

Contents

Preface ix

Acknowledgments xv

PART I. A RIVER THROUGH TIME

1. Conquering the Wild Colorado: The River before 1945 3
2. Farming the Desert: Agricultural Water Demands 31
3. Saving the River: The Environmental Movement 61
4. Sharing the Shortage: A River in Control 87

PART II. CURRENTS OF TODAY

5. The Metropolis and the Desert:
Growing Cities in the West 113
 6. Owning the River: Indian Water Rights and Settlements 149
 7. Crossing the Border: US-Mexico Relations and the River 177
 8. The Water Market: Banking and
Selling the Colorado River 207
- Conclusion* 233
- Bibliography* 247
- Index* 275

1

Conquering the Wild Colorado

The River before 1945

OF THE IMAGES THAT COME TO MIND WHEN ONE thinks of the arid American West, one of the most prominent is the Hoover Dam. Constructed from 1931 to 1936 during the most painful years of the Great Depression, this colossal structure symbolized multiple ideals for struggling Americans: the power of humans over the environment, the successful joining of federal power and individual ingenuity, and the validation of American capitalism and democracy in the midst of crisis and doubt. By far the tallest and largest dam on earth when it was constructed, this concrete structure is still one of the most impressive. Although today at least thirty-two dams worldwide are taller and even more have larger volumes, the Hoover Dam remains one of the most inspiring structures in the United States.

While seven large dams and around a dozen smaller ones straddle its banks, the Colorado River itself is less impressive. The Colorado River ranks seventh in length and watershed size in the United States, but its somewhat

meager flow places it far below at least twenty other American rivers. The importance of this long and unpredictable ribbon of water with an erratic cycle of flood and drought, however, cannot be overstated. At least 30 million people depend on the river's waters.

As the River Flows

Before people dammed and harnessed it, the Colorado was a wild and unpredictable river, prone to cyclical floods and drought according to the seasons. The main source for its water comes from snowpack in the Rocky Mountains that melts in the spring and summer and pours down into valleys, going wherever gravity and landscape take it. Flowing through seven southwestern US states and two Mexican states, the river and its many tributaries drain approximately 246,000 square miles. With an average flow of 15 million acre-feet (MAF) annually, it is the lifeline of the entire region.¹

Along the 1,500 miles of river are many canyons, the deepest of which is the Grand Canyon, one of the only natural landmarks on earth that is visible from space. There are many other canyons, gorges, and a variety of landscapes along this long river. Close to seventy tributaries feed the main stem, but the four primary ones are the Green River in Wyoming, the Gunnison in Colorado, the San Juan that passes through New Mexico into Utah, and the Gila in Arizona. The Colorado's waters once contained one of the world's largest numbers of fish species native only to its ecosystem. Biologists assert that at least sixteen unique species once lived exclusively in the Colorado River.²

Water comes to the Colorado River watershed primarily from two sources: precipitation and accumulation of snowpack in the Rockies, and the summer North American monsoon. These two annual events create interesting seasonal and inter-annual hydrological variability in the basin. When snowpack melts in spring, the water seeps into the ground, recharging the aquifers, while the remainder flows down into streams that feed rivers—including the Colorado. As this melting snowpack increases water flow, the Colorado has experienced dramatic spring floods, at least during the years before human alteration of the river. In the summer, the monsoon is a change of wind pattern that brings moisture from the subtropical Pacific and the Gulf of Mexico up into the lower basin region. Most of the river's annual flow comes during the months of April to July from melting snowpack. Monsoon storms add to the flow of the main stem and tributaries in the lower part of the basin in July and August.³

In addition to the seasonal changes in flow, there are inter-annual variations caused by atmospheric circulation patterns, including El Niño or La Niña events, as well as the Pacific Decadal Oscillation (PDO). An El Niño event is caused by trade winds

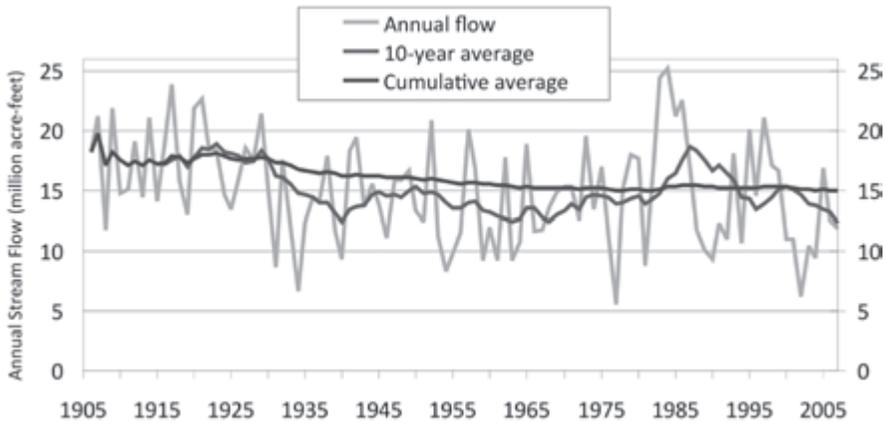


FIGURE 1.1 *Natural flows of the Colorado River at Lees Ferry, Arizona, from 1905 to 2005. Courtesy, Jeff Lukas, Western Water Assessment; data from US Bureau of Reclamation, <http://www.usbr.gov/lc/region/g4000/NaturalFlow/current.html>.*

that blow west across the tropical Pacific Ocean, creating a warming effect. Lasting generally between six and eighteen months, El Niño usually creates increased precipitation and flooding, especially in the lower Colorado basin. La Niña events are periods when trade winds increase over the eastern and central Pacific, generally causing colder ocean temperatures. This event often results in a much lower amount of precipitation, with less snowpack in the mountains and low river flows or drought. The less familiar PDO event creates periods of warmer or cooler temperatures in the Pacific for much longer cycles of 30 to 50 years. The water will be either predominantly cool or warm for stretches of 15 to 25 years during one or the other variation.⁴

These details mean that the Colorado River watershed has a natural pattern of variations in climate and precipitation both within years and within long stretches of time, creating cyclical wet periods alternating with long and sometimes very intense drought. During the early twentieth century, when records of the river's flow were kept, a lot of variation occurred. Between 1905 and 1922 the river's flow was high, averaging 16.5 MAF. More recently, US Geological Survey records show that the highest flow occurred in 1984 at 22.2 MAF and the lowest was in 2002 at only 3.8 MAF (see figure 1.1).⁵

Currently, the flow is affected by climate change as well as other factors such as dust. Recent studies have shown that when dust covers snow because of high levels of agriculture and overgrazing, the snow melts faster, causing a quicker rate of evaporation from vegetation and resulting in less runoff. Climate change studies predict

that increasing global temperatures could affect the Colorado River by lowering flow levels between 7 and 20 percent.⁶

Although current figures are disturbing, understanding the river's past is important for finding solutions in the present. Beyond expected climate change, other actions of humans specific to the river have changed its nature, altered its flow, and impacted the entire bioregion. What follows in this chapter is a tracing of the early history of the Colorado River up to 1945. Within this story, one can see two distinct phases in the human relationship with the river. In the first, explorers and settlers wrestled with the wild river, finding themselves at the mercy of its whims. In the second phase, engineers and politicians took control of the Colorado during a great dam-building era and bent it to human will. While this apparent victory of humanity over nature symbolized for westerners the triumphant march of progress, conflict over shares of the Colorado's life-giving water soon dominated the human partnership with the river. The relationship became unsustainable.

