From Raindrop to Field: Irrigation History in Idaho, 1860-1970, and Beyond

A Historic Irrigation Context for Idaho

Laura Woodworth-Ney and Sarah E. Robey

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Figure 1A - 115811 Irrigation (near Richfield), Idaho State Archives

Figure 1B - "50 potatoes grown on Chas. Hogenson ranch, near Burley, Idaho. Fair average of his crop, weighing 87.5 lbs. and 4 measuring 38' in length." University of Idaho Archival Idaho Photo Collection, Source: NARA College Park, Still Photo Branch, RG 115: JO-Minidoka Project, Box 90.

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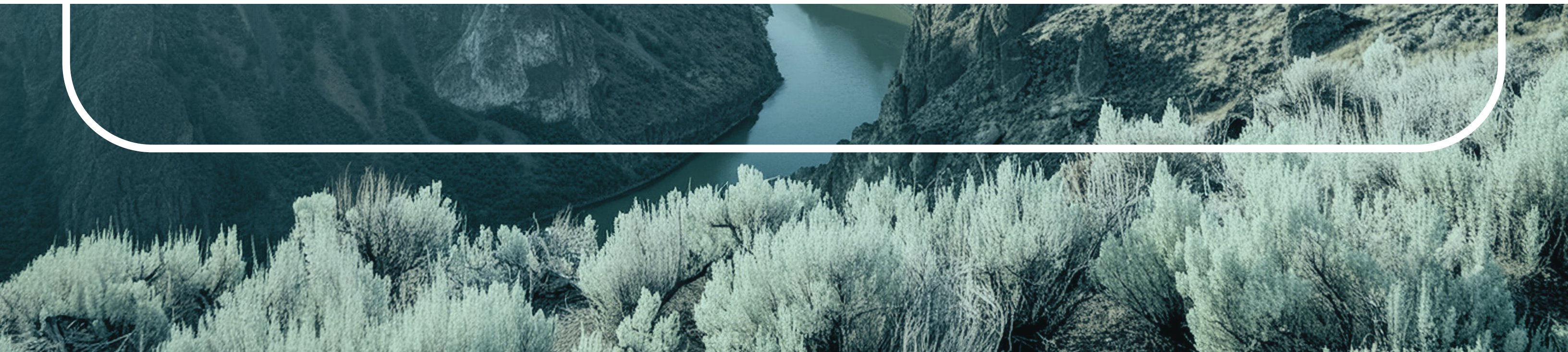

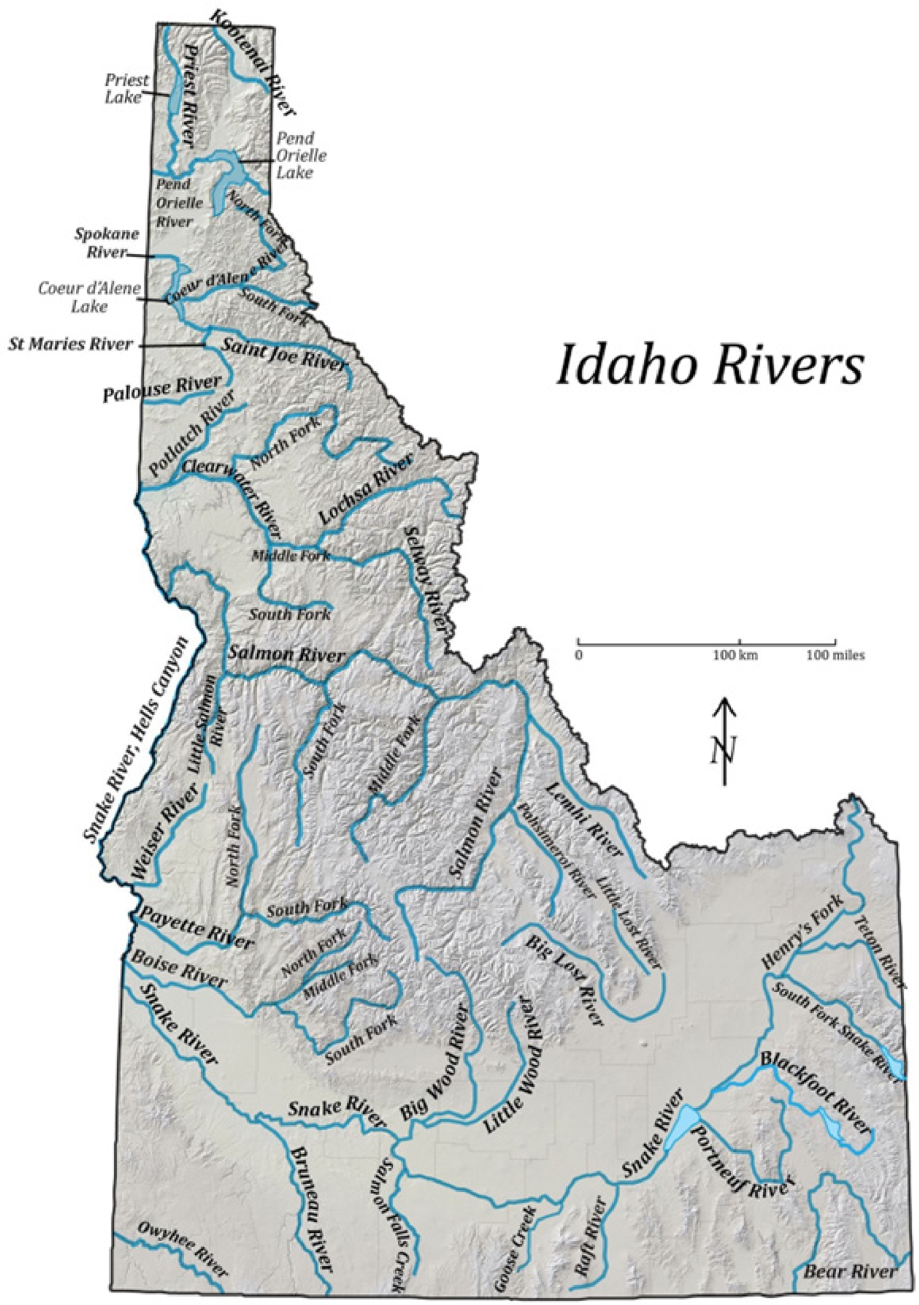

Figure 2 - Idaho Rivers. Map courtesy of Idaho State University Department of Geosciences.

