The Ocean Bountiful?

De-salination, de-politicisation, and binational water governance on the Colorado River

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Abstract
The emergence of large-scale seawater desalination as an alternative urban water source represents a significant reconfiguration of the hydro-social cycle and the scalar politics of water governance. 'Binational' desalination is being proposed as a solution to the insoluble inter-state and inter-national contestations that characterise the governance of the Colorado River. By tracing the technological, discursive and political formations that have coalesced around the desalination 'solution', this chapter argues that desalting technologies are being advanced as a spatial and political 'fix' that sustains a very particular mode of water management and development without addressing its deep contradictions and historical failures.

Introduction

In May 2010 an extraordinary document was published. Although technical in nature and understated in terms of its political implications, this document in many ways represented the culmination of nearly a century of disputes on the Colorado River. 88 years after the signing of the Colorado River Compact, under which the entire annual flow of the river was (over)allocated, and 66 years after the United States and Mexico reached an unstable compromise over their respective entitlements to water, a number of the basin's largest water users were looking for new ways to fix intensifying

disputes and shortages. Their conclusion: manufacture water to add to the Colorado River Basin. Four water agencies in the United States and four from Mexico collaborated in a feasibility study proposing the construction of a large seawater desalination plant located about 30km south of the border at Rosarito Beach (SDCWA, 2010). This international infrastructure project would be financed by agencies on the Colorado basin on both sides of the border. Desalted ocean water would then be transferred to the US either by pipeline (as 'wet water') or through the transfer of entitlements to river water (or 'dry water'). This way, water users as far inland as Las Vegas could finance coastal desalination in return for more secure access to Colorado water (Shrestha et al., 2011). In other words, by effectively increasing overall supply in the basin, 'binational' desalination was proposed as a technical fix for the intense political disputes that beleaguer water governance between the states on the Colorado River.

This chapter is about the historical emergence of seawater desalination as a techno-political strategy in the governance of international and multi-state waters in southwest United States and northwest Mexico. Transboundary and multi-state water governance is, of course, a topic of growing pertinence in policy, industry and business, and academia (e.g. Pahl-Wostl, 2015, Rieu-Clarke et al., 2015). This chapter traces the technological, discursive and political formations that have coalesced around desalination as a water governance 'solution' for the Colorado River states. From the utopian visions of the 1960s and 1970s that saw the combination of desalination and nuclear energy technologies as a path towards a resource-abundant future; to the use of purification technologies to fix specific governance problems in the 1980s and 1990s; and the more recent addition of seawater as a water supply diversification and decentralisation strategy, desalination has – for the last half century – intersected water governance and international politics in extraordinary (and largely unexplored) ways. Although the political ecology and political economy of desalination has recently become the focus of critical scholarship concerning national or regional hydro-development (Loftus and March, 2016; March et al., 2014; McEvoy, 2014; Swyngedouw, 2013; Feitelson and Rosenthal, 2012), with some notable exceptions (Wilder et al., 2016; Aviram et al., 2014), there has been very

little consideration of desalination as an important political technology of transboundary water governance.

The chapter argues that desalination, first and foremost, represents a technological fix for the dialectically intertwined challenges of politically contested terrestrial water governance and economic development facing the Colorado River states. The use of this language invokes two related notions of the technical fix. First, as a spatial fix for internal contradictions of capital. Drawing on the work of David Harvey (1996; 2006; 2014), Neil Smith (1984), and more recently Micheal Ekers and Scott Prudham (2015), and Jason Moore (2015), I argue that the primary function of desalination is to secure the socio-ecological conditions (i.e. the security and resilience of water supply) necessary for the continued expansion of capital accumulation and the economic development of the lower Colorado River Basin states. Second, drawing on the growing body of literature on the ecological conditions of post-politics (Kenis and Lievens, 2014; Wilson and Swyngedouw, 2014; Swyngedouw, 2011), the chapter argues that desalination is emerging as a political fix for contested relations of water governance. Mobilising Murray Li's (2011) concept of the process of 'rendering society technical,' I argue that the development of seawater desalination for the Colorado River states represents an attempt to secure reliable water supply and fix the political problems of allocation without addressing the underlying causes of those problems.

