights in the area since 2008, has committed to supply the remainder. The water contributed by the two

countries, which should be generated from water savings resulting from infrastructure repairs, will be provided in the form of a one-time, high-volume “pulse flow” (§ III.6.e.i). The pulse flow of about 105,400 acre-feet (approximately 130 million m<sup>3</sup>) is intended to mimic the natural flows that historically resulted from melting Rocky Mountain snows and that periodically scoured the channel and floodplain, helping in the germination of willows and cottonwoods (which require flooding) and thwarting the growth of salt cedar. Under the agreement, the pulse flow will be released over the course of one or two months sometime between 2014 and 2016 (§ III.6.d.i; Fountain, 2013). That pulse flow will be augmented by the Delta Water Trust’s base flows, which will be slowly released over the next five years. Scientists and advocates project that, together, the pulse and base flows could create 2000 acres (approximately 809 hectares) of new wetland habitat and will lay the groundwork for more extensive restoration projects (Walton, 2012). At the very least, they anticipate that for the first time in years, the river will actually reach the Gulf of California (Fountain, 2013).

The revolutionary nature of the environmental-flows provisions of Minute 319 has been widely applauded by the environmental community, which seems satisfied that the obligations embedded in Minute 319 are meaningful and will positively affect the Colorado River. Jennifer Pitt (2012), Colorado River project director for the Environmental Defense Fund, has written that Minute 319 is “the most important bilateral Colorado River agreement since the 1944 Treaty”. Sandra Postel (2013a), director and founder of the Global Water Policy Project, has called the agreement “a grand achievement in international river cooperation”. National officials also appear convinced of its significance: former US secretary of the interior, Ken Salazar, in his exit ceremony, called Minute 319 “the most important agreement that has ever been put together between the United States and Mexico on water in the Colorado River” and stated that river watchers “will see a restoration of the Colorado River on the Mexican side of the border” (quoted in Pitt, 2013).

### **Implications for stakeholders and the Colorado River delta**

The new agreement offers a number of benefits for both nations, as well as for the political subdivisions, water utilities and environmental organizations that depend on and care for the Colorado River. In addition to enhancing Mexico’s storage capacity and longer-term water security, the cooperative storage arrangements benefit the United States by keeping water levels in Lake Mead more stable and predictable, which, in turn, protects the water-intake pipes that supply the vast majority of Las Vegas’s drinking water. From a broader perspective, Minute 319 provides water departments, cities, states and other political subdivisions that rely on the river for freshwater with the additional certainty and peace of mind of a consistent water supply, which, in turn, will allow them to make better business and risk-allocation decisions.

The programme also benefits Mexico by allocating resources to rehabilitate its damaged water infrastructure and upgrade antiquated water-delivery mechanisms (e.g. new or renovated concrete-lined canals instead of the current dirt channels). This in turn will benefit water users throughout the basin, because the improvements will enhance water-use efficiencies and reliability of water deliveries to Mexican farmers and other water users. The transaction will also provide additional water to the US in the short term; in exchange for the infrastructure investments in Mexico, the US will receive a one-time allotment of 124,000 acre-feet (approximately 153 million m<sup>3</sup>) of water.

In addition, water allocated under Minute 319 for use as environmental flows in the Colorado River delta will benefit the delta region and the myriad species that are found there. The delta has been largely dry for decades. Most years, the flow of the river is diverted before reaching its mouth at the northern end of the Gulf of California, leaving the river channel completely dry more than 90% of the time and damaging the delta ecology and wetlands that once covered the region. Farmers in the region also will benefit from the pilot project. The Delta Water Trust is paying fair market value for water rights formerly owned by Mexicali farmers, which offers the farmers a new and potentially more lucrative revenue stream (Postel, 2013b). Furthermore, the Delta Water Trust's restoration projects are indirectly creating employment opportunities for locals. The Mexican government has funded temporary employment programmes in which workers are paid to clear the land of salt cedar, an invasive plant that has taken over much of the delta and has one of the highest evapotranspiration rates of any riparian shrub (U.S. Water Alliance, 2013). Moreover, delta restoration efforts are expected to generate future employment opportunities for local residents by growing the region's ecotourism industry (Preston, 2010).