Narrative History

The lines are clearly defined. It is scarcely 10 steps from barrenness to fertility--from desert to Eden. This striking contrast is explainable in one word: irrigation; the intelligent application of water to arid land.
--*Los Angeles Herald,* December 17, 1893 [1]

Ghost towns and dust bowls, like motels, are western inventions... Western cities are likely to have an artificial look, and why not, since so many of them are planted in an artificial environment maintained by increasingly elaborate engineering.
--Wallace Stegner, *Where the Bluebird Sings to the Lemonade Springs*, 1992 [2]

Introduction

The purpose of this context study is to provide an historical overview of irrigation history in Idaho and to provide a basic framework for identifying, preserving, and managing Idaho's significant irrigation sites. Idaho's irrigation history represents one of the most important stories of water use in the United States, and today southern Idaho remains one of the most heavily irrigated places in North America. As of 2021, Idaho ranked second in the nation, after only California, in total water withdrawn for irrigation purposes. The United States Geological Survey estimates that Idaho diverts or pumps "about 17 million acre-feet of water per year" for irrigation, approximately 97% of which is used for agricultural irrigation or water needs. [3] As the majority of Idaho's agriculture occurs on the deserts of the Snake River Plain, significant irrigation is needed to support the state's crops. Much of the Snake River Plain receives less than ten inches of precipitation per year. [4]

Idaho leads the nation in the production of potatoes, producing about 30 percent of all United States potatoes; ranks second nationally in the cultivation of sugarbeets and hay; supplies more than 25 percent of the nation's yellow onions; leads the nation in dry-pea and lentil production; and is a top producer of seed (especially hybrid temperate sweet-corn seed), beans, fruit, mint and greenhouse plants. Idaho leads the nation in several livestock categories as well, out-producing all states in the aquaculture of trout and supplying 70 percent of the nation's commercial trout production. Idaho ranks third among all states in the production of cheese and the state's annual milk production yields over $2.2 billion in value, making dairy the state's number one agricultural industry. Idaho farmers raise more beef cows than there are people in Idaho and more than 210,000 sheep and lambs, cementing Idaho as a top national producer of both beef and lamb. [5] All of these agricultural commodities rely on irrigation, either in the form of direct water or in the production of feed. With global warming and drought changing the climate and challenging traditional agriculture, understanding Idaho's irrigation history has never been more important.

[1] "Arid Lands and Their Use," Los Angeles Herald 41, no. 57, December 17, 1893.
[2] Wallace Stegner, Where the Bluebird Sings to the Lemonade Springs: Living and Writing in the West (1992) Reprint Edition New York: The Modern Library, 2002), xxii.
[3] Sean Ellis, "Idaho Ranks Number 2 in Total Irrigation Withdrawals," Idaho Farm Bureau Foundation, https://www.idahofb.org/news-room/posts/idaho-ranks-no-2-in-total-irrigation-withdrawals.
[4] "Climate of Idaho," Western Regional Climate Center, https://wrcc.dri.edu/Climate/narrative_id.php.
[5] Idaho State Department of Agriculture, "Idaho Crops," "Idaho Livestock," https://agri.idaho.gov/main/idaho-livestock.

Idaho's irrigation history falls into the following distinct timeframes:

- Development of Irrigated Settlement in Southern Idaho, 1860-1902
- Irrigation in the New Century and the Reclamation Service, 1902-1923
- The Bureau of Reclamation, Depression, and War, 1924-1945
- Technological Advancement and Farm Development, 1945-1970
- Modern Changes and Future Challenges, 1970s-Present

Irrigation also brings with it unique historical and cultural developments. Some of these trends seem counterintuitive. Southern Idaho is an arid desert, yet it has the second highest unintentional drowning rate in the nation for the one- to five-year-old age group due to its enormous network of irrigation canals.[6] Idaho's extensive reservoirs have created a booming tourism and recreational industry based on boating, fishing, and other water sports. These reservoirs provide habitat for wildlife, such as the Minidoka Wildlife Refuge located near the Minidoka Dam, and form the basis for some of Idaho's state parks, including Lake Walcott State Park on the Minidoka Project, Lucky Peak State Park on the Boise Project (Between Lucky Peak Dam and the Boise Diversion Dam), and Lake Cascade State Park behind Cascade Dam. [7]

In addition to covering distinct and overlapping time periods, irrigation history touches on a number of significant historical themes, including United States territorial expansion; agricultural development; colonization; population migration; Indian policy (including reservations, Dawes Severalty Act, education); town building; emigrant trails; stage routes; railroad development; irrigation technology; dams; tourism; corporate farming; sugar beet factory development; climate change/drought; and water policy. Because the history of irrigation includes so many diverse touchpoints, the narrative presented here will be both linear and thematic. We will follow a rough chronology while pointing out the areas of overlap and cross referencing throughout the text. Some movements happened simultaneously, such as railroad building and the earliest irrigation projects, but will be treated separately within the text.