The chapter proceeds in four phases. It begins with a brief overview of desalination as a technology of water governance. The chapter then sketches the historical development of the lower Colorado River Basin and the origins of contestations between its constituent states, before considering the emergence of desalination, firstly as an elusive panacea, and more recently as a significant technology in the scalar restructuring of water governance on the Colorado.

Water, desalination and the nation state

Although the drivers of desalination are always highly contextual – the governance decisions that led to desalination developments in Rosarito are, for example, very different to those in Riyadh –

proponents laud the desalination 'solution' for producing a rainfall and climate-independent source of water to address the combined challenges of increasing demand and reducing traditional supply. "Seawater desalination," in a word, "offers a seemingly unlimited, steady supply of high-quality water, without impairing natural freshwater ecosystems" (Elimelech and Phillip, 2011: 713). There are two broad methods of removing dissolved impurities from saltwater: thermal distillation and membrane. Thermal distillation, which, put simply, involves the separation of salt from water through the creation of water vapour, can be achieved through a number of processes (Khawaji et al., 2008). Until the 1990s, a process called multi-stage flash distillation was the industry standard technology for municipal-scale desalination plants, and remains the most widely used technology in the Middle East (Al-Kharaghouli and Kazmerski, 2013).

Membrane desalination processes, by contrast, separate non-saline water from a saline brine reject with a physical barrier. Techniques include electrodialysis, membrane distillation, forward osmosis, and reverse osmosis. Reverse osmosis (RO), where saline water is forced at high pressure through membranes that trap dissolved salt and allow pure water to pass through, is now the most dominant desalting technique globally (Fritzmann et al., 2007). Improvements in membrane technology and the introduction of energy recovery devices has reduced the energy consumption of seawater conversion from 20 kWh/m^3 in the 1970s to 2 kWh/m^3 today (Peñate and García-Rodríguez, 2012). This has, in part, facilitated a *global* profusion of large-scale seawater desalination plants in cities as diverse as Singapore, San Diego, London, Tel Aviv, Melbourne and Alicante – a phenomenon that has accelerated only over the last 10-20 years (Feitelson and Jones, 2014).

Water desalination has, in just a few short decades, undergone an extraordinary transformation from fringe water source utilised only under the most extreme circumstances or for specific manufacturing functions, to a global industry, increasingly the focus of techno-managerial solutions to urban water stress. Although long overlooked in geography and the social sciences, the desalting phenomenon has lately attracted more sustained critical attention (March, 2015).

The contested Colorado

The Colorado River, sometimes referred to in the West as the 'river of law', is one of the most contested, legislated and litigated river basins in the world (Reisner, 1986). From its source in the Rocky Mountains, the 'American Nile' flows through seven of the United States (Colorado, New Mexico, Utah and Wyoming in the Upper Basin; and Arizona, California and Nevada in the Lower Basin) and the two Mexican States of Baja California and Sonora. The Colorado is not so much noted for its size than for the seasonality of its flow. Prone to seasonal flooding, before its comprehensive impoundment by the Bureau of Reclamation, streamflow for 10 months of the year would be only around 10% of peak flow during the spring. By the end of the 1920s, following the signing of the Colorado River Compact in 1922 and the Boulder Canyon Act of 1928, the entire annual streamflow of the river had been fully allocated between the Upper and Lower Basin states in the USA. The history of the river since has been one of fierce disagreement and protracted legal battles over the fair apportionment of its waters, between the two nations that make up its basin and the various states and stakeholders therein.

The disagreements between the United States and Mexico over allocations on the Colorado go back to the late 1920s. The United States had, by that time, fully allocated the river's annual output, and had begun work on the Boulder Dam (which would later become the Hoover Dam) and other works towards the comprehensive development of the lower basin. To this point, having been witnesses to this water-grabbing fever and eager to secure resources for economic development in Baja California and Sonora, in 1929 Mexican authorities argued that the farmable land area in the basin area amounted to 1.4 million acres. Mexico therefore claimed 5.5 million mega litres a year for irrigation, primarily in the Mexicali Valley, that should be guaranteed by the United States (Six States Committee, 1944). The US government, in turn, insisted that Mexico was not entitled to any more water than the average base-flow in dry months. The US offered to guarantee delivery of only 920,000 mega litres, the amount that Mexico had claimed for irrigation in 1928, before the signing of the Boulder Canyon Act and the full development of the lower basin by the Bureau of Reclamation.

