

# UC Berkeley

## UC Berkeley Previously Published Works

### Title

The canal and the pool: infrastructures of abundance and the invention of the modern desert

### Permalink

<https://escholarship.org/uc/item/77k542m7>

### Journal

Landscape Research, 47(1)

### ISSN

0142-6397

### Author

Cooper, Danika

### Publication Date

2022-01-02

### DOI

10.1080/01426397.2021.1958308

Peer reviewed



## The canal and the pool: infrastructures of abundance and the invention of the modern desert

Danika Cooper

To cite this article: Danika Cooper (2021): The canal and the pool: infrastructures of abundance and the invention of the modern desert, Landscape Research, DOI: [10.1080/01426397.2021.1958308](https://doi.org/10.1080/01426397.2021.1958308)

To link to this article: <https://doi.org/10.1080/01426397.2021.1958308>



© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 28 Jul 2021.



Submit your article to this journal [↗](#)



Article views: 87



View related articles [↗](#)



View Crossmark data [↗](#)

# The canal and the pool: infrastructures of abundance and the invention of the modern desert

Danika Cooper 

Landscape Architecture & Environmental Planning, University of California, Berkeley, CA, USA

## ABSTRACT

Modernist ontologies of water physically materialise in Phoenix's landscape: over 100 miles of canals convey water to the suburban grid, where thousands of gallons are piped into backyard swimming pools. The canal and pool are thus joined in architectural folly to move, hold, and control water in the service of sustaining the belief that dry ecologies are but supply chain problems in need of engineering solutions. These typologies reveal longstanding entanglements between the promises of modernity and aridland urbanism; and they further amplify the immense challenge of transitioning away from modern water infrastructure in the face of climate change. By using the canal and the pool as signifiers of the insidious entanglements between modernity, growth, and aridland urbanism, this article advances an historical examination of Phoenix that destabilises tropes of water scarcity as a problem to be solved but which has also created cultural perceptions of abundant water.

## KEYWORDS

Arid lands; landscape histories; modernity; climate adaptation

Phoenix, Arizona is notable for both its dry ecology and its spectacular use of water, typified by the sprawl of golf courses, manicured lawns, and backyard pools. These ostentatious displays of abundant water are the product of incredible feats of hydraulic engineering—entirely human-made and designed to divert the flows of distant water across the desert towards Phoenix's booming agriculture and residential development. Successful efforts by politicians, institutional agencies, and citizens to override the region's inherent dryness exemplify how modernist approaches to the environment underpin Phoenix's spatial logic and economic agenda. In the modernist paradigm, water is a commodity that is controlled and harnessed for its economic and political potential; and water scarcities, like those endemic to a desert ecology, do not set ecological limits to growth and development (Linton, 2010; Neimanis, 2017; Schmidt, 2017). Instead, water scarcities have justified desires for more sophisticated and intensive techniques to bring increasing quantities of water from far away and to sustain economies built for and dependent on an abundance of water.

The vast networks of infrastructure upon which America's arid cities depend have been consistently endorsed through public support and funded by governmental agencies and programmes. Federal subsidies—first put into effect during the Reclamation era (roughly 1902–1935) and then reinforced by New Deal liberalism (1933–1936)—have made water affordable despite its limited quantities and the massive effort required for the construction and maintenance of water infrastructure. Today, Phoenix has nearly 4.5 million residents, who are responsible for some of the highest per capita residential water consumption rates in the country and yet, are charged much lower rates per gallon than their counterparts in more temperate parts of the country (Bliss, 2016; Santos, 2013; U.S. Census Bureau, 2019). Affordability and access to water in Phoenix has had

a cyclical effect, generating demands for water that in turn result in even greater need for more of it with more intensive infrastructures to manage it.

The ubiquity of conveyance canals and backyard swimming pools is striking visual evidence of the powerful impact that modernist approaches to water have had on the physical environment in Phoenix: 131 miles of public canals supply an average of 244 billion gallons of water annually to the suburban grid, with hundreds of thousands of gallons piped into backyards to fill private swimming pools (Salt River Project, 2021). These features make water ever-present in the cultural imagination, falsely upholding the perception of an abundant availability of water in the desert. This perception, in turn, normalises the modernist belief that aridity is simply a supply chain problem in need of an engineering solution and further incentivises financial and political investment in modernist hydraulic infrastructure.

These infrastructures are particularly effective devices in the modern aridland city not only because they deliver enormous amounts of water, but also because they effectively keep the reality of its limited water supplies invisible and illegible, offering assurance to those that occupy the modern desert that water is plentiful and secure. Water in the desert, no matter how plentiful it may appear, is, however, not abundant. The sources of water that currently enable Phoenix to thrive—primarily the Salt and Colorado River waters, but also ground and reclaimed waters—are becoming increasingly precarious and are likely to be altogether unavailable in the future, regardless of how advanced the infrastructures and technologies. There is simply not enough water to keep up with the demand for it.<sup>1</sup> The canal and pool are thus joined in an architectural folly to move, hold, and control water, in a show of wilful ignorance to increasing threats of water scarcity.

This article identifies how the political strategies and economic agendas designed to encourage progress, growth, and prosperity have driven the socio-spatial development of American aridland cities. A critical reframing of Phoenix through its infrastructures of abundant water—the canal and the pool—reveals the modernist paradigm not as an inevitability, but instead, as an active, normalised, and deliberate mechanism of aridland urbanism. This article repositions the history of the American aridlands as the direct outcome of modernist agendas and posits that future visions of the aridlands—those that respond to futures of fewer water sources but higher demands—necessitate new engagements with the environment and with water. Starting with the notion that histories of the environment shape our perception of them, an examination of historical images and texts demonstrates (1) how cultural perceptions were constructed through images of Phoenix and its surrounding landscape, and (2) that those very perceptions were made material through the management, regulation, and politics in the American aridlands. Drawing from primary and secondary textual sources as well as historical documents amassed in the Arizona Salt River Project's digital archive (1880s-present) and past issues of *Arizona Highways Magazine* (1921-present) illustrates how the aridlands were ideologically imagined and physically constructed under the assumptions of modernity. These documents promoted Phoenix as a landscape of abundance, a persuasive and successful method given that the audience were largely those who had never been to the American aridlands. This article analyses these documents not as mere records of history but instead as persuasive instruments that catalysed and motivated migration to and settlement in the aridlands. A new reading of history that upends the dominant, unquestioned assumptions about aridland development, is therefore an essential undertaking. By using the canal and the pool as signifiers of the insidious entanglements between modernity, growth, and aridland urbanism, this article advances an historical examination of Phoenix that destabilises dominant tropes of water scarcity as a problem to be solved with advanced technologies: one that has historically brought more water to the aridlands but which has also created cultural perceptions of abundant water in the desert.