Early Exploration

Scholars assume that the first non-indigenous people to see the Colorado River were the Spanish conquistadors Coronado sent north to search for the fabled "seven cities of gold."⁷ The first written record of the Colorado River comes from Francisco de Ulloa, who explored part of the river's mouth at the Gulf of California in 1539. Sent by Hernán Cortés to explore up the Pacific Coast, Ulloa is credited with drawings of the Baja Peninsula that made cartographers assume California was an island. The next record comes from another Spanish explorer, Hernando de Alarcón, who worked with Coronado's exploration of western North America. In 1540 Alarcón explored the Colorado River up to the present site of Yuma, Arizona.⁸

A few other Spaniards explored the river right after Alarcón's expedition, including Melchior Díaz and García López de Cárdenas. The latter was the first non-indigenous person on record to view the Grand Canyon. After the 1540s, no other exploration of the area entered the records, but cartographers illustrated the mystical region and gave the river several names. The most common name from the Spanish maps and carried on by other European mapmakers was *Rio del Tizon*, meaning "River of Embers." This name was presumably given by Díaz, who named the river for the way he saw local native peoples staying warm in cold weather.⁹ Eventually, the name *Colorado* or *Colorade* began to show up on various maps of the region, sometimes referring to the Gila River or other tributaries and sometimes to what we know as the Colorado today. By the 1740s, some maps started to replace the name *Tizon* with Colorado, Spanish for "red river."¹⁰

In the years that followed, the Colorado River basin region remained largely unexplored and unmapped. Most maps of North America showed a large blank in the Southwest, with only a few notations and incorrect assumptions that a river led to an enormous inland lake or that California was an island. Some fur trappers and explorers went down part of the Colorado River around 1812, not long after the explorations of the Missouri and Columbia Rivers by Meriwether Lewis and William Clark. Knowledge of what became known as the “South Pass” through the Continental Divide was shared among trappers during these early years but had been largely forgotten a little more than a decade later when Jedediah Smith began his travels through the region. Smith rediscovered the pass in 1824, and other mountain men and traders started using this crossing, which took them in and out of the Colorado River basin on their trek to California and the Pacific Coast.¹¹

The South Pass would eventually provide a major migration route for more explorers, gold prospectors, Mormons, and many others who went west in the years after Smith’s travels. Passage along that route took many across the Green River, the major northerly tributary of the Colorado River. Eventually, maps began to show more and more of the Colorado’s headwaters and tributaries but still left blank a great deal of space in the river’s middle. Once the Mormon migration began in 1847 and the California Gold Rush started in 1849, caravans of people moved across the upper basin of the Colorado River through present-day Wyoming. In later years, Mormon migration south into Arizona would bring them across the river at other places far below the Grand Canyon.¹²

In the decades that followed, more than 300,000 settlers migrated to California, passing through the Colorado River basin region. No one stayed there; the goal was to get through the dry and desolate country as quickly as possible to reach California, the Promised Land. At the end of the Mexican-American War in 1848, this desirable paradise became part of the United States by the Treaty of Guadalupe Hidalgo. Forced to the peace table, Mexicans agreed to cede their claim to the North American Southwest—including all of present-day California, Arizona, New Mexico, Utah, and Nevada. Texas had already gained independence from Mexico a little more than a decade before, and in 1848 it was officially annexed. With the exception of a small piece of land along the present Mexico-Arizona border known as the Gadsden Purchase of 1853, the geographic shape of the United States was complete.¹³

As various motives pushed and pulled Americans to the far West, an interesting kind of organization evolved as a way to find order in wild chaos. Although it would be challenged and fought over, a new water law developed to address the region’s specific conditions. In the rest of the country and in much of Europe, riparian water law formed the basis of most water rights. Growing out of English common law traditions, this

riparian doctrine stipulated that whoever owned the land adjacent to a water source owned the right to a proportional amount of its water. Such rights also implied that water users would not impede the rights of others who used the same water source. Under this law, water could not be transferred outside of a watershed or be sold separately from adjacent land.¹⁴

This principle worked adequately in the eastern part of the country but not in the West, where water was often located many miles from where humans lived and farmed. Growing out of ad hoc rules gold miners had settled on to keep the peace, the doctrine of prior appropriation meant that whoever arrived first and mined the gold or land or water had priority rights to it. These miners' codes eventually became legal statutes, and the influence of prior appropriation is evident in the 1862 Homestead Act and the 1872 General Mining Act. As it evolved, whoever had physical control of water had the right to divert it to any "beneficial use." This stipulation was meant to ensure that individuals or companies did not hoard water, a scarce resource in the arid West. One could not simply "own" water and keep others from using it. Beneficial use dictated that whoever diverted or claimed the water had to actually use it for some tangible and beneficial purpose.¹⁵

One of the assumptions behind prior appropriation law and particularly the beneficial use principle was that water users would seek legal redress if another user took more than his or her share or polluted water used by those downstream. One of the problems with this assumption is the cost of lawsuits. Financial costs of litigation might be higher than the costs of dealing with pollution, for example. As the twentieth century progressed, it became increasingly difficult to identify pollution sources and thus the party to pursue in court.¹⁶ Prior appropriation law encouraged people to use more water, regardless of whether they needed it, before someone else took it without enough incentive to ensure protection of other users' interests. This unsustainable relationship with the river remains the basis of present western water law.

Although western migration and exploration were slowed by the outbreak of the Civil War in 1861, the years that followed saw huge waves of migration west across the Colorado River. Thirty-six-year-old Civil War veteran John Wesley Powell became the river's next and perhaps last great explorer. In 1869 he led an expedition down the Green River to the main body of the Colorado River, determined to explore the length of the Grand Canyon and complete the map of this great southwestern river. Against all odds, he and most of his men made it through alive to tell their stories. Powell led another expedition in 1871 and published detailed records and maps of the river after that journey.¹⁷

In the years following his expeditions, Powell used his expertise as a geologist to work as director of the US Geological Survey. In this position he was responsible

for further exploration, mapping, and planning for irrigation and land use. In 1878 Powell issued a report on the American West and his views of its needs and potential. This landmark study was largely ignored at the time of its publication, but within it are the foundations for reclamation projects in the twentieth century.

In his report, Powell paid specific attention to the Colorado River basin, labeling it the “arid region.” He further subdivided the basin into districts he called irrigable lands, forest areas, and pasturelands. These three areas would be valuable for different reasons, but he did argue that low areas near streams—irrigable lands—would prove amenable to agriculture with the right irrigation support.¹⁸ Early in his report, he asserted that agriculture might actually never work well in the Colorado River basin because it experienced regular periodic droughts.¹⁹

Powell’s main argument, however, was that the arid region of the West would never succeed agriculturally without large-scale government planning. He argued firmly that individual farmers would seldom be able to construct or afford the necessary irrigation infrastructure. He used the Mormons as an example of successful irrigation, with a church organization to organize and fund irrigation projects. Powell believed that without this kind of structured planning, most western irrigable lands would never be used successfully.²⁰ He further argued that large water storage reservoirs would have to be constructed to ensure adequate water supply year-round. In general, however, Powell’s vision was one of yeoman farmers settling on homesteads in the West and cooperating with others in creating water districts that would conform to basic government laws for western water. He warned against a lack of control and advocated passing strict laws on land allocations, keeping land grants small enough to properly irrigate, and creating strong oversight of all water issues.