Mexico had been unable to develop its own large projects on the Colorado for two main reasons. Firstly, given that only 3% of the basin is located in Mexico, by the time the river reaches the international border it is already flowing in a flat estuary. This means that geological and hydrological conditions in the entire Mexican portion are unsuitable for large dams, diversions and reservoirs. Any significant Mexican-led infrastructural projects would therefore have to be located within the United States. Secondly, Mexico is bound by the 1848 Treaty of Guadalupe-Hidalgo and the Gadsden Treaty of 1853 to ensure that the river remains navigable for US ships and trading vessels. Notwithstanding that navigation of the Lower Basin has been virtually impossible since the completion of works by the Bureau of Reclamation, given that now only rarely does any water from the Colorado actually reach the Gulf of California, these historic treaties clearly preclude any damming or significant diversions of the river by Mexico. For these reasons, Nevada Senator Key Pittman argued at a debate on the Boulder Canyon Project Act in 1928 that "the only water that Mexico could claim would be water that she has appropriated from the natural flow of the stream," and was therefore entitled to "none of the benefits of the water increased by our impounding works" (cited by McCarran, 1945; 50). By contrast, the Mexican government argued at the time, firstly, that the extensive development of the river by the US violated these same treaty agreements; and secondly, that any diversions of the Colorado by the US would reduce the total annual flow to Mexico, of which its citizens and farmers had a right to use fair proportion. Mexico was, therefore, entitled to a share of the annual yield from the Bureau's projects.

The concern around these claims and counter claims, and their potential implications for economic development in the desert west on both sides of the border, remained an issue of severe political disagreement between the two nations. The California Governor at the time, Earl Warren, even went so far as to argue that;

> *"Every acre in Mexico which is irrigated by Colorado River water, necessitates that a corresponding acre in this country be doomed forever to the sterility of desert."* (Warren, 1945: 5)

Following Mexico's claim in 1929 to 5.5 million mega litres of Colorado water a year, the disputes continued unresolved for more than a decade. In this time Mexican off-takers expanded their combined annual use to 2.2 million mega litres. A resolution was in the development interests of both nations. From the Mexican perspective, a legally allocated apportionment of water would provide security for agricultural development and urban growth. At the same time, it was in the interests of off-takers in the United States –between whom the annual yield of the river was fully allocated but their capacity to withdraw was not yet fully developed– to, in a sense, cut their losses by limiting the withdrawals in Mexico that had grown rapidly in the absence of a treaty (CRWU Committee, 1945).

Finally, in 1944 the two countries reached a compromise, and in 1945 ratified an agreement on the 'Utilization of waters of Colorado and Tijuana Rivers and of the Rio Grande.' Under this treaty the United States committed to delivering to Mexico 1.8 million mega litres a year of Colorado water suitable for irrigation. This compromise, however, was not well received by all water users. In California – the state which stood to lose the most from any allocation of water to Mexico – it was received with particular hostility. Representatives of off-takers argued that "any guarantee of water to Mexico must invade the commitments made by the United States to its own projects (Colorado River Board of California, 1944: 3). Although this agreement stands today, the United States has since consistently been in breach of its delivery commitment. The implications of this are discussed more in the next section

This brief sketch of the historic disagreements over entitlements to Colorado water is given for two reasons. Firstly, illustrate that the governance of the Colorado River since the 1920s has been characterised by disputes between the basin's constituent states and right-holders. Secondly, that the infrastructural projects of the 1930s-1970s and associated governance structures entrenched a model of economic development based on large agribusiness and a highly inert and hierarchical system of water rights.