## Converting the aridlands to the modern desert

Despite ample archaeological and ethnographic evidence of thriving desert civilisations, in Euro-American contexts, arid landscapes have often been deemed *terra nullius* and described as empty



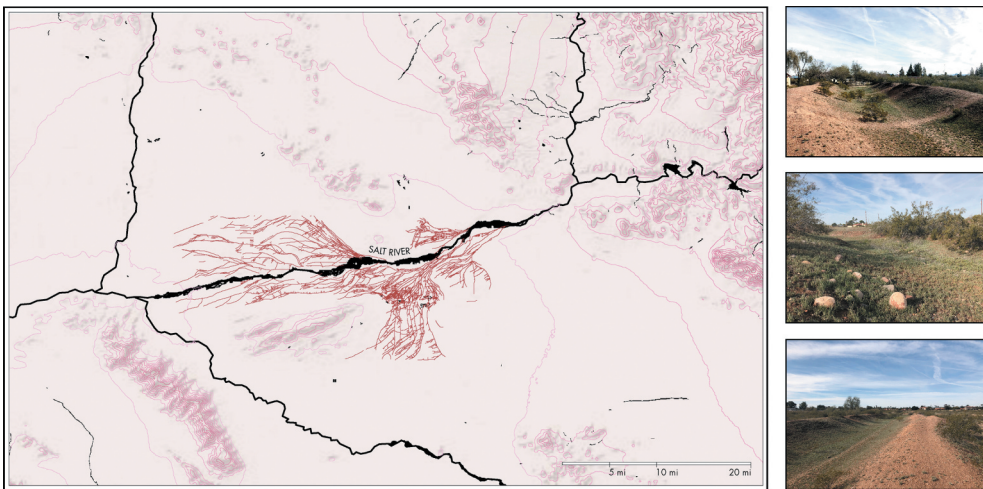
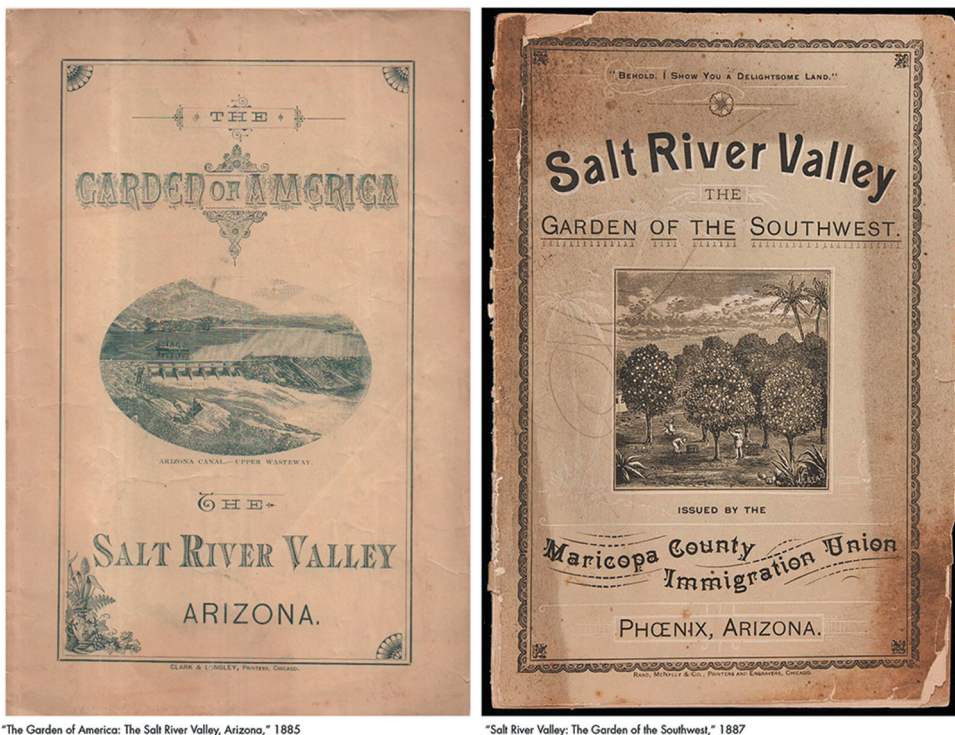


Figure 1. Danika Cooper, *Pre-Columbian irrigation canals, 200 CE-1450 CE*, 2020.

and valueless (Cooper, 2020; Davis, 2016; Ryan, 1996) (Figure 1).<sup>2</sup> Approaches to the environment imagined through the lens of modernity have fortified this longstanding characterisation of the desert as valueless while simultaneously seeing the desert as a desirable place for development: the desert as a valueless landscape has long been used to justify its wholesale transformation. Modernity, an historic moment as well as a philosophic and sociotechnical set of norms and practices, celebrates scientific, technological, and political progress, measured through economic growth (Almond et al., 1982). Within this ideology, nature is treated as a malleable object, evaluated through scientific reasoning, and commodified to ensure economic prosperity. Landscapes that do not effectively advance economic or political power are positioned as hindrances to the progress of contemporary society, necessitating their transformation into places that generate value (Linton, 2010; Schmidt, 2017) (Figure 2 diptych).

In the aridlands—territories that are defined by a precarious relationship between precipitation and evapotranspiration—the transformation to a controlled and engineered ‘modern desert’ has required both an ideological invention and the physical construction of a landscape of abundance. Scarcity—itself a modern construction that denotes economic insufficiency—is thus a technocratic challenge, solved through the construction of engineered systems (Mehta, 2003; Santha & Sasidevan, 2018). In the modern desert, hydraulic infrastructures have fashioned an entirely human-made hydrological system that fundamentally distorts ecology. They are designed to deliver a dependable and constant supply of water, thereby avoiding any reliance on the unpredictable dynamics of seasonal water cycles and weather patterns. Though hydraulic engineering is not specific to modernism, the scale and influence of modern control mechanisms in arid America is unparalleled with anything that came before it (Scott, 1999; Worster, 1992). Today, nearly every waterway in the American West has been engineered to precisely track, regulate, and account for every drop of water: a staggering phenomenon that has become so normalised in modern society that it often goes almost entirely unnoticed. Thus, the modern desert is equal parts geographic space, conceptual ideology, and new social and cultural backdrop (Figure 3).