Powell’s advice was heard but largely ignored because representatives of western regions and states did not like his suggestions. They wanted government support for large-scale projects, and, unlike Powell, they foresaw transporting water out of one watershed to another when needed. Economist Lisi Krall has argued that while Powell understood the need for cooperation, he had a naive belief in the notion of a kind of “enlightened capitalism where people are sensitive to the limitations of the land.”²¹ In fact, market capitalism assumes individualism and accumulation of property and, in Krall’s words, “alienation from the land rather than sensitivity to it.”²² Such an alienation or disconnection from the land also meant a similar disconnection from the water that made that land usable for agriculture.

In the years following the Civil War, the country turned its attention to the Industrial Revolution and economic expansion. Fed by unlimited immigration from Europe, northern industrial cities became crowded and overstretched, leading many to look west for better conditions and opportunities. The passage of legislation in

1862 authorizing the transcontinental railroad and its eventual completion in 1869 opened the West to further settlement and enterprise. Although gold rushes continued sporadically, those seeking fortunes in the West turned more often to cattle ranching or farming.²³

At first, settlers moving west passed hastily through the land between the Mississippi River and California, but between 1870 and 1900 they began to stop and stay in the Great Plains. The 1862 Homestead Act made access to public land a basic American right, and many homesteaders headed out to try their hands at farming the West. Free land was there for the taking, and if someone could survive and develop a 160-acre homestead for five years, the land became theirs. Eventually, the best of these grasslands were claimed, and any further pursuit of free land would have to occur in the arid Southwest. Individual farmers, however, could only use these lands if major reclamation projects provided water through irrigation.²⁴

Many believed reclaiming the deserts of the Southwest was necessary for the entire nation. Frederick Jackson Turner's 1893 speech on the closing of the American frontier simply confirmed a pervasive fear that there was no more free land.²⁵ If there were no more frontiers for individuals to claim and tame, the problems that accompanied industrialization and massive immigration in the East could not be alleviated. A quasi "back-to-nature" movement began in which people looked back nostalgically at an earlier time before the Industrial Revolution. Those who observed the unrest of labor unions and the political agitation of sharecropping farmers hoped reclamation in the arid West would release some societal pressure.²⁶

To further settle the West and respond to pressure from a growing western presence in the US Senate, Congress passed the Desert Land Act in 1877. In this first federal act to affect western reclamation, the government gave land grants of 640 acres to married couples (320 acres to single males) if they could prove that they would irrigate the land within three years. Congress thought this act would attract the right kind of settlers with some capital to construct irrigation systems for their land grants. From the beginning, however, there were problems with fraudulent claims and simple underestimations of the challenges of irrigation works. Very few land grants were irrigated through this act.²⁷

While John Wesley Powell argued for locally controlled, farmer-run irrigation districts in the West, congressional members from the new western states argued for government support. Then came the particularly painful economic depression of 1893–98. Boom and bust in the US economy had long been the norm, but the length and depth of this depression made many assume that Turner was right. Some of the most violent labor strikes in US history occurred during this economic crisis, and the number of farmers who lost their land and became tenants increased expo-

nentially. To make matters worse, a severe drought hit the western states from 1893 to 1895.

Many in the West already felt the region was the country's poor stepchild. During the nineteenth century the US Congress had put large amounts of money and effort into reclamation projects for eastern rivers and streams. While there had also been government focus on the West, there was always a feeling that the region was last in line for federal spending. Mapping and surveying projects in the West, the building of military forts and railroads, and encouraging settlement through the Homestead Act did seem to focus a fair share of government attention and money on the West, however. Some scholars argue that the West had become accustomed to federal money during the crisis in the 1890s and now expected such subsidies.²⁸

As ranchers and farmers struggled during western droughts, many fled Plains states like Kansas and Nebraska for either homes back east or new farms further west. Taking advantage of the opportunity, Wyoming and Idaho encouraged farmers to move to their states, but they wanted to find a way to provide irrigation so they could absorb more people. Wyoming engineer Elwood Mead eventually gained the support of Wyoming senator Francis E. Warren, who began sending various irrigation bills to the US Congress. Named for Senator Joseph Maull Carey of Wyoming, who first introduced the bill in 1892, the Carey Act (also called the Federal Desert Land Act) was finally adopted in 1894.²⁹ Warren did not believe the government would build dams and canals, so he lobbied for the government to grant public lands to the states so the lands could be sold and the profits used by private companies to build them. The provisions of the Carey Act gave western states millions of acres in 160-acre homesteads to sell for small fees.

The Carey Act failed the same way earlier attempts had. Western settlers were often unable to manage the irrigation projects they needed and gave up their claims to move on to better, watered pastures. While some private companies managed to set up irrigation projects in various places, many others failed, convincing even more congressmen that more federal money and action were needed to build dams and canals in the arid West.³⁰

Even before the federal government officially began its western reclamation projects, several individuals tried to create irrigation works from the Colorado River. One of the 49ers who came to California looking for gold was Dr. Oliver M. Wozencraft, who believed he could divert the river into what was known as the Colorado Desert, a very hot region near an ancient lake bed. Also called the Salton Sink (Lake Cahuilla by the region's indigenous people), the lake had dried up many centuries before and the surrounding soil was very rich, excellent for agriculture if only it could be irrigated.³¹ In 1856, geologist William P. Blake, who worked for the Pacific Railroad

Survey, made a similar observation, asserting that almost anything could grow in the soil. Wozencraft probably read Blake's observations, published in 1856, and persuaded the state of California to approve his plan to develop about 1,600 square miles of the desert. However, in spite of long efforts and numerous bills introduced, Congress never funded his scheme.

The next serious attempt to divert Colorado River water to irrigate the desert occurred in the 1870s when Californian O. P. Calloway developed a plan for what is now known as the Palo Verde Valley. He needed financial help for his plan, however, and finally found an investor named Thomas Henry Blythe. Blythe had purchased land in 1851 that later became the main downtown area of San Francisco, and he became very wealthy from his investment. Although Calloway did not live long enough to see any real progress on his dream, Blythe began filing claims for land and water rights along the Colorado River. By the early 1880s he probably owned around 175,000 acres of land and 400,000 miner's inches of the river's water.³² For whatever reason, he never cultivated any of it.