Irrigation projects in Idaho did not develop in an orderly, linear fashion. Most of Idaho's early projects began as private enterprises that relied on investment capital from out of state for completion. Early irrigators often referred to these investors as "silk hatters" or "Eastern investors," even if the investors themselves were not actually from the Eastern United States. If they succeeded, or at least survived long enough, these early efforts were often absorbed by subsequent state and federal projects.[8] Idaho's federal projects contain the remnants, for example, of the previous private ditches and irrigation works that they absorbed. The names of projects may have stayed the same as these evolutions occurred, leading to confusion even during the period of transition.

Moreover, many investment firms and organizations might be tied to a single irrigation project. A dizzying array of overlapping water-users associations, irrigation districts, and private irrigation companies could be, and were, affiliated with a single project or even a single canal. Over time, irrigation organizations have been defined and structured in Idaho Code and through other official means, but during the historical period these definitions had not been fully prescribed. Today, "irrigation district" refers to an organization "created pursuant to local elections authorized by a county commission upon petition of land owners," while private irrigation companies are "canal companies, mutual ditch companies (or 'ditch companies'), and reservoir companies…[that] are privately-formed, non-profit, [and] fee-collecting" with the purpose of delivering water for irrigation. [9]

[6] Nampa and Meridian Irrigation District, http://www.nmid.org/safety_canalSafetyLaunch.html.

[7] Lucky Peak Dam is owned and operated by the Army Corps of Engineers, but the Boise River Diversion Dam is operated by the Bureau of Reclamation.

[8] An example is Boise's New York Canal, a private entity that was ultimately absorbed by the Boise Project. See later section on Arthur and Mary Hallock Foote.

[9] Idaho Department of Water Resources, "Irrigation Organizations," https://idwr.idaho.gov/water-rights/irrigation-organizations/. For Idaho statutes related to irrigation districts and canals, see Idaho Statutes, "Title 43: Irrigation Districts," https://legislature.idaho.gov/statutesrules/idstat/Title43/. See also Idaho Department of Water Resources, Idaho Statutes Pertaining to Canals and Laterals (Boise, Idaho: Idaho Department of Water Resources, Water Distribution Section, 2018).

Irrigation enterprises also routinely absorbed canals and merged with neighboring projects. As a result of these variations, Idaho's irrigation past presents a patchwork of swirling projects, water-users' groups, irrigation companies and water districts that collectively built a vast network of water-distribution systems. Today's irrigation projects have inherited this complex lineage. The Idaho Department of Water Resources tracks water organizations throughout the state of Idaho, and as of September 2022 it listed nearly four hundred active entities. [10] [11]

Water Rights: Riparian and Prior Appropriation

The right to utilize water sources such as streams or rivers evolved in the United States during the colonial period and was based on English law. Known as the "riparian system," this English-based doctrine emphasized the "idea that those who owned land along a stream also owned a right to the use of the water in that stream." The riparian doctrine served to support the interests of the landed gentry in England and was transferred to North America. The right was not one of ownership, but one of use, and the accompanying doctrine of "natural flow" dictated that landowners and rights holders downstream held the same right to the flow of water, so that the water flow could not be diverted or permanently altered by the upstream user. [12]

United States expansion into the Arid West challenged riparian rights. The scarcity of water in arid climates created a new doctrine of water use known as "appropriation," in which water is theoretically "best put to use in places where it can be of the greatest benefit, which may not be along the courses of waterways." Colorado instituted the first statewide prior appropriation water rights system, which was built upon territorial supreme court decisions in its 1876 state constitution. [13] The Colorado Doctrine influenced water rights throughout the Arid West. In addition to supplanting the tradition of riparian rights, the doctrine also gave preference to agricultural uses of water over industrial or recreational uses. The Colorado Doctrine would ultimately be used to serve large-scale irrigation projects in the states that adopted it, including Idaho, Nevada, Utah, Montana, Wyoming, New Mexico, and Arizona.

Principles of an Irrigation System [Figures 3-6]

Irrigation systems include the following basic components [14]:

- Water Supply Source: Water source for the system, such as a river, reservoir, or aquifer (groundwater). Dams are often used to divert water and create a supply source.
- Main Intake or Pumping System: Directs water from the supply source into the conveyance system. Gravity systems rely on natural topography, while pumping systems use powered pumps to deliver water across topographical features or from a ground source.
- Conveyance System: Network that takes the water from the supply source and delivers it to the irrigation destination (up to the fields but not onto the fields). Southern Idaho conveyance systems have historically been made up of main canals and lateral canals (secondary canals leading away from the main canal). Pioneer projects often used the river or water tributary as the conveyance system, turning the river itself into part of the irrigation network.
- Distribution System: Ensures the transport of water from the conveyance system onto the fields/crops. In Idaho this process involves secondary canals and ditches as well as pumping systems that feed modern sprinkler systems.

[10] Idaho Department of Water Resources, "Active Irrigation Organizations," https://idwr.idaho.gov/water-rights/irrigation-organizations/active/.
[11] While our study alludes to the complexities of water management and to individual irrigation organizations, it does not present a detailed analysis of the water associations and districts related to any single project.
[12] Steven L. Danver, "Riparian Rights," in Steven L. Danver and John R. Burch, Jr., eds., The Encyclopedia of Water Politics and Policy in the United States (Los Angeles: Sage/CQ Press, 2011), 163-164.
[13] Steven L. Danver, "Colorado Doctrine of Water Rights, in Danver and Burch, The Encyclopedia of Water Politics and Policy, 234-235.
[14] For a detailed description of these components, see C. Brouwer, A. Goffeau, and M. Heibloem, Irrigation Water Management: Training Manual No. 1: Introduction to Irrigation (Rome, Italy: Food and Agriculture Organization of the United Nations, 1985).

Figure 3 - Boise Diversion Dam, Boise Project, Boise, July 2017, Laura Woodworth-Ney, Photographer. Shows the dam and part of the main intake system diverting water into the New York Canal (in the background), which is part of the system's conveyance system.