The American modern desert manifested in Phoenix through two distinct though entwined historical moments, both profoundly entangled with modernist ideas about the relationship between society and nature. In the late nineteenth and early twentieth centuries, federal investment in massive systems of hydraulic engineering gave arid regions access to an abundance of water. In Phoenix, this meant that the seemingly ‘empty’ landscape was transformed into one of agricultural productivity. Then, in the decades following the American economic downturn of the 1930s, subsequent financial incentives propelled



"The Garden of America: The Salt River Valley, Arizona," 1885

"Salt River Valley: The Garden of the Southwest," 1887

Figure 2. Left: *The garden of America: The salt river valley, Arizona, 1885*; right: *Salt River Valley: The garden of the southwest, 1887*.

Phoenix's reinvention once more through (sub)urban development that repurposed agricultural spatial typologies and hydraulic infrastructures into sprawling neighbourhoods. By the end of the twentieth century, the Phoenix metropolitan region had been converted from a landscape of scarce water into one of the fastest growing, most economically productive, and water-intensive metropolitan regions in the United States (Ross, 2011). Its dependence on engineered water requires that the hydraulic mechanisms of control in the aridlands must be continually reproduced to ensure its success. The modern desert has, thus, created and then trapped itself in a continuous and paradoxical cycle which necessitates enormous amounts of water while simultaneously depleting its already scarce supplies. It is for this reason that an explicit historical assessment of the modernist political and infrastructural mechanisms that undergird the socio-spatial formation of Phoenix is imperative when imagining the region's future.

### Irrigation and the modern agricultural desert

The modern desert's dependence on reliable and abundant water has necessitated policies to ensure both the economic and physical feasibility of constructing hydraulic infrastructure that brings water into the desert as well as the management of its distribution and use. The nineteenth-century doctrine of Manifest Destiny constituted the transformation to the modern desert as both inevitable and morally imperative for the nation's political advancement, while associated federal policies like the Homestead Act (1862) and Desert Land Act (1877) enticed eastern settlers to migrate by offering free 'empty' land. The perceived 'emptiness' was pitched as an opportunity to transform a blank slate into a cultivated, agrarian nation (Figure 4).

The success of this agrarian nation relied on steady streams of water, even when that water was not endemic to the settlement's location, and a logic that rationalised the construction of massive hydraulic infrastructures. In recounting this legacy, one historian notes:



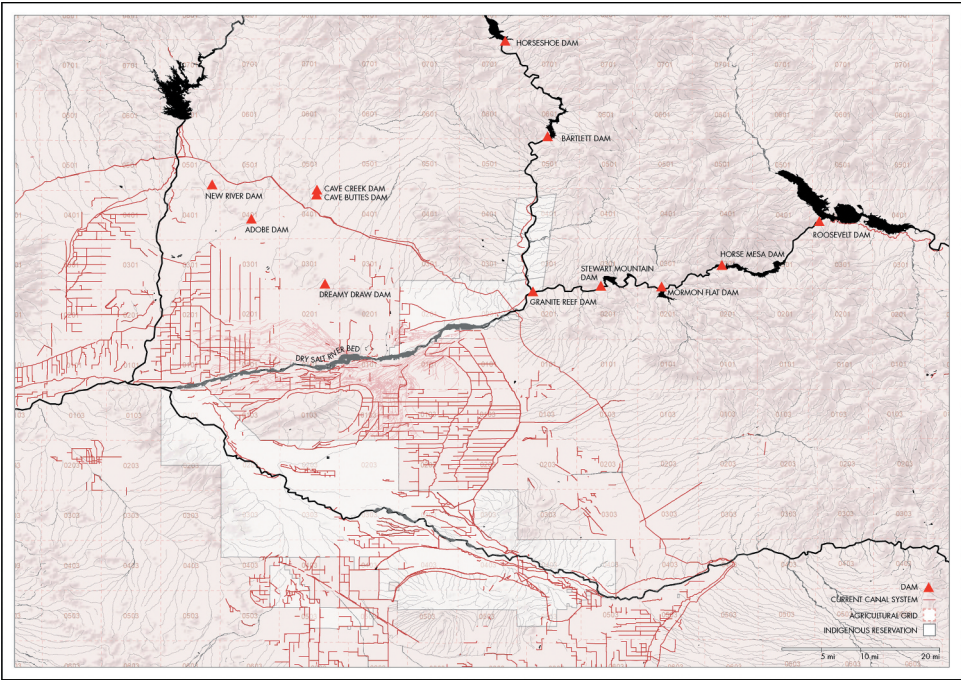


Figure 3. Danika Cooper, *Modern water infrastructure in contemporary Phoenix*, 2020.

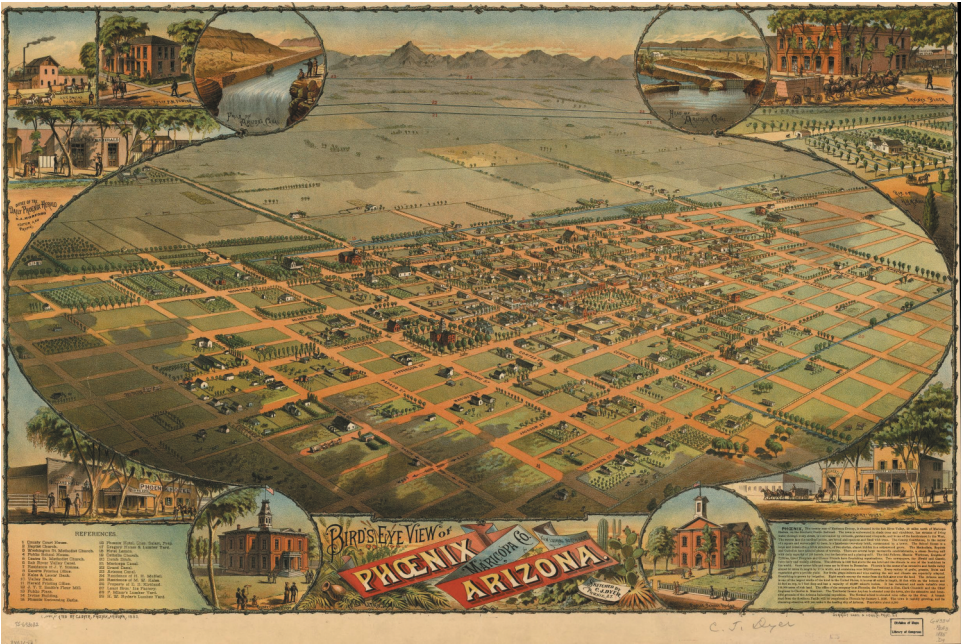


Figure 4. C. J. Dyer, *Bird's eye view of Phoenix, Maricopa Co., Arizona. view looking north-east*, 1885. Retrieved from the Library of Congress, <https://www.loc.gov/item/75693082/>.