On the other side of the Colorado River delta, one of Blythe's former business partners was Mexican businessman Guillermo Andrade. Blythe bought into Andrade's struggling company, and both men continued to purchase land along the river until they owned nearly all the land on both banks from the US-Mexico border to the Gulf of California. In 1883, just when it looked as though the two men had an enormous region ready for development, Blythe died abruptly. After a lengthy legal battle, Andrade obtained legal rights to a large portion of the original landholding.³³

In the mid-1890s Charles Rockwood, like Wozencraft before him, also thought he could divert the Colorado River into rich soil in Southern California. Eventually, he found a funding partner named George Chaffey, a private irrigation engineer. Together, the two men planned for a canal to divert water from the Colorado River into the flat desert valley. An old flood channel known as the Río Álamo seemed the best route for a canal and by far the cheapest to build, but it ran through Mexican land. Once Andrade's legal claims had been settled, he sold Rockwood and Chaffey the right-of-way for the canal. In 1901 the Mexicali Valley in Mexico and the California desert region became prime agricultural land, thanks to the Colorado River.³⁴

Renamed the Imperial Valley, the rich land on the US side began to draw settlers. More than 7,000 came in during the first three years, many from Arizona's Salt River Valley. Developers jumped at the opportunity. Soon, three boomtowns sprang up, and railroad construction began to connect them to markets outside the region. Rockwood, Chaffey, and the other partners of the new Colorado Development Company (CDC) must have felt elated by their almost overnight success.³⁵

What happened next surprised nearly everyone. The Colorado River is one of the most sediment-filled rivers in the world, and Rockwood's canal and its irrigation ditches were quickly clogged with silt. It was the CDC's responsibility to clear the channels, but it was a losing battle. As more and more land was cultivated and more water demanded, more silt ran through the channels; by the summer of 1904 the canal was almost completely blocked. The worst area was the spot where the river intake connected to the canal; although several bypass intake channels were cut, each one quickly silted up. Finally, Rockwood decided he had to cut a new and larger bypass intake just below the border. Mexico agreed to the new intake with the understanding that 50 percent of the canal water would go to farmers in the Mexicali Valley. Rockwood had no choice but to agree.³⁶

The new, temporary channel's gates were flimsy, meant to function only until the old one was dredged out. Before that could be done, spring floods pushed abnormally high amounts of water down the Colorado. The weak gates gave way, and the entire Colorado River left its channel and flowed into the Imperial Valley. By midsummer 1904 over 90,000 cubic feet of water per second were pouring into the valley, which quickly became a lake. In desperation, Rockwood asked Edward Henry Harriman of the Southern Pacific Railroad for help. Harriman agreed, but only if he was given complete control of the CDC. Reluctantly but with little other choice, Rockwood handed him control.³⁷

For the next year and a half, Harriman paid engineer Harry Thomas Cory and a team of Indian workers to stop the river. Over and over, the powerful Colorado washed away all their attempts and continued to pour its full flow into the valley. Finally, in February 1907, Cory's men managed to plug the wall of the riverbank with tons of rock and stop the flow.³⁸ The river returned to its natural channel, and the crisis had ended. Thousands of acres of farmland had been destroyed by water and silt, and a new lake had been created.³⁹ By the 1920s the Salton Sea had become a major recreation and tourist location. In recent decades, however, the sea's health has been threatened by increasing salinity levels and nutrient pollution from the irrigation runoff that feeds it. Causing eutrophication, these high levels of nitrogen and phosphorus feed excessive algae growth that depletes the water's oxygen levels.⁴⁰ The Imperial Valley is still one of the most important agricultural locations in the country. This first diversion of the river was plagued with disaster, but later canal projects along virtually the same routes annually flood the Imperial Valley with approximately 3.1 MAF of water each year.⁴¹

To many, Rockwell's disaster in the Imperial Valley demonstrated the need for federal policy and support for reclamation of the desert. The late nineteenth century had been fraught with economic depression, drought, labor unrest, unrelenting

immigration, and other side effects of the Industrial Revolution. Some Americans began looking back nostalgically to an older “Agrarian Myth” as a cure for some of these side effects. What the country needed in the new century was more independent farmers and more attention to the good in nature.⁴² Some of the movements in the late nineteenth and early twentieth centuries—the Back to the Land Movement, the City Beautiful Crusade, the Parks and Playground Campaign, and others—addressed a loss brought about by urbanization, the loss of a connection to nature.

In some ways, the creation of a federal reclamation policy was an outgrowth of these ideas: that America’s salvation might be found in irrigating arid land in the West. There was a very large, unsettled portion of the country to which the Turner thesis could still be applied, if only it had water. Supporters of federal reclamation projects believed reclaiming arid western lands would provide an important safety valve for America’s cities. Some individuals, such as George H. Maxwell and William E. Smythe, tried to apply social planning principles in the West and hoped federal reclamation would allow cheap land to be reclaimed for small farmers. They argued for the passage of a bill that would bring federal help for constructing dams and canals and distributing land to help settle poor urbanites on small farms.⁴³

People like Maxwell and Smythe made a number of assumptions about the West and its water. First, planners assumed there was enough water for large-scale settlement without worries about shortages. The West was enjoying one of the wettest decades in the entire twentieth century, so no one thought of shortages. There was also no awareness of the role evaporation would play in future scarcity. While the idea of damming and storing water sounded good on paper, collecting water in a lake increases the surface area exposed to heat and wind. It is estimated that Lake Mead loses approximately 800,000 acre-feet per year to evaporation—almost 2.5 times the amount of Colorado River water allocated to Nevada.⁴⁴

By 1900, both the Republican and Democratic Parties were supporting some kind of federal reclamation policy, although no one could agree on the shape it should take. Western senators worked very hard to emphasize the need for federal help for arid lands and used some of the same arguments other social planners did to justify the projects. While many eastern politicians opposed such a bill, the ability of western members of Congress to filibuster and block other legislation finally caused the opposition to crumble. With support from President Theodore Roosevelt, the Reclamation Act of 1902 (sometimes called the Newlands Act) passed with the help of Francis G. Newlands, US representative from Nevada. He and other western politicians were mostly interested in what reclamation projects could do for the West, while Smythe and Maxwell believed they could save the entire country.⁴⁵

In short, idealists who hoped to conduct some social engineering or “home making” envisioned a specific future for the Colorado River. Irrigating the West would allow small families to create homes independent of the fluctuating value of life experienced in crowded eastern cities.⁴⁶ Some, such as Frederick H. Newell, who later became the Bureau of Reclamation’s chief engineer, believed there was a shortage of good farmland in America and that population pressures made creating new farmlands necessary. Irrigation projects would solve the major societal issues of the day.⁴⁷

Others supported federal reclamation because of political pressure. Even Roosevelt supported reclamation at least in part because he needed western support in Congress. The whole idea of federal reclamation also appealed to him in ways it would not have to earlier presidents. Roosevelt appreciated the attitudes of those who saw independent farmers carving successful enterprises out of the desert. All they needed was a little water, and eventually it would all pay for itself.⁴⁸

Taming the River

Thus, with presidential support and a strong western lobby in the US Senate, Congress passed the Reclamation Act, setting aside federal funds from public land sales in the West for irrigation projects in sixteen western states (seventeen when Texas was added in 1906). Irrigation projects would be spread fairly, and money from land sales would be used for projects within those states. To administer the project, the act created the United States Reclamation Service, housed in the US Geological Survey. A few years later it was renamed the Bureau of Reclamation and housed in the Department of the Interior, where it remains today.⁴⁹

Those involved with the Bureau of Reclamation in its early years had high hopes for its success. Roosevelt, Newlands, Newell, Smythe, and Maxwell all saw the new bureau as the answer to many social challenges of the time. In retrospect, however, the bureau never fulfilled its social planning goals. Smythe, Maxwell, and Newell eventually admitted that their ideas for the bureau had failed. While Smythe and Maxwell blamed the bureau for abandoning their goals, Newell blamed the farmers. The fact that so many gave up and left their project farms seemed to him a failure of spirit. He also admitted that perhaps there had never really been a shortage of farmland in America at the turn of the twentieth century. Land speculation created uneven settlement patterns and soaring costs for farmers, who often defaulted on their loans.⁵⁰ As the bureau abandoned social engineering for dam building, Newell viewed the 1902 act as an unnecessary and expensive failure.⁵¹

In spite of what some saw as failure, the Bureau of Reclamation became one of the most important players in the story of the Colorado River. While the bureau

created many other projects on other rivers and in other river basins, its work on the Colorado continues to be its largest and most significant effort. The Gunnison (later the Uncompahgre) River Project in Colorado was the bureau's first diversion of a Colorado River tributary to provide irrigation for area farmers in western Colorado. Efforts were already under way to have private companies and the states build canals to irrigate the Uncompahgre Valley. Federal assistance made it possible to turn the project into a much grander one, not fully completed until 1925.