- Field Application System: Originally involved the opening of gates to flood fields, but has evolved to include sophisticated sprinklers, pivots, and drip systems.
- Drainage System: Network of ditches or other drainage mechanisms that manage excess water from rainfall, snowmelt, or irrigation.

Irrigation-system components vary based on the era of the project, the topography of the region, and the type of water source. Modern projects in Idaho often include components from multiple eras, such as historical waterworks, lava-stone-lined canals, and historical gates; updated equipment, including pumping stations; and a mix of contemporary and dated field conveyance systems, including wheel lines and modern pivot systems. Today's irrigation projects, particularly in areas settled under the terms of the Carey Act or Reclamation Act, frequently encompass an entire history of irrigation from canals constructed during the late 1800s to new pumping sections to updated drainage and conveyance systems. Each irrigation project and area in Idaho represents multiple time periods and technologies.

Figure 4 - Main Canal from Lake Walcott, part of the Minidoka Project's conveyance system, September 2021, Laura Woodworth-Ney, Photographer. Portions of the Main Canal are lined with lava rock dating from the Civilian Conservation Corps era of the 1930s.

Figure 5 - Wheel-line sprinkler system with a modern pivot sprinkler in the background, both examples of field-conveyance systems on the Minidoka Project, summer 2021, Laura Woodworth-Ney, Photographer.

Figure 6 - Irrigated fields on the North Side Twin Falls Project, near Hazelton, Idaho, with a pivot distribution system in the foreground, Summer 2021, Laura Woodworth-Ney, Photographer.

Figure 7 - Panoramic view of the Shoshone Falls on the Snake River and the terrain of Southern Idaho taken by Clarence E. Bisbee, Twin Falls 1913. Bisbee, C. E., Copyright Claimant, Shoshone Falls, cirkut no. 6., Idaho, Twin Falls County, https://www.loc.gov/item/2007662263, accessed December 30, 2022.

Development of Irrigated Settlement in Southern Idaho, 1860-1902

Idaho's irrigation history represents a localized example of a vast United States federal effort to fully incorporate and connect the American West to the rest of the country at the end of the nineteenth century. The American Civil War (1861-1865) interrupted a process of United States expansion, colonization, and territorial acquisition that began in the decades prior to the Civil War and continued after it ended. America's victory in the Mexican-American War in 1848 transferred a massive Mexican territory that became the American Southwest. The negotiation of the Oregon Treaty in 1846 resulted in United States title to the Oregon Country, which included all of the present-day Pacific Northwest, including what became the state of Idaho. New territories drove new questions that framed American policy. The question of how to occupy and settle the recently acquired arid American West was second only to the question of slavery and the expansion of slavery. Following the end of the Civil War and the elimination of slavery in the United States with the ratification of the Thirteenth Amendment, the most pressing federal challenge became the occupation and development of what was then known as "The Great American Desert" [Figure 8].

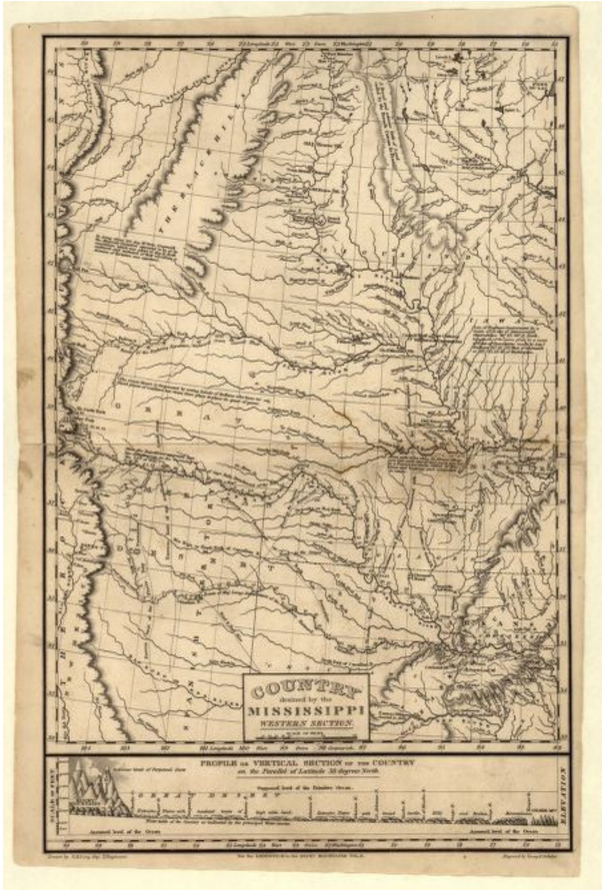

Figure 8 - "Country Drained by the Mississippi," as mapped by Steven H. Long in 1823, showing the "Great American Desert" of the West. Philadelphia: Young & Delleker.

Most nineteenth-century maps identified the arid western lands between the midwestern United States and the Pacific Coast as "desert." In his classic 1966 work, *The Great American Desert*, historian W. Eugene Hollon defined the desert West as approximating "an area of 900,000 square miles, or approximately 30 per cent [sic] of the conterminous United States," bounded by the high plains on the east and the Sierra Nevada mountains on the west, and encompassing the states of Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, and Nevada, and portions of Texas, Kansas, Nebraska, South Dakota, North Dakota, Washington, Oregon, and California. [15] Since Hollon's writing, irrigation has transformed portions of this desert but has not changed the fundamental reality of aridity, made more pressing by climate change. [16] Perhaps no one has more starkly defined the American West's relationship with water than Marc Reisner in his 1986 work *Cadillac Desert*, where he summed up a century of irrigation as a "heroic [effort] and many billions of dollars" to turn a "Missouri-size section green—and that conversion has been wrought mainly with nonrenewable groundwater." [17]

[15] W. Eugene Hollon, The Great American Desert: Then and Now (New York: Oxford University Press, 1966), 2, 9, 12.
[16] A flurry of works detailing the American West's water crisis and the fragility of irrigation have appeared since 1985, including Marc Reisner, Cadillac Desert: The American West and its Disappearing Water (New York: Viking Penguin, 1986); James Lawrence Powell, Dead Pool: Lake Powell, Global Warming, and the Future of Water in the West (Berkeley: University of California Press, 2008); and David Owen, Where the Water Goes: Life and Death Along the Colorado River (New York: Riverhead Books, 2017).
[17] Reisner, Cadillac Desert, 5.