Desalination, the elusive catholicon

Since the mid twentieth century the promise of saline water conversion, or desalination, has emerged in various guises as a potential panacea for the contested politics of the Colorado River. In the United States interest in desalination really began to pick up in the 1950s and 1960s, under direction from a well-funded Federal programme. This began in 1952 when Congress authorised funding through the Department of the Interior, under the Water and Power Development scheme. Research was coordinated by the newly established Office of Saline Water, which operated between 1955 and 1974. The era of state-funded R&D reached its height under the Kennedy Administration, when desalination was a high priority issue for the government. When the country's first ocean desalting test plant –a Multi-Effect Vertical Distillation facility in Freeport, Texas, with a 1 million gallon per day capacity– opened in 1961, President Kennedy said:

> *"I can think of no cause and no work which is more important, not only to the people of this country, but to people all around the globe… I am hopeful that the United States will continue to exert great leadership in this field, and I want to assure the people of the world that we will make all the information that we have available to all people. We want to join with them, with the scientists and engineers of other countries in their efforts to achieve one of the great scientific breakthroughs of history."* (Kennedy, 1961)

The desalination programme during this time was international in scope and ambition. The US government even signed an agreement with the USSR for the exchange of scientific information relating to saline water conversion. R&D funding was primarily contracted out to private research companies and engineering consultants. General Atomics, a subsidiary of General Dynamics, for instance, emerged as a major player. Its desalination group, Reverse Osmosis General Atomics (or ROGA), was very successful in attracting government funds and pioneered the reverse osmosis method of desalination, which now dominates the industry. Although desalination never became the panacea that Kennedy had envisioned, the programme was in many respects highly successful. It really

kick-started the desalination industry and facilitated the development of novel technologies, like RO, that many in the industry believe would not have been developed otherwise.

During the 1960s desalination was the focus of interest at virtually every level of water management in Southwest United States from Federal level to local water authority, and was seen by the state as a panacea for insoluble disagreements over access to the fully allocated riparian waters of the American West. For instance, the development of coastal desalting capacity was an important –although never realised– component of the Federal government's efforts to resolve a series of protracted disputes between California and Arizona over allocations of Colorado water. The roots of the conflict went back to Arizona's refusal to ratify the 1922 Colorado River Compact because of the so-called 'tributary issue' over whether withdrawals from tributaries of the Colorado should be included in a state's overall allocation. After more than a decade of legal battles, a landmark ruling at the Supreme Court in 1963 effectively increased Arizona's allocation and therefore reduced availability for California. A major planning document from the Department of the Interior (1963) – known as the Udall Plan for the Pacific Southwest– proposed the construction of a large desalter as a way of compensating Southern California for some of the water rights lost to Arizona. Similarly, throughout the 1960s and 70s the Metropolitan Water District of Southern California, the largest urban water wholesaler in the United States, also pursued collaborative desalination R&D programmes with its member agencies.

At the time, most of the proposed projects for large-scale desalination utilised the thermal distillation method – membrane technologies still being in the very early stages of development. Most were based around a model of co-production, which is still utilised on the Arabian Peninsula, whereby desalination facilities are twinned with thermoelectric power plants to take advantage of waste heat (Kamal, 2005). During this time various proposals circulated for plants with capacities up to 570 mega litres a day: three times larger than the Carlsbad desalination plant, which began operating in 2015 and is currently the largest desalter in the Western Hemisphere. In the United States in the 1970s, much as it was in Spain at the same time, the desalination panacea was premised on, and intimately

linked with, the assumption of long-term cheap nuclear energy. This was, after all, the height of the atomic era, and it was generally agreed that large-scale desalination could take advantage of both low-cost energy and efficiencies through co-production with thermoelectric nuclear plants. Nuclear technology would, it was thought, solve the problems of energy and water supply simultaneously.

The huge efficiency gains borne out of the intensive R&D programmes during this time, combined with falling energy prices and the promise of unlimited cheap nuclear energy, led to optimistic (and entirely unrealistic) forecasts about the future cost of desalted water. Indeed, one respected Berkeley professor confidently calculated that because the unit cost had fallen so rapidly in the decade following the commencement of Federal funding, by 1990 California would be able to produce desalted seawater at less than $30 a mega litre (Seckler, 1965). Even taking inflation into account, he could hardly have been more wrong: water is now sold from the recently completed Carlsbad desalting plant, which is touted as the most efficient of its kind in the world, at $1,900 a mega litre. Although several of the large facilities proposed in the 1960s and 1970s got past the feasibility and design stage (Holtom and Galstaun, 1965), as the nuclear sector went into decline and energy prices rose rather than fell, the desalination industry underwent corresponding changes, and the planned developments – including large project proposed in the Udall Plan – were abandoned.