Although the first major dam construction by the Bureau of Reclamation would be Roosevelt Dam on the Salt River in Arizona, this first diversion of the Colorado happened where it did because of political connections. Congressman James Shafroth of Colorado was a member of the House Committee on Irrigation and had helped Newlands draft the Reclamation Act.⁵² The first major phase of the project—a diversion dam across the Gunnison River and a diversion tunnel to the Uncompahgre River—was opened and dedicated by President William Howard Taft in 1909. It was a difficult project from the start, drilling through 2,000 feet of rock filled with water that kept interrupting the workers. At the cost of twenty-six lives and just under \$3 million, water from the Gunnison River finally flowed to farmers.⁵³

At nearly the opposite end of the Colorado River, the second major diversion of the river was on the Gila, another major tributary. The Gila River empties into the Colorado at the present-day city of Yuma in the southwest corner of Arizona. Although the Hohokam and later Euro-American settlers farmed the valley, periodic flooding and extreme drought made regular success difficult. However, very soon after the Bureau of Reclamation was created, Yuma became a candidate for federal help. Approved in 1904, the Yuma Project soon boasted irrigation canals, and construction on the Laguna Dam began soon thereafter. Built from 1905 to 1909, it was the first federal dam on the Colorado River and diverted water to farmers in the Yuma Valley. Upkeep of the earthen dam proved costly, however, and Imperial Dam, built during the 1930s, eventually replaced it.⁵⁴

Over the next few years, federal reclamation took on projects in almost all the western states to garner support in Congress and prove its real value. Newell hoped that extending water projects as fast as possible would enable small farmers to settle, preventing land speculators from gobbling up large tracts. His actions, however, only spurred land speculation and drove up land costs to exorbitant levels. Many farmers defaulted on their debts and left the Bureau of Reclamation with the total cost of water projects.⁵⁵ While grappling with these issues, bureau engineers continued earlier surveys for a possible dam and large reservoir on the lower Colorado River—one that would provide enough water storage for Southern California's rapidly growing population and farming enterprises. Los Angeles needed such a dam to provide elec-

tricity, and engineers soon identified two possible sites. Before any construction or even serious planning took place, however, another issue needed resolution: water distribution.

For many decades, Southern California's population had been growing, Los Angeles's in particular. By 1913 the city's leaders feared a water shortage and eventually constructed the Los Angeles Aqueduct to bring water down from the Owens Valley (see chapter 5). Farmers in the Imperial Valley, however, needed a better water supply to maintain their profitable agriculture. Water still flowed from the Colorado River through repaired channels that took water south of the border with Mexico and then back north into the valley. However, in 1910, Mexico began a revolution that turned into a civil war, lasting in varying degrees of severity until the early 1920s.⁵⁶ Because of all the chaos south of the border, California politicians began seeking support for a canal to the Imperial Valley—which they named the All-American Canal—that would be completely within US borders. The Imperial Irrigation District (the new name of Rockwood's CDC) sent lawyer Philip David Swing to Washington to lobby for the new canal. Swing and California politicians thought the federal government would help them and that the new Bureau of Reclamation could take over the project. They were very surprised, however, when Arthur Powell Davis, the director of the US Reclamation Service (as it was then called), refused to support their plans.⁵⁷

Davis, a nephew of Major John Wesley Powell, was not really opposed to building the All-American Canal but believed the Colorado River was the key to western reclamation. He thought developing the river would be an enormous and complex project that needed comprehensive planning, of which the All-American Canal would be only one part. So he campaigned and received support for a large-scale study of the entire Colorado River basin. Completed in 1922, the resulting "Fall-Davis Report" laid out extensive plans for developing the Colorado River. Its centerpiece was a large dam in Boulder Canyon with hydroelectric generation and enormous storage capacity in the reservoir. It also recommended the construction of the All-American Canal from Laguna Dam to the Imperial Valley.⁵⁸

The question of utmost importance to western politicians was how the water would be divided. They had to settle this issue before they could support any bill authorizing a large dam project. Accordingly, representatives from each of the seven states affected (Wyoming, Colorado, New Mexico, Arizona, Nevada, Utah, and California) held a series of meetings in 1922 to try to reach an agreement. The main impetus for these meetings came from Colorado attorney Delph Carpenter. Like many others, Carpenter worried that if the states did not actively make major decisions about water sharing, the federal government would end up with too much control over state issues.⁵⁹

As the meetings progressed, it became apparent that reaching an agreement might be impossible. Herbert Hoover, the secretary of commerce, was attending the meetings, representing President Warren G. Harding's office. Hoover had long been an active conservationist. Early-twentieth-century conservationists viewed nature as an important resource that should not be wasted. Conserving meant making the best human use possible of something like a river. Hoover was enthusiastic about cleaning up harbors and streams and managing natural resources. He believed in harnessing rivers to stabilize and encourage the growth of fisheries while simultaneously controlling flooding and improving navigation. Water that flowed to the oceans without being put to good use was a waste. A dam on the Colorado would fulfill this important criterion.⁶⁰

Hoover's experience as an engineer gave him credibility in the eyes of the compact negotiators, but the situation was much more politically complicated than he had first realized. California was intent upon securing as much water as possible from the river and believed Arizona was not entitled to any water from the main stream. Arizona politicians argued that the state deserved a sizable share in spite of the water it used from the Salt and Gila Rivers, two of the Colorado's tributaries. California believed water from the two rivers should count as part of Arizona's allocation of Colorado River water. Neither side was willing to budge on this issue. As a possible solution to the impasse, Hoover suggested that the basin be divided in half. Surely the states could then agree on a division of water between the two halves at least. They could later negotiate specific distributions. Most delegates thought this idea was a perfect solution and signed what became known as the Colorado River Compact on November 24, 1922. The member states then headed home to convince their constituencies to ratify the document.⁶¹

Although Sonora and Baja California were important users of the river's waters, representatives from those Mexican states were not invited to the meeting. Most of those present believed that while the United States might want to make some kind of agreement with Mexico over Colorado River water, Mexico did not have any legal rights to that water. Since all the tributaries and sources for the river originated inside the United States, Mexico could not demand a right to its water. Most recognized that some kind of agreement would eventually be made, but Hoover worried that any record of the commission mentioning Mexico could be used to prove an assumption of rights. Accordingly, Hoover asked that any mention of Mexico be expunged from the record, and the commissioners agreed.⁶²