For many nineteenth-century lawmakers and American thought-leaders, United States expansion required settling the Great American Desert, however it was defined, with white American families. The Homestead Act of 1862 embodied the principle of development based on family settlement as an offset to land speculation and plantation slavery. While emergent mining towns spotted the area between the West Coast and the Great Plains, these communities were perceived as fickle settlement agents, booming and busting at random and often exhibiting a lack of gender diversity. Great Plains homesteaders—known as "sodbusters" because they built their homes out of the only building material available on the treeless plains, the earth itself—pushed the population of the Great Plains states to six million by 1890. These areas, however, received more annual rainfall than the deserts between the Rocky Mountains and the coastal mountain ranges (although incessant drought combined with the plow would turn the plains into the Dust Bowl by the 1930s, called by historian Donald Worster "the darkest moment in the twentieth-century life of the southern plains"). [18] Unlike the dry farming of the Great Plains, which could rely only on precipitation, family settlement in the arid Interior West required irrigated agriculture, which in turn required water. Irrigation would drive American family settlement and expansion of the arid West, including present-day Idaho. Transportation networks and irrigation projects arrived in the western United States before extensive settlement and were necessary precursors to settlement in southern Idaho.

Many non-Indian pioneers initially dismissed the interior West, home to powerful Native American tribes and considered unsuited to agriculture, as a pass-through region fraught with dangers. Oregon Trail and California Trail guidebooks highlighted and spread this perspective, while Oregon Trail travelers contributed by commenting in their diaries and letters that they were anxious to pass through the arid reaches of what is now southern Idaho. As late as the 1870s the writer Carrie Adele Strahorn, who accompanied her railroad-developer husband on overland routes throughout the Interior West, commented that "in all the thousands of miles of stage travel which our pioneering covered, there was none more uncomfortable and disagreeable than through the desert lands and lava beds of southern Idaho, which was still marked on the school maps as unexplored country." [19] American policymakers, however, viewed the lack of American settlement in the interior West as adetriment to the stability of the United States. Without a strong American foothold, the region could be subject to foreign intervention—a significant United States foreign policy concern throughout the nineteenth century. As the historian Ken S. Coates has written, "In the mid-nineteenth century the United States was quite belligerent about its boundaries—established or desired." [20]

Elected officials as well as white settlers perceived the American West's Native American tribal nations as a barrier to United States settlement. The rhetoric of white settlement on the Oregon and California trails further hardened anti-Native sentiment among whites throughout the United States. Exaggerated and fabricated tales of Indian attacks on the trails and upon fledging pioneer settlements emphasized to many white Americans the need to address, by force, the "Indian Problem." [21] The United States shifted its federal army—by the end of the Civil War a massive entity—to the subjugation of the West's Indian tribes during the decades between 1870 and 1900. Confrontations between the United States Army and tribal peoples ultimately resulted in the subjugation of the Native American tribes of the Plains and the arid West and the creation of Indian reservations, including Fort Hall and the Nez Perce, Duck Valley, and Coeur d'Alene reservations. The violence of American military policy opened the door to white settlement in southern Idaho and elsewhere. Viewed as one of the largest incidents of genocide in American history, a Union army under the direction of Colonel Patrick Edward O'Connor attacked a sleeping and peaceful Shoshone encampment near the Bear River in Idaho Territory in 1863, brutally killing upwards of 400 people, including at least 90 women and children. The event demonstrated the intention of the United States federal government to clear the way for white expansion and settlement regardless of the bloody, inhumane cost. The memorialization of the massacre further illustrated white goals.

[18] Donald Worster, Dust Bowl: The Southern Plains of the 1930s (New York: Oxford University Press, 1979, 2004), 4, 84.
[19] Carrie Adell Strahorn, Fifteen Thousand Miles by Stage: Volume I, 1877-1880 (Lincoln: University of Nebraska Press, 1988), 174-175.
[20] Ken S. Coates, "Border Crossings: Pattern and Processes along the Canada-United States Boundary West of the Rockies," in Parallel Destinies: Canadian-American Relations West of the Rockies (Seattle: University of Washington Press, 2002), 14.
[21] Robert Hays, Editorializing "The Indian Problem": The New York Times on Native Americans, 1860-1900 (Carbondale: Southern Illinois University Press: 1997), 1.

The original 1972 Idaho Department of Transportation historical marker at the site referred to a two-sided "battle," and the site was repeatedly desecrated by non-Indian activity. In 1990 the National Park Service renamed the location the "Bear River Massacre Site," giving it historical landmark status, and the Idaho Transportation Department marker was changed to denote a "massacre." More than 150 years after the massacre, the Northwestern Band of the Shoshone Nation acquired a portion of the land in 2018 and placed a new memorial at the site. [22]

As federal policy and the war against tribal peoples cleared the way for white settlement in the arid West, other factors created additional motivation. Some trail travelers to Oregon and California opted to stop prior to arriving at Pacific destinations and began founding small communities. The Church of Jesus Christ of Latter-Day Saints pioneer exodus to the Great Salt Lake region created a large and growing settlement in present-day Utah that migrated northward to Idaho and southward to Arizona. Mormon pioneers from Utah established Idaho's earliest irrigated settlement areas, first in 1854 in the Salmon River Valley (Lemhi County) and later in 1860 in Franklin, near the Utah border. Most early Idaho histories identify Franklin (Franklin County) as Idaho's "first permanent settlement." [23] The Bear River Massacre took place very close to Franklin, where settlers had complained about tribal peoples in the region.