Most settlements had begun, like Phoenix, on the basis of immediate proximity to water. But when the local supply proved inadequate, existing investments in land made it preferable to search for new water sources rather than to move. Instead of a grand scheme to manage hydrologic basins and plan development accordingly, water was a commodity that entrepreneurs sought to transport to where they had already established a toehold. (Gammage, 2016, pp. 25–26)

The modern desert thus was not established in response to its hydrological context and environmental realities but instead depended on the deliberate construction of an artificial context of dams, pumps, reservoirs, and canals, all of which provided the hydrological abundance required to sustain the modern desert. Roosevelt Dam, a hallmark of such aridland water technology, impounded the Salt River at its headwaters and allowed the city's water managers to carefully regulate the flow and quantity of the river's water year-round (Heslop, 2014, pp. 42–46). The Dam was the first of many intensive engineering projects funded by the National Reclamation Act of 1902 and constructed under the supervision of its new agency, the Bureau of Reclamation. In 1903, President Theodore Roosevelt, for whom the dam was named and who championed irrigation legislation throughout his political career, proclaimed that the National Reclamation Act was 'one of the great steps not only in the forward progress of United States but of all mankind' (Jackson, 1993, p. 539). Roosevelt's explicit association between infrastructure and the advancement of society was imperative in solidifying investments in modern hydraulic engineering, and in solidifying the modern desert as the dominant typology in aridland urbanism.

Between 1902 and 1935, the Bureau of Reclamation leveraged modern approaches to nature—treating nature as a commodity—to invest massive amounts of public funding into water technologies that were designed to 'reclaim' lands from aridity and to supply enough water for their conversion into more liveable regions (Pisani, 2002). The Bureau's first director, Frederick H. Newell, a hydraulic engineer by training, saw the transformation of arid America into the modern desert as vital when he pronounced that 'the dead and profitless deserts need only the magic touch of water to make arable lands that will afford farms and homes for the surplus people of our overcrowded Eastern cities' (Billington et al., 2005, p. 28). During the Reclamation era (1902–1935), providing the 'magic touch of water' was the key to arid development: federally subsidised settlement was encouraged by constructing massive water-moving engineering systems that ignited the growth of agriculture and development at astonishing rates, and in doing so, directed economic, social, and political power towards the domination of nature (Worster, 1994).

After Roosevelt Dam's completion in 1911, Phoenix's location was stabilised as it was no longer subject to unpredictable water fluctuations (Figure 5). By 1930, five dams along with 131 miles of conveyance canals diverted Salt River water, supplying irrigation, and generating power for Phoenix's farmlands. The river was characterised as 'a wide, dry bed' with its water only released in efforts to 'make the desert bloom' (Peplow, 1957, p. 14). The consequences of controlling the river's water had astounding effects on the economy and spatial layout of Phoenix: the extensive network



Figure 5. West Coast Art Co, *Roosevelt dam, general view*. United States Theodore Roosevelt Dam Arizona, ca. 1913. Retrieved from the Library of Congress, <https://www.loc.gov/item/2007661443/>.



of canals, many of which were built atop the remnants of infrastructure built by the O’odham peoples, became ubiquitous water features of the Phoenix landscape.<sup>3</sup> As a consequence of harnessing and stabilising water in the region, Arizona’s economy became anchored to copper mining, cattle ranching, cotton and alfalfa harvesting, and citrus orchards (Logan, 2006; Shermer, 2013). Between 1890 and 1930, the number of irrigated farms in Arizona grew from just over 1,000 to over 8,500, and the number of acres of irrigated land expanded from 65,000 to 575,000 (Walker, 2012, p. 98). The underlying logic of the modern desert—that the environment is malleable to the whims of capital and that it can be manipulated through technical expertise and advanced technologies—justified the emergence of a desert landscape not limited by its ecological conditions but one that had triumphed over them. In the Phoenix desert’s first transformation, hydraulic infrastructures of abundant water satisfied the desires for agricultural bounty. The agricultural system formed the foundation for the modern desert’s second iteration in the middle of the twentieth century that accommodated changing economic conditions and public attitudes.

### Development and the modern residential desert

When the nation suffered an economic downturn during the Great Depression (1929–1933), and amid mounting fears surrounding the Dust Bowl (1930–1936), Arizona’s agriculture, mining, and ranching industries severely declined. Between 1929 and 1932, copper prices dropped by nearly 70% and annual revenues from agriculture and ranching fell 65% and 55%, respectively (Needham, 2014, p. 60). Hoping to revive the economy, the second President Roosevelt—Franklin Delano Roosevelt—passed the New Deal legislation, a series of public works projects, financial reforms, and new federal programs and agencies. In the three decades since the National Reclamation Act of 1902, the aridlands had been radically transformed, and the New Deal reinvented them for a second time. These federal policies played a substantial role in giving form to the modern desert, as the implementation of New Deal policies and programs were reliant on the irrigation projects enabled by the Reclamation Act, one paving the way for the other. As settlement patterns in Phoenix changed over time, the modern prerogative to settle and control the environment remained steadfast.

Phoenix’s suburbanisation was embedded within broad political, economic, and social systems. Under New Deal liberalism that offered tax concessions and regulatory giveaways to cities, Phoenix diversified its economy by introducing high-tech manufacturing, defence production, and tourism, all of which increased demands for water and necessitated improvements and expansions of Reclamation-era irrigation projects (Shermer, 2013). Beginning in the mid-century, new hydraulic infrastructure was built on both the Salt River and the adjacent Verde River, additional spillways were added to existing dams, and a new public water treatment plant was constructed, giving Phoenix residents access to 30 million gallons of water per day, all of which contributed to the mid-century transformation of Phoenix from a relatively small agricultural town into a booming metropolis. By underwriting and incentivising urban development, the Federal Housing Authority, newly formed under the New Deal, encouraged settlers to buy homes by guaranteeing mortgage loans. The Salt River’s water was redirected once again, this time away from its fields and into residential and urban development; between 1940 and 1960, the Phoenix area grew in population from 65,000 to 440,000, growing from 4,000 to 62,000 single-family homes (Needham, 2014, p. 55). In one year, 1959, there was more construction in Phoenix than from 1914 to 1946 combined, with a total of 5,060 new buildings (Luckingham, 1981, p. 224).