The Colorado River Compact created two divisions: the upper basin consisted of Wyoming, Colorado, Utah, and New Mexico; the lower basin included California, Arizona, and Nevada. According to rather optimistic hydrological reports, the Colo-

rado River contained an average annual flow of approximately 18 MAF. As was later understood, this estimate was made during a time of unusually high water flows, so later years had much less than 18 MAF to divide. The problem was not seen in 1922, however, and the law governing Colorado River water usage was based on this erroneous assumption.⁶⁵ As a consequence, no one asked whether the water would keep flowing or whether the allocation arrangement would be sustainable in the long term. This narrow view was largely the result of a longstanding attitude toward the natural environment. Historian Roderick Frazier Nash has argued that from the time of the earliest explorers of North America, settlers developed an attitude of fear toward the untamed wilderness that might destroy them. Military phrases such as “conquering” or “defeating the wilderness” became commonplace when speaking of early America’s relationship to the wilderness. Attitudes toward the mighty and wild Colorado River, from the first Imperial Valley farmers to congressional committee members, considered the river something that must be conquered to bring the benefits of civilization to the arid Southwest.⁶⁴

According to the Colorado River Compact, each basin would receive 7.5 MAF of water each year. The lower basin was also allowed to take an additional 1 MAF if needed, and 2 MAF were set aside in a reserve, part of which would be allocated to Mexico if a treaty were eventually signed. The bill divided the watershed into two basins mostly to reassure states such as Colorado that there would be water for their projects, somehow protected from California farmers. Each of the involved states ratified the compact fairly quickly except for Arizona, which feared that without specific allocations, California would take much more than its fair share. The compact division of water between the two basins set aside what had been the basis of western water law: the law of prior appropriation. The law did not, however, set aside prior appropriation among the states of each basin.⁶⁵ Arizona feared California would manage to claim all the lower basin’s share of the Colorado, since its water districts and organizations were already functioning well and planning canals.⁶⁶

Finally, in 1928, Colorado suggested that the compact be considered law if ratified by six of the seven states, with a specific stipulation limiting California’s total water allocation. If California’s consumption is left unchecked, California could easily appropriate the entire allocation for the lower basin, and Arizona might later appropriate its share of water from the upper basin. Since Arizona had not signed the compact, it would not be bound by it and could simply establish prior rights to water Colorado had not yet been able to appropriate. Congress began debating these issues in earnest as it held hearings on the Boulder Canyon Bill.⁶⁷

Other pressing questions had to be answered before the bill could pass, however. One concerned the location of the dam, and Congress authorized studies of two

dam sites (Boulder and Black Canyons). Eventually, the resulting study showed that Black Canyon would be the better location, but by the time this decision had been made, the entire country was already referring to the project as the Boulder Dam or Boulder Canyon Project. The name stuck and would remain until the completed dam was rechristened Hoover Dam in 1929. Meanwhile, Congressman Philip David Swing and Senator Hiram Johnson of California drafted a bill, alternately called the Swing-Johnson Bill or the Boulder Canyon Bill, that authorized Boulder Dam as well as canal construction to bring water to the Imperial and Coachella Valleys in Southern California. Not surprisingly, most Arizona residents were adamantly opposed to the bill, firmly believing California was out to steal all the water it could from the Colorado River, leaving none for Arizona's deserts. The state's politicians became almost obsessed with a determination to fight greedy Californians at every turn. In Yuma, Arizona, however, farmers and local business owners supported the bill because they wanted the promised flood control and federally subsidized water.⁶⁸

There were other opponents of the Boulder Canyon Bill. Eastern politicians thought the project was an enormous waste of federal dollars, and electric-power interests did not want the government entering their business, fearing a government-run monopoly. A duel between two large newspapers added to the discussions. Harry Chandler, publisher of the *Los Angeles Times*, did not support the bill because he feared plans for the All-American Canal would take away all the water from farmland he owned in Mexico just south of the border. William Randolph Hearst used his *Los Angeles Examiner* and other newspapers to champion the bill.⁶⁹

To garner support from the Colorado's upper basin states, Congress made important adjustments to the bill. First, it agreed that the Colorado River Compact could become law with only six of the seven states ratifying it. Second, it inserted a limitation of 4.4 MAF of water annually to California. After much wrangling in various congressional committees, the bill (in its fourth version) reached debate on the floor of the US Senate, where the senators from Arizona filibustered. Finally, however, the bill passed both houses on December 21, 1928. The Boulder Canyon Project Act authorized the spending of \$165 million for the dam and the All-American Canal.⁷⁰

In many ways, this enormous project was Herbert Hoover's creation. During his tenure as President Warren G. Harding's interior secretary, Hoover was very active and vocal in support of conservationism and reclamation. He, like others, became intrigued by the idea of harnessing the Colorado River both to prevent devastation by its periodic floods and to provide water to a burgeoning population in California and elsewhere in the West. Hoover, once a resident of California, understood the water pressures there and also saw the federal government as the best supporter for such a large-scale project. While he had little to do with its actual shape and con-

struction, Hoover considered the dam that was to bear his name one of his greatest legacies.⁷¹ Without his efforts to obtain the 1922 compact, the dam might never have been possible.

The dam is actually a combination of two types of dams: the “arch” and the “gravity” dam. Made of concrete, Hoover Dam was both the largest concrete structure and the largest electric-power generator in the United States and remained so until the construction of Grand Coulee Dam on the Columbia River in 1945. Built from 1931 to 1936, Hoover Dam “contains enough concrete to pave a strip 16 feet wide and eight inches thick from San Francisco to New York City.”⁷² While statistics are conflicting, approximately 112 people died during the dam’s construction. Its building is an epic unto itself, filled with stories of success and failure, trial and error. When it was finished, however, the dam generated approximately 4 billion kilowatt-hours of electricity every year and stored up to 28.5 MAF of water in Lake Mead when it was full.⁷³

The Hoover Dam has changed very little over the years and remains one of the largest and most identifiable dams in the United States, becoming a major tourist destination after World War II.⁷⁴ Water stored by Lake Mead helps to irrigate more than 1 million acres of land in California and Arizona and an additional 400,000 acres in Mexico. In fact, Hoover Dam makes possible much of the produce grown in the United States today. Construction on the All-American Canal south of the Imperial Valley started in 1936 as soon as the dam was completed. Built eighteen miles north of Yuma, Arizona, Imperial Dam diverted water into the All-American Canal and carried it eighty miles to the Imperial Valley. The Coachella Canal was completed in the early 1950s and sent water another 124 miles north of the Imperial Valley. In 2000, the Imperial and Coachella Valleys alone produced more than \$1.6 billion worth of farm products.⁷⁵

To distribute the water California would receive from Hoover Dam and its reservoir, various water users in Southern California met to hammer out an agreement. This second major “law of the river,” called the Seven Party Agreement, apportions the majority of California’s water share to agriculture. In 1929, California agreed that its share of the Colorado should be 4.4 MAF annually and that it would try not to exceed that amount. Arizona refused to sign any agreements on apportionment, so California was actually free to exceed its allocation whenever it chose. California did, however, sign the 1931 agreement that listed priorities and water amounts granted to seven major water users: Palo Verde Irrigation District, Imperial Valley Water District, Coachella Valley Water District, Metropolitan Water District (Los Angeles), City of Los Angeles, City of San Diego, and the County of San Diego, listed in order of priority. One of the problems with the Seven Party Agreement was that it apportioned far more than 4.4 MAF. In fact, California would use more than 5 MAF annually

in the years before the US Supreme Court ruling in 1963. Temporarily, however, the agreement minimized a developing struggle between agriculture and growing metropolitan areas in Southern California that would revisit the region in the future.⁷⁶

While Colorado River water finally flowed to agricultural interests in California, Los Angeles knew it would soon need a much larger share. In 1931 the Metropolitan Water District, in charge of providing water for Los Angeles, began plans to construct a canal that would bring Colorado River water to the city. The Bureau of Reclamation began construction of Parker Dam in 1934 to provide a reservoir for the aqueduct to Los Angeles.⁷⁷ While these plans were of utmost importance to Southern California, they seemed a threat to Arizona, which still refused to sign any apportionment agreements or to recognize California's claim to Colorado River water. In fact, Arizona had filed lawsuits against California three times during the 1930s to establish its own water rights and minimize California's, all to no avail.