Irrigation efforts in Idaho's Franklin County mirrored those used by Church of Jesus Christ of Latter-Day Saints pioneers in the Salt Lake region [24] and relied on local initiative and water sources. The volume of irrigation made possible by individuals and small communities limited the scope of early agricultural communities and led to concerns about non-resident (generally "Eastern") investors and speculation. As more settlers attempted to establish themselves in places like Franklin, Idaho, the cry for federal aid for irrigation and transportation exploded. Expansionists supported the creation of a transcontinental railroad that would link American settlements in California and Oregon to the rest of the nation, and irrigation proponents began a campaign to lobby for irrigation projects and water delivery investment.

The Oregon Short Line Railroad, Boosterism, and Settlement

As the nation's largest western landowners, the transcontinental railroads had a vested interest in expanding western settlement along their rail routes, which supported railroad profits in two ways: through the sale of land and, more importantly, through the establishment of towns and points of interest to draw rail travelers. The first transcontinental railroad passed south of Idaho, tracks from the east and west joining at Promontory Point, Utah. By the 1880s the Union Pacific Railroad began construction of a "short line" route from Granger, Wyoming, to Huntington, Oregon. The proposed route cut across the Snake River Plain north of the Snake River (now an area that encompasses the Magic Valley), as shown in a circa 1880 Oregon Pacific Railroad Company proposed route map. No large settlements existed on the proposed southern Idaho route; the only sizable city appearing on the map is Boise City, which the Short Line ultimately left out of the route in favor of Kuna, Idaho. Shoshone, Kimama, Minidoka, and the now-lost communities of Owinza and Omam appear on the route map, but only as small dots in a sea of desert. These fledgling outposts did not possess even minor non-Indian settlement populations. [25]

[22] "Bear River Massacre," The Historical Marker Database, https://www.hmdb.org/m.asp?m=165800, accessed December 30, 2022; Kalama Hines, "Small Town Spotlight: Bear River Massacre Interpretive Center in Works for Site Near Preston," East Idaho News, Idaho Falls; Susannah Hopson, "The Bear River Massacre: Multiple Memories and Cultural Contradictions," U.S. Studies Online, https://usso.uk/the-bear-river-massacre-multiple-memories-and-cultural-contradictions/.

[23] Hiram Taylor French, History of Idaho: A Narrative Account of Its Historical Progress, Its People and Its Principal Interests (Chicago: Lewis Publishing Company, 1914), 365.

[24] The Wasatch Front adjoining the Great Salt Lake was settled by pioneers affiliated with the Church of Jesus Christ of Latter-day Saints, also known as the Mormon Church (the Church discourages the use of this term but it is prevalent in the historical record), beginning in 1847 with a migration under the leadership of Brigham Young. These pioneers created the first non-Indian water conveyance systems in Utah. See Carol Cornwall Madsen, Journey to Zion: Voices from the Mormon Trail (Salt Lake City, Utah: Deseret Book, 1997). For information about the official name of the church, see the Church of Jesus Christ of Latter-day Saints' style guide.

[25] Oregon Pacific Railroad Company, "Map, showing lines under construction and proposed routes and connections," 1880?, Oregon Historical Society Library, G4241.P3 1880 .O73.

Oregon Short Line (OSL) organizers understood that they would need to directly advocate for additional pioneering along their route. Completed in 1884, the new line transformed eastern and southern Idaho by attracting town site development and supporting irrigation to drive settlement (and thus ridership and commerce). The railroad established Pocatello, Idaho, as a major transit hub for the Interior West and solidified the "Gate City" as the center of late nineteenth-century commerce for southern Idaho. Founded by the Oregon Short Line as "Pocatello Junction" in 1881, Pocatello began as a terminal site for the OSL and soon outgrew its original forty-acre grounds. Years of trespassing on the Shoshone Bannock Reservation by railroad workers and commercial interests who spilled over from the original railroad reserve onto tribal lands forced the negotiation of a treaty in 1887 in which additional tribal lands were ceded for the Pocatello townsite. By 1892 OSL travelers stopping off in Pocatello found a main terminal; "round house" [Figure 9]; shop facilities; coal station; United Pacific Hotel with barber shop, laundry facilities, and dining room; hardware store; general store; "Chinese laundry"; milliner; and a public school (eventually Pocatello High School) under construction. [26]