During the mid-twentieth century, Phoenix and its surrounding areas were advertised as a lush, modern oasis and rebranded as the ‘Valley of the Sun.’ With year-round sunshine, seemingly endless supplies of water, and recreational activities, Phoenix was touted as the future of American development—headlines like ‘Sunshine for Sale!’ (*Arizona Highways*, September 1947) and ‘Dream Homes by the Dozen’ (*Arizona Highways*, September 1954) helped to portray Phoenix as a place of untapped opportunity, spurred by fast growth, good weather, low-cost housing, and an ample water supply.

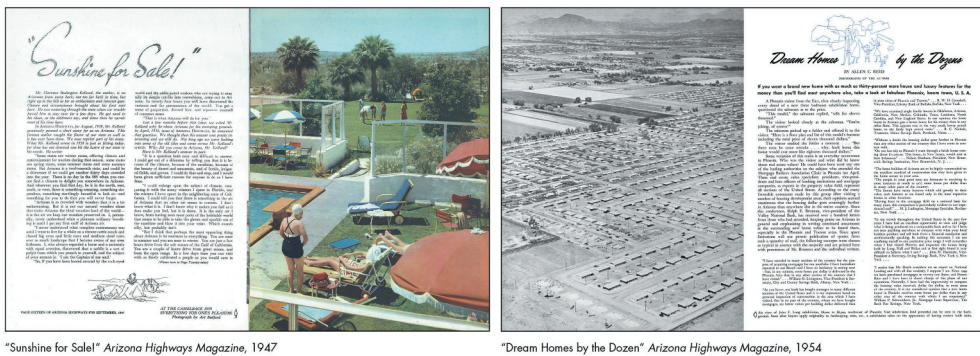


Figure 6. Left: Arizona Highways Magazine, *Sunshine for sale!*, September 1947; right: Arizona Highways Magazine, *Dream homes by the dozen*, September 1954. Courtesy of Arizona Highways.

One Phoenix resident wrote, 'It isn't one feature, but it is a combination of a large group of desirable things that seem to promise you the sort of life you want to live ... I am contented because I have everything I want. I have everything that is modern and convenient if I want it ... It has all the glamour of distant places and all the handiness of culture and civilisation and electricity. It is the only place I know where you can have your cake and eat it' (Kelland, 1947, p. 29). The phrase, 'have your cake and eat it' is an especially fitting platitude for Phoenix in the mid-twentieth century: its existing water infrastructure allowed the city to reinvent itself as a place where its dryness was not a hindrance to any desire for pleasure and progress (Figure 6 diptych).

To that end, in 1952, the city of Phoenix negotiated its first domestic water agreement with the Salt River Project (SRP), the governmental agency responsible for allocating water harnessed from the Salt River. The agreement allowed the city to divert water to residences—a significant shift in the region's priorities from agricultural to residential development. By the 1980s, the most profitable land use was single-family housing, providing more incentive to direct water towards urban use and away from agriculture. In 1984, for the first time in its history, SRP's urban water use surpassed agricultural use with 55% of its water deliveries going to urban areas and only 45% going to agricultural (Salt River Project, 2018). Acknowledging that suburban living was more of a priority than agriculture, land that had once been 'reclaimed' from the desert and converted into productive agricultural fields was now reconceived via 'subdivision,' the process of dividing large agricultural plots into smaller lots with residential tract homes, financed by federal bank loans and guarantees (Needham, 2014, p. 68). Prior to 1948, only 22,000 acres of irrigated land had been lost to suburban development, but by 1960, an additionally 32,000 acres of farmlands were subdivided and developed (Luckingham, 1981, p. 222). By the mid-twentieth century, residential development became the primary source of capital investment and the organising principle of Phoenix's spatial logic. Though this transformation, the perceived emptiness that had initially prompted modern hydraulic engineering was replaced by new cultural attitudes that perceived the Phoenix landscape as abundant with water and with the potential for evermore economic growth.

### Lining the canal and the pool: building efficiency in the modern desert

These moments in Phoenix's urban history—marked by the conversion of 'empty' desert into agricultural landscape and then again reimagined as suburban development—underscore the transformative impact modernism and its associated ideas about nature had on the aridlands in the United States. The notion that a hydrological system can be fundamentally changed to better serve aspirations for economic prosperity and political power was an idea that went largely unchallenged in Phoenix; and as such, new technologies and tools were invented to uphold this

approach to dryland ecology as well as to spur and sustain further development efforts. In Phoenix, gunite, a form of liquid concrete that could be sprayed from a hose quickly and easily, was one such innovation.

With the second wave of migration to the Phoenix metropolitan area, not only did the spatial logics and land uses in the metropolitan region shift, but the canal infrastructure itself needed to increase in capacity to keep up with growing demand. Up until the mid-twentieth century, the canals were mostly unlined with sandy bottoms, and not only conveyed water but were also spaces of cultural and recreational activity. Phoenicians gathered on their banks for picnics and many of the canals were used as swimming holes. Historic images show wooden swings hung from the cottonwood trees that lined and splayed over the canals and children were often taught to swim in their waters (Berger, 2019, p. 64). Beginning in the 1960s, however, SRP began lining the canals with gunite in order to control seepage losses, increase canal capacity, and reduce the burden of maintenance, decisions that espoused the modernist drive to maximise economic growth and efficiency (Salt River Project, 2019). Today, all 131 miles of SRP canals are lined with gunite, and swimming in the canals is banned to preserve the cleanliness of the water and maintain efficiencies in water conveyance (Salt River Project, 'Canal Safety') (Figure 7 diptych).