Unrealistic technological optimism aside, the plans for saltwater desalination during this period in many respects prefigured those of today. For instance, the Udall Plan and the MWD collaborative programmes clearly position desalination as a viable technological solution to increase the overall allocation in the Colorado River's Lower Basin. The contemporary binational desalting plans for Rosarito Beach effectively reproduce this logic, albeit through different technological, political and economic configurations. Even as early as the 1960s, then, ocean desalination was being proposed as a political 'solution' that addressed water supply issues without addressing those of a dysfunctional water rights system and a metabolic logic of capitalism based on agrarian accumulation in the context of an increasingly urbanising coastal economy. Rather than forming the centre of a new water paradigm, however, as was envisioned by some in the optimism of the 1960s, the few examples of

successfully developed desalination plants in Southern California during this time were built as technological solutions to resolve specific inter-state political conflicts. Two examples stand out as particularly illuminating: the plant at Point Loma and the Yuma Desalter.

In 1962 a company called Burns and Roe, funded by Federal research grants, began operating a small seawater conversion plant at Point Loma, San Diego. This was a test facility, the second of five commissioned by the US government, designed to trial different techniques and produce the necessary data for the development of commercial facilities (Foster and Herlihy, 1965). The plant used a multi-stage flash distillation process, was twinned with three thermoelectric steam turbine units, and could produce 4.5 mega litres a day. In the end, Burns and Roe ran this facility at Point Loma for less than two years, before the plant became embroiled in political struggles between the US and Cuba. At the end of 1963, as tension between Cuba and the United States escalated, Fidel Castro ordered the water supply to the US military base in Guantanamo Bay to be cut off (Gleick et al., 2009). Faced with this unanticipated water crisis, the US Navy began shipping in potable water at great expense. When relations did not improve, Navy commanders cut the old pipeline, symbolically denying their reliance on Cuba for water. In February 1964 the desalting module at Point Loma was disassembled and shipped to Guantanamo Bay, where it was operated by Burns and Roe for many years.

The Yuma desalination plant also emerged from the intersection between water and international dispute. It was designed and built during the 1970s and 1980s as a political fix for ongoing disagreements between the United States and Mexico over deliveries of Colorado River water (Postel et al., 1998). Construction of the Yuma Desalting plant was agreed between President Nixon and President Echeverria in 1974 under the Colorado River Basin Salinity Control Act. For years the United States had been in breach of the quality component of its water delivery commitment to Mexico (Judkins and Larson, 2010). Saline spent irrigation water from the various irrigation districts in the Colorado basin was being returned to the river untreated, meaning that at certain times, the water reaching Mexico had too high a salt content for Mexican irrigators to use. The severity of this problem

had become a point of significant political disagreement between the two countries. After lengthy negotiations the US government embarked on a campaign of point-source treatment of agricultural run-off and various irrigation efficiency measures, aimed at lowering the salinity of water re-entering the stream and bringing US deliveries of Colorado water to Mexico in line with quality commitments.

The plant at Yuma, located very close to the border, was the flagship infrastructural development of the Salinity Control Act. It was built to desalt agricultural runoff from the Whelton Mohawk Irrigation and Drainage District, which at the time was one of the main polluters in the basin (Taylor and Haugseth, 1976). The design stage of the plant was very long –indeed, although agreed in 1974 the facility did not become operational until 1992. The Bureau of Reclamation used the plant as an opportunity to conduct research and develop desalination technology (Moody et al., 1983). Six different processes were extensively tested at Yuma, both membrane and distillation. After extensive research and development it was decided that spiral-wound reverse osmosis technology was the most promising (Lohman, 1994). So while the facility was built to treat agricultural runoff, its design and operation is very similar to a modern seawater desalter. At the time, its development was cutting edge. Such was the success of the other point-source treatment deployed upstream, however, that since completion in 1992 the Yuma plant has only been operated twice (Bureau of Reclamation, 2015). It stands as an idle monument to the ecological carelessness that has characterised the Bureau of Reclamation's development of the Colorado River.