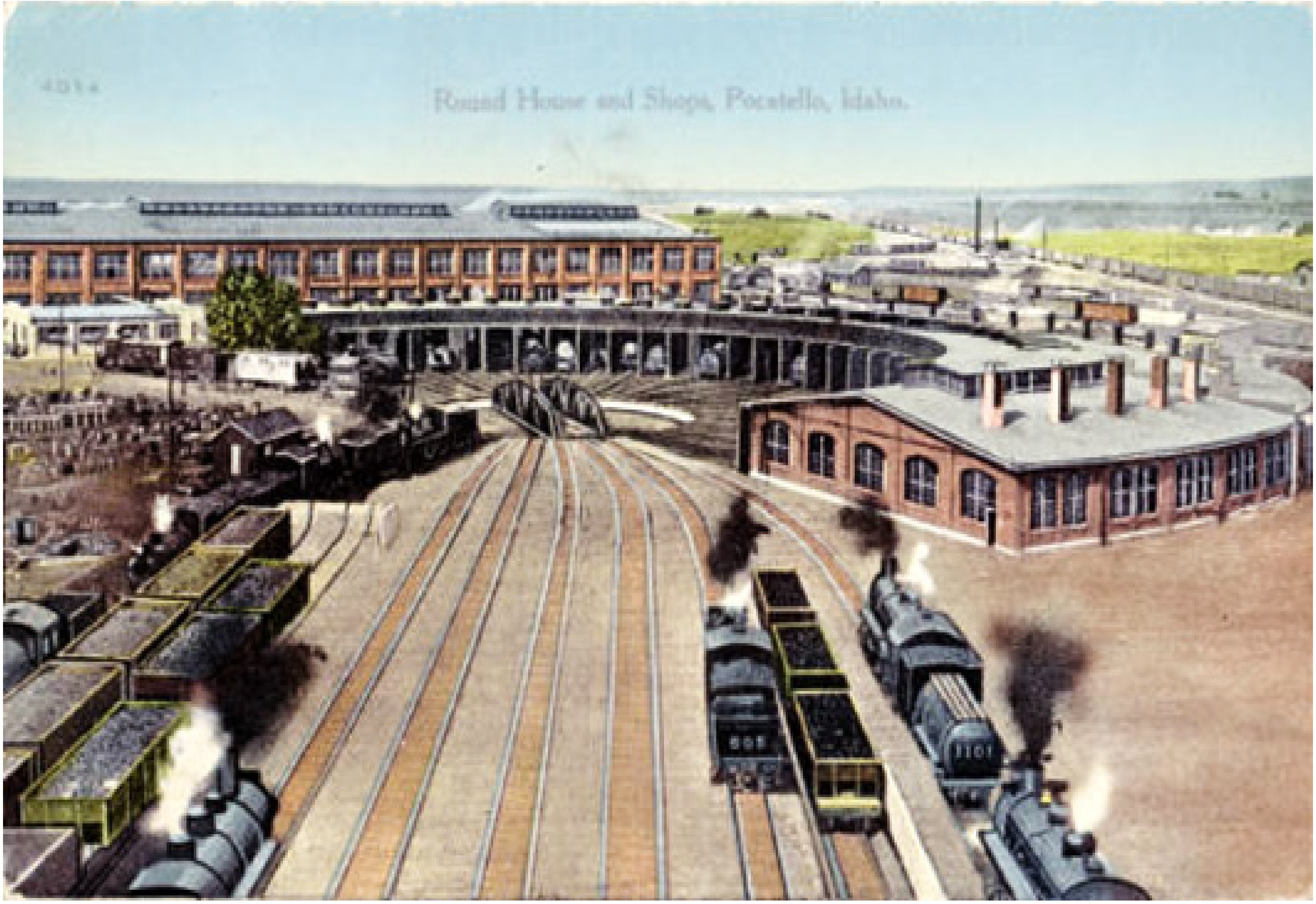

Figure 9 - Postcard, "Round House and Shops, Pocatello, Idaho," 1910-1930?,
Denver Public Library Special Collections, Z-5403.

[26] *Sanborn Map Company, "Sanborn Fire Insurance Map from Pocatello, Bannock County, Idaho," September 1892. Retrieved from the Library of Congress.*

Other communities grew up along the Short Line and created the foundational structure of irrigated settlement in southern Idaho. Early Short Line stops included American Falls, Shoshone, Gooding, and Glenns Ferry. An additional spur completed in 1884 from Shoshone north to Hailey and Ketchum linked the Wood River Valley to the main thoroughfare. The railroad's decisions about routes and depots determined the fate of southern Idaho's communities during this era.

The advance effort for the development of the lands along the Oregon Short Line's route fell to Robert Strahorn, whom the Union Pacific Railroad hired during the 1870s as a publicist. Strahorn and his wife traveled thousands of miles by coach throughout the American West as Strahorn undertook his duties, experiences that Carrie Adell Strahorn wrote about in a two-volume set, *Fifteen Thousand Miles by Stage*. In 1890 Robert Strahorn's assignment was the "colonization" and development of the lands through the OSL's route. He and other Union Pacific officials formed the Idaho-Oregon Land Improvement Company for the purpose of establishing towns, attracting settlements, and building irrigation works. For nearly a decade the Strahorns worked to build communities along the Short Line and were instrumental in founding Ontario, Oregon, and Hailey, Caldwell, Shoshone, Mountain Home, Weiser, and Payette in Idaho.

The tiny hamlet of Weiser received a bump of population and development when the OSL chose it over Salubria for a depot. The Oregon Short Line's booster publication about Weiser— one of many created during the OSL pioneer period to attract settlement to rail communities— characteristically featured a classical goddess wrapped in a banner of fruits and vegetables and framed by a blue-sky pastoral scene. "It can truthfully be said," the Weiser pamphlet declared in reference to the abundance of water available for agriculture, "that the resources of this district in this respect are admirable and can never be exhausted." [27] The OSL further asserted that the soils of the district, "similar" to the "soil under the ditches of Sicily and the Nile River in Egypt," would persist in the same manner for "thousands of years." [28] The Weiser publication's style and outlandish proclamations echoed through similar booster pamphlets for American Falls, Richfield [Figure 10], Buhl, and other towns situated near or on the Short Line's route. It was to publications like these that Annie Pike Greenwood, a homesteader near Hazleton during the 1910s, referred to when she wrote that while "the last thing in the world I wanted to do was to go on a farm," her husband "brought home a certain magazine published for city farmers, who love to make fortunes on the imaginary acres in their heads." [29]