Gunite also became an essential and ubiquitous material in swimming pool construction. Swimming pools by the 1960s had become a common feature in subdivisions, a sign and symbol of abundance concomitant with Phoenix's emerging reputation as a landscape of 'easy living.' In 1974, one resident said of the Phoenician lifestyle, 'employees work from seven till three and can be home in twenty minutes, swimming, playing tennis or golf, relaxing with their families' (Luckingham, 1989, p. 206). The declining cost of pool construction, largely due to gunite and other advancements in building technologies, meant that pools became a standard part of the Phoenix middle-class landscape.<sup>4</sup> Between 1950 and 2000, private in-ground swimming pools increased from 2,500 to more than four million in the United States (Appelbaum, 2015). In the Phoenix metropolitan area, by 2007, more than 26% of the 1.08 million single family residential properties had a pool, and today, approximately 30% of all homes have private pools (Forrest & Williams, 2009, p. 5601; James, 2020).

Notably, domestic properties with pools have markedly increased water consumption compared to those without (Forrest & Williams, 2009, p. 5601). In 2009, pools in Phoenix accounted for 22% of household electricity use and 13% of their water use (Forrest & Williams, 2009, p. 5601). Further, maintaining a pool requires the owner to regularly change its water, sanitise the water with chemicals, and remove unwanted substances, processes that not only require energy, but also a constant supply of water. On average, maintaining a pool in Phoenix requires 30,000 gallons of water a year, an unusually high amount because of high consumptive evaporation rates—Phoenix



Swimming in the Grand Canal, Salt River Project, c. 1930s



"No Swimming," Salt River Project, c. 1960s

Figure 7. Left: Salt River Project, *Swimming in the grand canal*, ca. 1930s; right: Salt River Project, *No swimming*, ca. 1960s. Courtesy of salt river project archives.





Lining Roosevelt Canal with Gunite, Salt River Project, 1934



Contemporary Backyard Pool Construction with Gunite, 2011

**Figure 8.** Left: Bureau of Reclamation, *Salt river-power canal-typical section of gunite lining, roosevelt power canal*, 1934. Retrieved from National Archives, <https://catalogue.archives.gov/id/294602>; right: Dorian Wallender, *Neighbour's swimming pool*, 2011. Retrieved from Wikimedia Commons, [https://commons.wikimedia.org/wiki/File:Neighbour's\\_swimming\\_pool\\_\(5762411241\).jpg](https://commons.wikimedia.org/wiki/File:Neighbour's_swimming_pool_(5762411241).jpg). CC-BY-SA-2.0.

pools lose an average of about 50% of their total water over the course of the year (Forrest & Williams, 2009, pp. 5604–5). Despite these factors, the pool is a mainstay of the Phoenix suburban landscape: its popularity and ubiquity successfully contribute to the perception that Phoenix's dry ecology has been effectively re-engineered into a landscape of abundant water.

Pool culture relies on the extensive modern infrastructure of dams, canals, pumps, and pipes in order to collect and transport water from its distant sources and supply it to backyard pools. When used to line canals, gunite not only maximises the supply of water, but also ensures a reliable and measurable flow for irrigation and domestic water. When used in swimming pool construction, it holds water in curvaceous hulls, enabling recreation and pleasure to emphasise Phoenix's hot and dry climate as benefit rather than hindrance. Gunite has doubly reinforced the modern approach to water in the aridlands, both in its application for infrastructural efficiency and as an essential factor in the swimming pool's popularity the Phoenix residential built form (Figure 8 diptych). As an overtly visual feature within the landscape, the swimming pool, much like the canal, is read as the manifestation and an icon of modern ideologies afforded by the environmental transformations of the aridlands through hydraulic infrastructures. Despite the ubiquity of pool culture in Phoenix, the city's current dependence on distant and dwindling water supplies, and predictions that temperatures will increase and precipitation decrease in the future, will make Phoenix more vulnerable to the long-term ecological and economic effects. As cities across the world transition into more sustainable water practices, Phoenix, too, will need to reinvent itself to keep its pools afloat.

### Writing new histories, imagining new desert futures

The modern logic that undergirds water management practices in Arizona has remained relatively unchanged despite the state population tripling over the last five decades and—perhaps even more importantly—despite widespread knowledge of the attenuation of water sources, even those that were once truly plentiful (Robbins, 2019). When forced to acknowledge that these new conditions demand adjustment to water usage, management, and regulation, many politicians are quick to argue that the depletion of water supplies is a technocratic problem, rather than an ecological or social one. Tom Buschatzke, current Director of Arizona's Department of Water Resources, is committed to strengthening and refining existing water management methods, rather than reimagining them: in the department's 2019 Annual Report, he asserts that the state is 'opting to improve on the work of previous generations of state leaders to ensure that the word "crisis" remains banished from Arizona's water lexicon' (Arizona Department of Water Resources, 2019b), p. 21). In reality, the word 'crisis' is already an appropriate word to describe Phoenix's climate situation. Other bureaucrats, like



Kathryn Sorensen, current Director of Phoenix Water Services, are working to advance and devise new hydrological technologies: Sorensen advocates for the pumping of Phoenix's groundwater despite the water's heavy contamination, saying that 'as long as the contamination isn't nuclear, we can fix it. What matters here is that the water is wet' (Robbins 2019). In Sorensen's view, any ecological or social cost is worth paying for water so long as the status quo remains. In the modern desert, and in particular in Phoenix, water management has in the past and continues presently to largely revolve around inventing technocratic solutions for diminishing supplies and poor quality to meet increased demands rather than fundamentally reorienting society's attention to more ecologically resilient strategies that are not dependent upon distant or contaminated water sources. These strategies could help catalyse new engagements with water in everyday life.

Even those who advocate and lobby for conservation policies and sustainable practices in Phoenix largely prioritise solutions that have a strong economic benefit and do not require structural shifts in living patterns nor in municipal water usage. The Arizona Municipal Water Users Association (AMWUA), a non-profit corporation made up of politicians and bureaucrats from the Phoenix metropolitan region, state that their mission is to 'advocate responsible water stewardship that supports economic prosperity and safeguards Arizona's water supplies for future generations' (AMWUA, 2021). Other governmental agencies working to implement adaptive water conservation strategies in Arizona are also guided by similar economic agendas and have continued to propose adaptation to existing technologies for diverting, storing, cleaning, desalinating, and conveying distant water such that those industries and people who depend on abundant water are not required to directly reckon with changing water patterns (Arizona Department of Water Resources, 2019a; *Arizona Water Banking Authority*, n.d.). Most governmental agencies and institutions in Phoenix working towards more adaptive water management are doing so within the constructs of the modernist paradigm. As a result, the proposals for conservation do not adequately acknowledge nor address just how influentially modernist priorities of economic prosperity and growth form the ideological foundation of water management strategies and the ways that the modernity paradigm continues to reproduce systems which created the problems that conservation purportedly is trying to solve.