Notwithstanding the considerable support that Minute 319 has received from water-distribution, environmental and governmental entities alike, the agreement is not without its critics. Some stakeholders on the US side have expressed concern that keeping more water in Lake Mead could mean less water for hydroelectric power generation. They also contend that because lake levels in Lake Mead are used as a drought indicator by various US federal and local governmental entities, Mexico's storage of water in the lake would maintain artificially high water levels that could delay a declaration of drought, which in turn could postpone necessary distribution reductions (Varin, 2011). Furthermore, important groups like the Imperial Irrigation District, a primarily agricultural water district in California and the largest single recipient of Colorado River water, initially refused to sign on to the agreement. Among other concerns, they criticized the agreement for failing to provide water users on the US side with water storage and demand flexibility mechanisms comparable to those afforded to Mexican water users (Varin, 2011). The District has since agreed to help finance infrastructure repair in Mexico in exchange for water storage credit (Abou-Diwan, 2013).

Reception in Mexico was also mixed. Some Mexican farmers have benefited by selling their water rights, which are now valued at as much as seven times the average farmer's annual income (Postel, 2013b). Many Mexicans are also pleased that the river's water is being used locally for conservation rather than for industrial or municipal uses (Postel, 2013b). However, the Confederación Nacional Campesina, Mexico's national farmers' association, has expressed concerns about the minute's economic impacts on agricultural production in the region and has called upon farmers to present a "united front" against the agreement (OOSKANews, 2012). In particular, they object to the Delta Water Trust's diverting water from agriculture activities to instream flows. The association also contends that it was excluded from the negotiations of Minute 319, and that its exclusion created surprise, confusion and disorientation among its membership and farmers throughout Mexico's portion of the Colorado River ("Protestan por negociación", 2012).

Despite the opposition, the advantages of Minute 319 outweigh its shortcomings. In particular, in addition to offering new and unique possibilities for stakeholders and the greater Colorado riverine environment, the agreement has important political and legal implications for the long-term administration of the Colorado River and its delta. At the outset, the amendment radically changed the cooperative approach between Mexico and the United States over the Colorado River. Prior to the implementation of Minute 319, the

two riparians were primarily focused on sharing water shortages. The amendment, though, created mechanisms that facilitate sharing of both water shortages and water surpluses, an approach that is likely to enhance the predictability of available water supplies on both sides of the river's border.

Perhaps more significant is the precedent that the agreement created for future cooperation as the river is further impacted by overuse, drought and climate change. As noted above, Minute 319 is limited to a term of five years. Nevertheless, officials and stakeholders on both sides have expressed hope that Minute 319 may be extended, and the amendment itself includes language anticipating that it will be maintained into the future. Section III of the agreement provides that if by 16 December 2016 the Commission has not extended or replaced the minute, the Commission's principal engineers are to begin developing recommendations to do so. Section VII also references discussions during negotiations about the benefits of joint investment in and construction of international projects to allow for water conservation or the generation of new water sources, and states that these opportunities "should be pursued concurrently with development and execution of a Minute to extend the substantive provisions of Sections III.1-6 of this Minute 319 through 2026" (§ III.7).

But even if such explicit language were not included in the text of the minute, its substantive content facilitates its perpetuation and transboundary cooperation in general. Implementing the minute will further entangle stakeholders' financial, temporal and emotional investments, such that when it expires, a great deal of progress will have been made and money and other resources will have been committed. In order to meet the obligations imposed upon the Delta Water Trust by Minute 319, its partners have entered into collaborations with three additional non-governmental organizations<sup>6</sup> to create the Raise the River campaign, with the goal of raising \$10 million by 2017 (Raise the River, 2014). Stakeholders have also spent the last year developing implementation plans. On 14 January 2014, pursuant to Minute 319, stakeholders submitted to the IBWC a draft delivery plan for environmental flows, proposing that the pulse flow to the delta be released beginning in late March or April of 2014 (Governor's Representatives, 2014). The pulse flow was released on March 23, 2014, and within a few days resulted in a marked increase in visible wildlife (Carcamo, 2014). Binational groups continue to meet to develop monitoring plans and share ecological and hydrological information. Accordingly, there is likely to be considerable pressure on the parties to either extend the minute or draft a new one.