The desert west is a place of wild water dreams. The monumental efforts undertaken during the twentieth century to deliver water in abundance to an arid and isolated regions of northwest Mexico and southwest United States were no less extraordinary than the countless schemes that failed. For much of the last hundred years the recurrent dreams of desalting the waters of the Pacific Ocean were firmly in the latter group; always just beyond the horizon of viability. The barriers were generally technical, rather than political, and almost always associated with the dual challenge of cost and energy intensity. Kennedy's dream of abundant water provided by high technology in the atomic age, of desalination as a panacea for scarcity, was never realised. Instead, seawater desalting has

emerged as a contemporary technological fix to address the complex politics that beleaguer terrestrial water, which are insoluble without major political and social change.

The scalar fix

The 'desalination fix' has, for the last half century, emerged periodically under various guises and in various forms (March, 2015). In the 1960s and 1970s saline water conversion twinned with cheap nuclear thermoelectric power, was at the heart of optimistic notions of imminent resource abundance; the end of scarcity. The projects proposed to 'fix' the contested politics of the Colorado River during this golden (but ultimately dry) era of desalination were more ambitious in terms of capacity than the projects of today. During the 1980s and 1990s desalination projects of comparably modest size were instead pursued to address specific water governance issues. The combined issues of energy intensity and cost of production prevented desalination becoming a significant element of municipal water supply for the Colorado River states, or from assuming the position of gateway to the high-technology utopia of its earlier promise (Shiermeier, 2008).

In the contemporary era, the *ocean solution* is once again being pursued as a scalar fix to the insoluble politics of Colorado River water transfers. Desalination has emerged as a powerful discursive and material strategy in paradigmatic shifts, currently underway throughout southwest USA and northwest Mexico, towards water supply localisation and diversification. Independent from the contested and inert system of water transfers, desalination is prized as the only "drought-proof supply" that "reduces…dependence on water from the Colorado River" (SDCWA, 2017). Desalination is not becoming the catholicon that was once hoped, and indeed, many water agencies have shunned it in favour of more cost-effective diversification strategies. These include the Los Angeles Department of Water and Power, which is pursuing a variety of alternative supplies, including storm water capture, wastewater recycling and groundwater recharge (LADWP, 2015); and Long Beach, which has for a number of years been advancing a highly effective efficiency and conservation agenda (LBWD, 2015).

Both of these agencies studied desalination in detail in the 1990s and early 2000s, but deemed it to be too costly.

Nevertheless, desalination has become an important techno-political strategy of water governance for several agencies that have historically relied on Colorado water, most notably San Diego County, which now receives around 10% of its supply from the Carlsbad desalination plant; and Orange County, where a large project in Huntington Beach is under development. Medium-sized projects (with capacities of around 20 mega litres a day) are also being developed across the border in Baja California in La Paz, Cabo San Lucas, Ensenada and San Quintín (D&WR, 2015; McEvoy, 2014). Desalination, in these cases, does not so much represent a silver-bullet solution, but is seen rather to add resilience through diversification of water sources. Thus, cuts to an agency's supply of Colorado water are less damaging if that source represents only one element of a diverse portfolio. This shift towards localisation and diversification, although signalling a broad movement away from the riparian transfer paradigm, does not represent total dis-assembling of its social and technical relations (upon which the Colorado River states still rely), but rather a socio-technical reorientation and assembling of supplementary networks. 'Desalination, the panacea' has become 'desalination, the more or less prudent component of a diversified portfolio.'

The idea for a binational desalination facility emerged from the large water wholesalers on the Colorado River, effectively as a way of 'freeing up' over-allocated water in the Lower Basin and reducing tensions between right-holders. The potential for such a collaboration was first floated by the San Diego County Water Authority in 2005, who had been studying a number of potential locations for a large facility along the coast on both sides of the border. A site on Rosarito Beach, around 30km south of the international border, was identified as particularly favourable, in part because it is adjacent to the *Presidente Juarez* thermoelectric power plant operated by Comisión Federal de Elecricidad, which would allow the plant developers to take advantage of a number of benefits of infrastructural co-location, including process efficiencies, lower capital costs from shared infrastructure, and simpler permitting from existing industrial land zoning (Pankratz, 2004).