Organisations like AMWUA replicate and strengthen modernist agendas for the environment that are incompatible with the desert's endemic ecological realities and hydrological cycles. A transition to truly sustainable water practices in Phoenix requires letting go of the modern desert altogether, a proposition that is indisputably radical and yet entirely necessary. Such a transition is impossible without first acknowledging the very assumptions that enabled the modern desert in the first place. The underlying ideological approaches to nature, water, and urbanism will need to shift by examining and challenging modernist assumptions about the environment and evaluating how those assumptions have created and normalised incompatibilities between ecology and urbanism. A future for Phoenix that addresses the imminent ecological crisis of the modern desert thus rests not on technological solutions nor even on climate science but instead depends foremost on widespread support of the public and others who have a vested stake in Phoenix's future. Phoenixians need alternative ways to think about the relationship between water and society that are not contingent on modernist assumptions about nature. While climate science is undeniably essential in efforts to identify, analyse, and construct a more climate adaptive future for arid America, the development of Phoenix's environment over the last century has been a direct consequence of its cultural and political past. As such, the canal and the pool are more than objects in the landscape; they typify the entanglements between the culture, politics, and ideologies of the modern desert. In imagining futures for the aridlands, the canal and the pool will need to be reconstituted as typologies that are deeply engrained and saturated with meaning. As David L. Feldman and Helen Ingram have so aptly written, 'future water decisions must embrace multiple values and multiple ways of knowing'—ways of knowing water directly impact how it is perceived, managed, and distributed (Feldman & Ingram, 2009, p. 16). In other words, if water is reducible to mere dollars and cents then damming, diverting, and pumping it may seem like an acceptable treatment, but if



Pools and canal, Google Earth, 2020

**Figure 9.** Google Earth, *Pools and canals in contemporary Phoenix, 2020*. Retrieved from Google Earth, [earth.google.com/web/](http://earth.google.com/web/).

water is known in other ways, then ways of engaging with it will fundamentally change. A critical examination and rewriting of Phoenix's modern past offer an opportunity to redefine the meaning of the canal and the pool, beyond the constructs and assumptions of modernity; and ultimately, a deeper critical engagement with these infrastructural histories is necessary to ensure that cultural norms and environmental policies are not established in isolation of ecological resiliency, but that they are concomitant with defining the contours of the future aridland city (Figure 9).

## Notes

1. Approximately 40% of Phoenix's municipal water is delivered from the Colorado River through the Central Arizona Project infrastructure. Currently, the Colorado River water is overallocated and climate evaluations predict that its flow will significantly reduce over the next 25 years. If Phoenix receives significantly less water from the Colorado, it will need to rely on the Salt and Verde Rivers, water banks, and groundwater, sources that have also already been adversely affected by both modernist approaches and changing climate patterns.
2. For millennia, civilisations survived in desert environments with scarce quantities and ephemeral sources of water. They did so by choreographing their lifestyles, food, and settlements around seasonal weather patterns and dynamic hydrological systems. A variety of such desert civilisations have existed across geographically and temporally diverse conditions. To give but one example, the Hohokam people, on land now occupied by present-day Phoenix, engineered an extensive and sophisticated water management system and distribution network that combined the watersheds of the Salt, Gila, and Verde Rivers in the 11<sup>th</sup> century CE (Hill et al., 2015). They hand-dug nearly 1,000 miles of canals and used the captured water to sustain 4,000 square miles of settlement and farming for nearly 1,500 years (Ross, 2011, p. 25).
3. The O'odham peoples constructed a sophisticated canal system that diverted water from the Salt and Gila Rivers into cultivated fields of cotton, tobacco, maize, beans, and squash. The system, with over 700 miles of canals, is considered to be the largest pre-historic irrigation system in the Americas and oldest in the United States. The canals were constructed by hand with their widest part at the headwaters and tapered through their length to manage erosion and siltation.

4. It should be noted that the increase in private pools in suburban communities in the 1950s and 60s was also attributable to desegregated public pools. Originally, public pools were considered public, egalitarian spaces. However, after desegregation, and as backyard pools became less expensive, most public pools were defunded in many parts of the country, including in Phoenix. See more on the racial history of swimming pools in Wiltse (2010).

## Disclosure statement

No potential conflict of interest was reported by the author.

## Notes on contributor

*Danika Cooper* is an Assistant Professor of Landscape Architecture and Environmental Planning at the University of California, Berkeley, where the core of her research centres on the geopolitics of scarcity, alternative water ontologies, and designs for resiliency in the world's arid regions. Her work incorporates historiographical research methods, data visualisations, and theories of urban infrastructure to evaluate and design for environmental and social justice. Specifically, Cooper is focused on emphasising alternatives to the prevailing nineteenth-century conceptions that the aridlands should be overturned through technocratic solutions and neoliberal politics.