Arguably, the process that contributed to the creation of Minute 319 supports the argument by Zamora-Arroyo et al. (2008) that a pre-existing legal framework addressing the delta's environmental needs was not required to ensure that the delta received the resources it needed: stakeholders, organizations and government agencies, all cooperating across the different levels of society, could and did generate the framework. Minute 319 formalized and enhanced this development, building upon prior cooperation between stakeholders in the basin.

## Conclusions

Disagreements over water resources are projected to be a leading – if not a primary – cause of cross-border social and political conflict in decades to come. This is becoming more evident along the Mexico–US frontier, as well as in other arid parts of the world. Scientific research and environmental models have aptly demonstrated that the region will continue to suffer from the effects of climate variability far into the future. Accordingly, it is essential that management decisions take into consideration the changing needs of the river and its

ecosystems as climatic and environmental circumstances evolve. Additionally, ties between Mexican and US governmental officials, institutions, scientists, basin and border communities, and water managers must be maintained and strengthened, because they are critical for facilitating future cooperation and minimizing tensions between the two neighbours.

Although Minute 319 can be lauded for addressing a number of immediate concerns regarding the management of the Colorado River, its most important achievement may be in setting a precedent in which resource allocations are made, at least in part, for the benefit of the environment. The creation of the pilot programme to provide environmental flows is a credit to the success of advocacy groups on both sides of the border in raising the profile of the environment as a water user that must be represented at the negotiation table. The successful completion of this agreement provides a precedent for cooperation going forward, giving the two nations an additional legal and political structure on which to build – one that by its terms recognizes the value of and encourages this cooperation. The personal and professional relationships forged in the process are likely to be invaluable for future compromises over the management of the Colorado River, as well as other transboundary waters on the border. More broadly, Minute 319 may serve as an example for other regions facing similar water-related challenges in creative cooperative management of limited, transboundary, freshwater resources.

## Notes

1. Each of the two sections of the Commission is administered independently and is directed by an engineer-commissioner, who is appointed by the president of the country to which the section pertains. The American section, called the United States Section of the International Boundary and Water Commission, is an agency of the US government, headquartered in El Paso, Texas, and operates under the foreign policy guidance of the US Department of State. The Mexican Section – the Comisión Internacional de Límites y Aguas – is under the administrative supervision of the Mexican Ministry of Foreign Affairs and is headquartered in Ciudad Juárez, Chihuahua, Mexico. Additional information about the sections is available on the Commission's websites at <http://www.ibwc.state.gov> (English) and <http://www.sre.gob.mx/cilano/index.php/home> (Spanish).
2. An acre-foot of water is the amount of water needed to cover one acre of surface area to a depth of one foot. An acre is approximately 0.4 hectares.
3. Other minutes addressing water deliveries include 185, 188, 189, 191, 194, 195, 197, 208, 209, 211, 221, 240, 243, 246, 252, 256, 259, 260, 263, 266, 267, 280 and 287.
4. See for example Reisner, M. (1993). *Cadillac Desert: The American West and Its Disappearing Water* (rev. ed.). New York: Penguin Group; Hundley, Jr., N. (2009). *Water and the West: The Colorado River Compact and the Politics of Water in the American West* (2nd ed.). Los Angeles: University of California Press; Worster, D. (1992). *Rivers of Empire: Water, Aridity, and the Growth of the American West*. New York: Pantheon Books; Grace, S. (2012). *Dam Nation: How Water Shaped the West and Will Determine Its Future*. Guilford: Globe Pequot Press.
5. The Colorado River Delta Water Trust was created in 2008 by the Sonoran Institute, Pronatura Noroeste and the Environmental Defense Fund. The trust's efforts have been funded by foundation support in the past, but the entity has made efforts to innovate and expand its funding mechanisms. In 2013, the trust began working with the Bonneville Environmental Foundation to use water restoration certificates to fund water conservation projects in hope of restoring approximately 39 million gallons per year to help the delta (Bennett, 2013; Bonneville Environmental Foundation, 2013).
6. The Raise the River campaign includes the three founding members of the Delta Water Trust, as well as the Nature Conservancy, the Redford Center, and the US Fish and Wildlife Service.

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