As construction on Parker Dam began in 1934, Arizona governor Benjamin Baker Moeur decided to do more than protest to the media. As had his predecessor, George P. Hunt, he adamantly opposed California's share of the Colorado River and any attempts to construct an aqueduct. To show his determination, he mobilized Arizona's National Guard and sent it to the dam site. Unfortunately, this action ended up as a joke to many observers because the troops became stranded on an old steamboat and were rescued by the Los Angeles Department of Water and Power. The *Los Angeles Times* sent a reporter it jokingly called a "war correspondent" to cover the dispute.⁷⁸ Arizona was determined to prevent the Bureau of Reclamation from anchoring the dam to the Arizona side of the river, and at this point the secretary of the interior decided to halt the project. He referred the issue back to the US Supreme Court, which promptly ruled that indeed the Boulder Canyon Project Act had not authorized a dam at Parker. Congress quickly drafted the necessary legislation to make the dam legal, and in 1935, Arizona had to stand back and watch as construction resumed.⁷⁹ In 1941 the California Aqueduct carried its first water delivery from Parker Dam into Los Angeles. Suddenly, Los Angeles had plenty of water to allow it to grow, and between 1940 and 1970 the city's population nearly doubled.⁸⁰

During most of the 1930s, President Franklin D. Roosevelt fully supported federal reclamation as part of his New Deal. At both ends of the Colorado River, the Bureau of Reclamation developed irrigation projects—one to address the needs of farmers in the Gila River Valley region near Yuma, and the other in Colorado to transport water from the western slope over the Continental Divide to Denver. The Gila Project, started in 1936, was not completed until after the interruption caused by World War II.⁸¹ The project consisted of two sets of irrigation canals, one called the Wellton-Mohawk Division running east-west along both sides of the river, and the second a

series of north-south canals called the Yuma Mesa Division. As farmers irrigated their fields along the Gila, over time the water and soil became more and more salty, making it impossible to grow crops. The canals carried Colorado River water to the area, and a series of drainage wells leached off excess groundwater from farms. Some of the canals brought in Colorado River water as early as 1943, but much of the Wellton-Mohawk Division was not ready until 1952 and was not fully completed until 1957.⁸²

In 1937, work began on a large project at the north end of the river—the Colorado–Big Thompson Project, one of the largest ever constructed by the Bureau of Reclamation. It covers approximately 250 miles and includes dams, reservoirs, pipelines, power stations, pumping stations, and canals—all meant to transport the abundant water from the Colorado River on the western side of the Rockies to the arid eastern side. In spite of ongoing mistrust between the two parts of the state, western slope residents reluctantly agreed to pump their water to the eastern cities of Denver and Boulder.⁸³

As with the Gila Project, construction on Colorado–Big Thompson began in 1937, slowed during World War II, and resumed until the project was completed in 1959. Both of these long-term projects diverted significant amounts of water from the Colorado River and used allotments in both the upper and lower river basins. The agreement for the Colorado–Big Thompson Project was made possible by the fear that if the upper basin did not begin using and storing its share of water, the lower basin would over-allocate and take more than its fair share. During the 1940s and 1950s, Colorado politicians such as Representative Wayne Aspinall would feel an urgency to develop more projects for the upper basin and Colorado in particular.⁸⁴

While those in the western basin divided up the Colorado River and competed with each other for allocations, most users ignored any claims by Mexico (see chapter 7). For many years, Mexican officials and farmers became increasingly concerned and frustrated as Hoover Dam and the All-American Canal reduced the flow of water across the border. Both sides also disagreed on sharing the Rio Grande between Texas and Mexico. Over several decades the two nations talked, made offers, and finally reached an agreement in 1944. In the resulting treaty, Mexico allowed the United States to draw 350,000 acre-feet of water from the Rio Grande, and the United States agreed to deliver 1.5 MAF to Mexico from the Colorado River.⁸⁵ The document made no mention of water quality, creating much debate later, in the 1960s. The treaty also did not stipulate who would give up water in times of serious drought. These issues reappeared in the 1960s when diversions of agricultural runoff near the border made Mexico's allocation too salty to use.

By the end of World War II, the Colorado River had been dammed, divided, litigated, and transferred inside and outside the river basin. While more dams and canals

would follow in the 1950s and 1960s, much of the work of turning the river into a complex plumbing system was complete. Most of the Colorado River's water was put to the "beneficial use" of agriculture, but although the Bureau of Reclamation continued to follow a policy of limiting irrigated agriculture, the ideal of individual farms gave way to a new reality of large-scale agribusiness. The story of the river in later decades became even more complicated, affected by a growing environmental movement and intensified disagreements between upper and lower basin states. Important issues such as Native American water rights, quality control, and urban demands versus agriculture characterized the story of the Colorado River in the second half of the twentieth century.

NOTES

1. An acre-foot is the amount of water it takes to cover one acre of land one foot deep, approximately 325,851 gallons. This is the primary unit of measure used for water flow in rivers in the United States. Eighteen acre-feet is approximately 1 miner's inch. Although miner's inches are still used in some parts of the American West, the acre-foot has been a much more common measure since the early twentieth century. The figure of 15 million acre-feet as the average water flow is somewhat limited in value. While current estimates over the past 100 years do place the average near 15 MAF (considerably less than the 1922 estimate of 18 MAF), recent tree-ring analysis indicates the existence of long drought periods over the past 500 years. This much longer-term analysis places an "average" flow well below 15 MAF and perhaps as low as 13 MAF. The evidence suggests the occurrence of a severe drought lasting multiple decades during the 1100s. See David M. Meko et al., "Medieval Drought in the Upper Colorado River Basin," *Geophysical Research Letters* 34, no. 10 (May 24, 2007): L10705.

2. Robert W. Adler, *Restoring Colorado River Ecosystems: A Troubled Sense of Immensity* (Washington, DC: Island, 2007), 27.

3. Western Water Assessment, Colorado River Streamflow, 2009, <http://treeflow.info/lees/index.html> (accessed December 30, 2012).

4. US Geological Survey, Climatic Fluctuations, Drought, and Flow in the Colorado River Basin, August 2004, <http://pubs.usgs.gov/fs/2004/3062/> (accessed March 17, 2011).

5. Ibid. A more recent assessment using tree-ring data is Jeff Lukas (Western Water Assessment), Connie Woodhouse (University of Arizona), and Henry Adams (University of Arizona), Colorado River Streamflow, a Paleo Perspective, 2009, <http://treeflow.info/lees/gage.html> (accessed January 24, 2012). See also National Research Council of the National Academies, *Colorado River Basin Water Management: Evaluating and Adjusting to Hydroclimate Variability* (Washington, DC: National Academies Press, 2007).