## ORCID

Danika Cooper  <http://orcid.org/0000-0002-3441-5875>

## References

- Almond, G. A., Chodorow, M., Pearce, R. H., & Chodorow, M. (1982). Introduction. In G. A. Almond & R. H. Pearce (Eds.), *Progress and its discontents* (pp. 1–15). University of California Press.
- AMWUA. (2021). *Who we are*. <https://www.amwua.org/who-we-are>
- Appelbaum, Y. (2015). American swimming pools have a long history of racial exclusion. *The Atlantic*, June 8. <https://www.theatlantic.com/politics/archive/2015/06/troubled-waters-in-mckinney-texas/395150/>.
- Arizona Department of Water Resources. (2019a, August 22). *GWAICC desalination committee (8.22.2019)*. <https://new.azwater.gov/media/videos/2019-23-08>
- Arizona Department of Water Resources. (2019b). "Arizona Department of Water Resources: Annual report 2019". [https://new.azwater.gov/sites/default/files/Annual\\_Report\\_2019\\_Online.pdf](https://new.azwater.gov/sites/default/files/Annual_Report_2019_Online.pdf).
- Arizona Water Banking Authority. (n.d.). *Arizona Water Banking Authority*. <https://waterbank.az.gov/>
- Berger, B. (2019). Phoenician shipwrecks. In *A desert harvest: New and selected essays* (pp. 61–78). Farrar, Stauss, and Giroux.
- Berry, W. (1970). The unforeseen wilderness. *The Hudson Review*, 23(4), 633–647. <https://doi.org/10.2307/3849627>
- Billington, D. P., Jackson, D. C., & Melosi, M. V. (2005). *The history of large federal dams: Planning, design and construction*. Government Printing Office.
- Bliss, L. (2016, February 17). Water costs 10 times more in flint than in Phoenix. *CityLab*. <http://www.citylab.com/politics/2016/02/why-water-costs-100-times-more-in-flint-than-in-phoenix-water-value-crisis/463152/>.
- Cooper, D. (2020). Waters resist: Modernity, aridity, and the fight over the orme dam. *Journal of Architectural Education*, 74(1), 37–47. <https://doi.org/10.1080/10464883.2020.1693820>
- Davis, D. K. (2016). *The arid lands: History, power, knowledge*. The MIT Press.
- Feldman, D., & Ingram, H. (2009). Multiple ways of knowing water resources: Enhancing the status of water ethics. *Santa Clara Journal of International Law*, 7(1), 1. <https://digitalcommons.law.scu.edu/scujil/vol7/iss1/1>
- Forrest, N., & Williams, E. (2009). Life cycle environmental implications of residential swimming pools in Phoenix, Arizona. *2009 IEEE International Symposium on Sustainable Systems and Technology*, 1. <https://doi.org/10.1109/ISSST.2009.5156782>
- Gammage, G. (2016). *The future of the suburban city: Lessons from sustaining Phoenix*. Island Press/Center for Resource Economics. <https://doi.org/10.5822/978-1-61091-624-0>
- Heslop, K. (2014). Making the desert blossom: Spreading the gospel of irrigation. *Journal of the Southwest*, 56(1), 29–51. <https://doi.org/10.1353/jsw.2014.0004>
- Hill, J. B., Lyons, P. D., Clark, J. J., & Doelle, W. H. (2015). The 'collapse' of cooperative hohokam irrigation in the lower salt river valley. *Journal of the Southwest*, 57(4), 609–674. <https://doi.org/10.1353/jsw.2015.0015>
- Jackson, D. C. (1993). Engineering in the progressive era: A new look at frederick haynes newell and the U.S. reclamation service. *Technology and Culture*, 34(3), 539–574. <https://doi.org/10.2307/3106704>

- James, I. (2020, January 29). Swimming pools and lush lawns? As water use slows, that image of phoenix is changing. *Arizona Republic*. <https://www.azcentral.com/story/news/local/arizona-environment/2020/01/29/homes-phoenix-arizona-swimming-pools-lawns-water/4593462002/>.
- Kelland, C. B. (1947, September). Sunshine for Sale! *Arizona highways*.
- Linton, J. (2010). *What is water? The history of a modern abstraction*. UBC Press.
- Logan, M. F. (2006). *Desert cities: The environmental history of Phoenix and Tucson* (1st ed.). University of Pittsburgh Press.
- Luckingham, B. (1981). Urban development in Arizona: The rise of phoenix. *The Journal of Arizona History*, 22(2), 197–234.
- Luckingham, B. (1989). *Phoenix: The history of a southwestern metropolis*. University of Arizona Press.
- Mehta, L. (2003). Contexts and constructions of water scarcity. *Economic and Political Weekly*, 38(48), 5066–5072. <https://doi.org/10.2307/4414344>
- Needham, A. (2014). *Power lines: Phoenix and the making of the modern southwest*. Princeton University Press. <http://muse.jhu.edu/book/36527/>
- Neimanis, A. (2017). *Bodies of water: Posthuman feminist phenomenology*. Bloomsbury Academic.
- Peplow, E. H., Jr (1957, April). You'll like living in phoenix. *Arizona Highways*.
- Pisani, D. J. (2002). *Water and American government: The reclamation bureau, national water policy, and the west, 1902-1935*. University of California Press.
- Robbins, J. (2019, February 7). In era of drought, phoenix prepares for a future without colorado river water. *Yale E360*. <https://e360.yale.edu/features/how-phoenix-is-preparing-for-a-future-without-colorado-river-water>.
- Ross, A. (2011). *Bird on fire: Lessons from the world's least sustainable city*. Oxford University Press USA - OSO. <http://ebookcentral.proquest.com/lib/berkeley-ebooks/detail.action?docID=800840>
- Ryan, S. (1996). *The cartographic eye: How explorers saw Australia*. Cambridge University Press.
- Salt River Project. (2018). *Historical timeline*. <https://www.srpnet.com/about/history/timeline.aspx>.
- Salt River Project. (2019, January 31). Grand Finish: Crews Complete 131-mile canal lining effort. *SRP Connect!* (blog). <https://blog.srpnet.com/crews-complete-131-mile-canal-lining-effort/>.
- Salt River Project. (2021). *Salt river project, one reliable future*. Srpnet. <https://www.srpnet.com/water/arizon-water.aspx>
- Santha, S. D., & Sasidevan, D. (2018). The social construction of water scarcity: An exploration study along the 'Bharathapuzha' in Kerala." *Glocalism: Journal of Culture, Politics, and Innovation*. <http://www.glocalismjournal.net/issues/sustainability/articles/the-social-construction-of-water-scarcity-an-exploration-study-along-the-bharathapuzha-in-kerala.kl>.
- Santos, F. (2013, June 16). "An arid Arizona city manages its thirst. The New York Times." sec. U.S. <https://www.nytimes.com/2013/06/17/us/an-arid-arizona-city-manages-its-thirst.html>.
- Schmidt, J. J. (2017). *Water: Abundance, scarcity, and security in the age of humanity*. NYU Press.
- Scott, J. C. (1999). *Seeing like a state: How certain schemes to improve the human condition have failed*. Yale University Press.
- Shermer, E. T. (2013). *Sunbelt capitalism: Phoenix and the transformation of American politics*. University of Pennsylvania Press.
- U.S. Census Bureau. (2019, July 1). *Maricopa county, Arizona*. United States Census Bureau. <https://www.census.gov/quickfacts/maricopacountyarizona>.
- Walker, S. (2012). *Making the desert bloom: Mexicans and whites in the agricultural development of the Salt River valley, 1867-1930* [Dissertation]. Arizona State University.
- Wiltse, J. (2010). *Contested waters: A social history of swimming pools in America*. University of North Carolina Press.
- Worster, D. (1992). *Rivers of empire: Water, aridity, and the growth of the American West*. Oxford University Press.
- Worster, D. (1994). *Under western skies: Nature and history in the American West* (Reprint ed.). Oxford University Press.