Interest in the Rosarito project increased rapidly and, led by the SDCWA, a total of eight water agencies[1] from both sides of the border embarked on an extensive feasibility and development study (SDCWA, 2010). Two mechanisms for water delivery to the Unites States were considered: the 'wet water' option and the 'paper water' option. A pipe connecting the desalination plant with San Diego's storage and distribution system could deliver 'wet water' across the border. Alternatively, the entire output of the plant could supply Tijuana and surrounding region, allowing US agencies to withdraw a portion of the output from Mexico's Colorado River allocation. This 'paper transfer' would mean that the desalination plant output would effectively augment the supply available in the Lower Colorado River Basin, allowing the various right-holding agencies to re-allocate water accordingly. For US agencies, the Rosarito project represented a viable way to ease contested Colorado supply. Indeed, the Las Vegas Valley and Southern Nevada had been considering the possibility of financing coastal desalination in return for increased Colorado allocation for some time (Shrestha et al., 2011). On the Mexican side, the Baja State Government had attempted a number of times to develop desalination capacity to increase supply reliability. In Tijuana particularly, which relies almost entirely on limited Colorado supply imported from the Mexicali Valley, per capita water consumption is 30% lower than the Mexican national average and there is widespread belief that inadequate and insecure water supply is retarding the city's growth (Meehan, 2013; Fullerton et al., 2007).

After the completion of the feasibility study, interest from the eight participating agencies slackened somewhat as alternative supply diversification strategies took precedence. For example, the San Diego County Water Authority, which had led the project up to 2010, focussed its attention instead upon securing an alternative transfer deal of Colorado River water with the Imperial Irrigation District, and developing desalting projects in the north of the county (SDCWA, 2013). Nevertheless, the idea for a binational desalting plant at Rosarito was not abandoned. After several phases of

[1] The eight participating agencies were: (USA) San Diego County Water Authority, Central Arizona Water Conservation District, Metropolitan Water District of Southern California, and Southern Nevada Water Authority; and (Mexico) Comision Nacional del Aqua, Comision Estatal de Servicios Publicos de Tijuana, Comision Estatal del Agua, and Comision Internacional de Limites y Agua Seccion.

restructuring the project is now being delivered through a public-private contract between the State of Baja and a company called NSC Agua, which is owned by the Cayman-based firm, Consolidated Water. Half of the plant's 125,000 mega litre a year capacity has been earmarked for sale to agencies in the United States (Smith, 2016).

Conclusion

The North American desert west is a place of wild water dreams. The monumental efforts undertaken during the twentieth century to deliver water in abundance to an arid and isolated corner of the country were no less extraordinary than the countless schemes that failed. For much of the last hundred years the recurrent dreams of desalting the waters of the Pacific Ocean were firmly in the latter group; always just beyond the horizon of viability. The barriers were generally technical, rather than political, and almost always associated with the dual challenge of cost and energy intensity. Kennedy's dream of abundant water provided by high technology in the atomic age, of desalination as a panacea for scarcity, was never realised. By placing desalination in historical context, this remarkable technological phenomenon is understood, conceptually, as fulfilling a function as a political and scalar fix for the transboundary contestations over allocation on the Colorado River. Desalination, because it is rainfall and climate independent and locally produced, has become a powerful discursive and material tool to address the complex politics that beleaguer terrestrial water, which are insoluble without major political and social change.

The structural tensions that characterise water governance in the arid west stem from the particular historical development of the region. It is from these historical conditions that desalination emerges as a 'solution' that allows thirsty urban economies to secure vital supplies without having to engage with the broader political questions of allocation. Ocean water desalting achieves a double movement in contemporary water governance. First, it essentially provides a way of increasing overall supply in the Colorado Basin, allowing urban regions to access secure supply, without entirely disassembling the socio-technical relations and systems that have historically been the catalyst for

development in the West. Second, desalination has been enrolled as a powerful discursive and material tool in the broad movement towards localised and diversified water supply portfolios. The extraordinary emergence of desalination for the Colorado River states is, therefore, symptomatic of the historical failures of water governance in the arid West.

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