6. NASA press release, Study Shows Desert Cuts Colorado River Flow, September 10, 2010, <http://www.nasa.gov/topics/earth/features/colorado20100920.html> (accessed March 17, 2011).

7. For information about the region's indigenous history, see Stephen Plog, *Ancient Peoples of the American Southwest* (New York: Thames and Hudson, 1997); Emil W. Haury, *The Hohokam, Desert Farmers and Craftsmen: Excavations at Snaketown, 1964–1965* (Tucson: University of Arizona Press, 1976). The best recent work is Craig Childs, *House of Rain: Tracking a Vanished Civilization across the American Southwest* (New York: Little, Brown, 2007).

8. For translated versions of Ulloa's journey, see Henry Raup Wagner, *California Voyages, 1539–1541: Translation of Original Documents* (San Francisco: J. Howell, 1925). See also Joyce Moss, *Spanish and Portuguese Literatures and Their Times* (Detroit: Gale Group, 2002).

9. Jack D. Forbes, "Melchior Díaz and the Discovery of Alta California," *Pacific Historical Review* 27, no. 4 (November 1958): 352.

10. An excellent study of the Spanish period is Michael C. Meyer, *Water in the Hispanic Southwest: A Social and Legal History, 1550–1850* (Tucson: University of Arizona Press, 1984).

11. See Richard W. Etulain, *Western Lives: A Biographical History of the American West* (Albuquerque: University of New Mexico Press, 2004); Robert Utley, *A Life Wild and Perilous: Mountain Men and the Paths to the Pacific* (New York: Henry Holt, 1997).

12. Richard Allen Chase, *The Pioneers of '47: Migration along the Mormon Trail* (Logan, UT: Watkins, 1997); Elliot West, *The Contested Plains: Indians, Goldseekers, and the Rush to Colorado* (Lawrence: University Press of Kansas, 1998).

13. Richard Griswold del Castillo, *The Treaty of Guadalupe-Hidalgo: A Legacy of Conflict* (Norman: University of Oklahoma Press, 1990). See also Treaty with Mexico, 1848, <http://www.mexica.net/guadhida.php> (accessed August 6, 2010).

14. For an excellent source on riparian water rights and the transition in the West to prior appropriation, see chapter 3 in Norris Hundley Jr., *The Great Thirst: Californians and Water—a History* (Berkeley: University of California Press, 2001 [1992]). See also Donald J. Pisani, *Water, Land, and Law in the West: The Limits of Public Policy, 1850–1920* (Lawrence: University Press of Kansas, 1996).

15. See Arthur Jay Sementelli, "Naming Water: Understanding How Nomenclature Influences Rights and Policy Choices," *Public Works Management and Policy* 13, no. 1 (July 2008): 4–11.

16. John C. Dernbach, *Stumbling toward Sustainability* (Washington, DC: Environmental Law Institute, 2002), 201.

17. John Wesley Powell, Eliot Porter, and Don D. Fowler, *Down the Colorado: Diary of the First Trip through the Grand Canyon, 1869* (New York: E. P. Dutton, 1969). See also Wallace Stegner, *Beyond the Hundredth Meridian: John Wesley Powell and the Second Opening of the*

West (Boston: Houghton Mifflin, 1954); Edward Dolnick, *Down the Great Unknown: John Wesley Powell's 1869 Journey of Discovery and Tragedy through the Grand Canyon* (New York: HarperCollins, 2001).

18. John Wesley Powell, *Report on the Lands of the Arid Region of the United States* (Boston: Harvard Common Press, 1983 [1878]), 6.

19. *Ibid.*, 3. See also Donald Worster, *A River Running West: The Life of John Wesley Powell* (New York: Oxford University Press, 2000).

20. Powell, *Report on the Lands of the Arid Region*, 13.

21. Lisi Krall, "US Land Policy and the Commodification of Arid Land (1862–1920)," *Association for Evolutionary Economics* 35, no. 3 (September 2001): 662.

22. *Ibid.*

23. For an excellent recent work on the California Gold Rush, see Leonard L. Richards, *The California Gold Rush and the Coming of the Civil War* (New York: Alfred A. Knopf, 2007). For studies of the transcontinental railroad, see Stephen Ambrose, *Nothing Like It in the World: The Men Who Built the Transcontinental Railroad, 1863–1869* (New York: Simon and Schuster, 2000); David Haward Bain, *The Old Iron Road: An Epic of Rails, Roads, and the Urge to Go West* (New York: Viking, 2004).

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27. United States Congress, "An Act to Provide for the Sale of Desert Lands in Certain States and Territories," *United States Statutes at Large* 19, ch. 107 (Washington, DC: Government Printing Office, 1877), 377.

28. Donald J. Pisani, *Water and American Government: The Reclamation Bureau, National Water Policy, and the West, 1902–1935* (Berkeley: University of California Press, 2002), xiv.

29. James R. Kluger, *Turning on Water with a Shovel: The Career of Elwood Mead* (Albuquerque: University of New Mexico Press, 1992).

30. Donald J. Pisani, *To Reclaim a Divided West: Water, Law, and Public Policy, 1848–1902* (Albuquerque: University of New Mexico Press, 1992), 273–98.

31. Barbara Ann Metcalf, "Oliver M. Wozencraft in California, 1849–1887," MA thesis, University of Southern California, Los Angeles, 1963. See also the reproduction of Blake's

report in William Phipps Blake and Harry Thomas Cory, *The Imperial Valley and the Salton Sink* (Charleston, SC: Nabu, 2010).

32. A miner's inch was the amount of water that could flow through a 1-inch-square hole in a miner's sluice at a set pressure level. In general, this amount is close to a flow of 1.5 cubic feet per minute, but the measurement varied by state. See "Convert Miner's Inches to Other Values," February 24, 2012, <http://www.western-water.com/water-calculators/convert-miners-inches-to-other-values>.

33. William Oral Hendricks, "Guillermo Andrade and Land Development of the Mexican Colorado River Delta, 1874–1905," PhD diss., University of Southern California, Los Angeles, 1967. Other sources on Andrade and the development of Baja California are David Piñera Ramírez, *Los Orígenes de las Poblaciones de Baja California: Factores Externos, Nacionales y Locales* (Mexicali, Baja California México: Universidad Autónoma de Baja California, 2006); Marco Antonio Samaniego López, coordinador, *Breve Historia de Baja California* (Mexicali, Baja California México: Universidad Autónoma de Baja California, 2006).

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35. Worster, *Rivers of Empire*, 196.

36. Laffin, *Salton Sea*, 21. See also Reisner, *Cadillac Desert*, 122–23.

37. Joseph E. Stevens, *Hoover Dam: An American Adventure* (Norman: University of Oklahoma Press, 1988), 13–15.

38. Kennan, *Salton Sea*, 32–63.

39. Worster, *Rivers of Empire*, 197.

40. For a recent study on eutrophication and its impact on water resources, see Abid A. Ansari et al., eds., *Eutrophication: Causes, Consequences and Control* (New York: Springer, 2011).

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42. See Donald Worster, *Under Western Skies: Nature and History in the American West* (New York: Oxford University Press, 1992).

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47. Frederick H. Newell, "What May Be Accomplished by Reclamation," *Annals of the American Academy of Political and Social Science* 33, no. 3 (May 1909): 174–79.

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