The Oregon Short Line permanently altered Idaho's landscape and determined the demographic and cultural development of southern Idaho. The location of rail lines and depot stops preordained where settlement would boom and where resources would be expended to support agriculture and irrigation. When the State of Idaho was created on July 3, 1890, the majority of its population lived in eastern or southern Idaho along the Short Line Railroad. Nine of Idaho's ten largest communities in the 1890 census were in southeastern or southern Idaho: Rexburg, Pocatello, Boise, Eagle Rock (Idaho Falls), Preston, Franklin, Dayton, Montpelier, and Blackfoot. Prior to the arrival of the OSL, Idaho's population was declining as mining communities waxed and waned; the 1870 census recognized 14,999 residents of Idaho, a decline from previous census records. By 1890, the census counted 88,584 Idahoans. Geographers Paul Karl Link and E. Chilton Phoenix have argued that the coming of rail service to southern Idaho "was the vital factor in the growth of Idaho." [30]

[27] Oregon Short Line Railroad, "Weiser, Idaho," 1910?, 5.
[28] Oregon Short Line Railroad, "Weiser, Idaho," 4.
[29] Annie Pike Greenwood, We Sagebrush Folks (New York: D Appleton-Century 1934; reissued, Moscow: University of Idaho Press 1985), N.p.
[30] Paul Karl Link and E. Chilton Phoenix, Rocks, Rails and Trails (Pocatello: Idaho State University Press, 1994), 63.

The Homestead and Desert Land Acts, 1862-1877

Even as non-Indian settlement expanded and the Oregon Short Line connected Idaho to the rest of the nation, aridity and irrigation remained the most taxing challenge to pioneers, developers, and investors. A series of land laws between 1860 and 1905 supported and enabled homesteading and the migration of certain types of Americans— primarily white pioneer families— to the arid West. During the Civil War, the Union Congress of 1862 passed the nation's first homesteading law, the Homestead Act of 1862, to support the western migration of non-slaveholding populations and to create a future of small family farms in the West in opposition to large plantations supported by slave labor. The Homestead Act granted 160 acres of land to citizens— including women who were the heads of household— who filed a claim, established residency, and "improved" the acreage. The Act allowed married women to inherit the claim if their husbands passed away during the "proving up" period of five years, thus supporting the expansion of land rights for married women. Some scholars have argued that women's land ownership under the terms of the Homestead Act helped fuel the expansion of women's suffrage in the western states prior to the ratification of the 19th Amendment that, in 1920, granted women citizens the right to vote. [31]

Figure 10 - Oregon Short Line community booster publications featured saturated color covers, ornately framed photographs, exaggerated narratives, promises of endless sun and irrigation water, and classical, toga-clad figures adorned with fruits, vegetables and flowers. Richfield, Idaho Promotional Pamphlet, Idaho Tourism and Travel Collection; MS544; Box 8, Pamphlet 9. Idaho State Archives.

The United States ultimately granted more than 270 million acres of land under the provisions of the Homestead Act, which prompted a swell of migration from the Midwest and eastern United States to the American West. Only 160 acres of dry land, however, proved untenable as a family farm in the arid West. Without irrigation, homesteaders could not raise crops or support a family. Homesteading without water on Southern Idaho's sagebrush plain proved futile at best and dangerous at its worst. Additional legislative efforts aimed at addressing the irrigation issue followed the Homestead Act. Under the terms of the Desert Land Act of 1877, an amendment to the Homestead Act, individuals could claim up to 640 acres through a desert land entry with the provision that the lands be irrigated, or "reclaimed." The stated intention of the Desert Land Act was to encourage settlement of arid and semi-arid lands. By expanding the amount of acreage that could be claimed under the Homestead Act, supporters of the Desert Land law believed that they were, at least in part, addressing the problem of homesteading in the Arid West.

[31] Jonathan Fairchild, "'Planted in the Soil': The Homestead Act, Women Homesteaders, and the 19th Amendment," available through the National Park Service at https://www.nps.gov/articles/planted-in-the-soil.htm.

While it allowed homesteaders access to more land, the Desert Land law created new challenges, as it did not retain the residency requirement of previous homestead laws. The Homestead Act's requirement that those filing claims reside "upon or cultivated the same for the term of five years immediately succeeding the time of filing the affidavit aforesaid" [32] did not appear in the Desert Land Act. The act thus resulted in speculation and land-grabbing for water, grazing, and other non-settlement purposes and came under attack for failing to adequately safeguard its expressed homesteading purpose. [33]

The Great Feeder Canal Company

Church of Jesus Christ of Latter-Day Saints [LDS] pioneers migrating from northern Utah to the Upper Snake River region in what is now southeastern Idaho built one of the state's largest private canal systems, the Great Feeder Canal, during the Desert Land Act era. After construction of the Oregon Short Line Railroad connected Idaho and Utah, Latter-Day Saints communities looked to the Upper Snake River country as a settlement area for a burgeoning church population that needed to acquire additional farming operations. The LDS Church officially sanctioned pioneering in the Upper Snake region in 1882. Thomas E. Ricks, a leading member of the Church, led a company of LDS pioneers into the Rexburg area of southeastern Idaho in 1883. Larger numbers followed; by the early 1890s numerous small settlements dotted the Rexburg and Rigby areas.

An irrigation crisis also appeared during these years: the Snake River's channel shifted, leaving farms without water as the old channel silted over following high runoff in 1894. The region became known as the "Dry Bed" as the river receded to its new channel. The Dry Bed settlers came together for a joint meeting during the fall of 1894 that resulted in the decision to pool all resources, build a headgate upstream, and divert the river's fickle water into the old, now dry channel. This example of pioneer cooperation resulted in the creation of the Great Feeder Canal Company in 1895, so named because all of the region's small canals would feed into the massive new channel. Located near present-day Rigby, the system incorporated many separately constructed canal companies and irrigation systems, including Butler Island, Harrison, Rudy, Lowder Slough, Burgess, Clark and Edwards, Labelle, The Island, Diltz Irrigation Company, Long Island Irrigation Company, Rigby, West Labelle, Parks and Lewisville, North Rigby, Progressive Irrigation District, Farmers Friend, and the Enterprise Canal Company. [34]

The Great Feeder's first canal waters pushed through in 1895. A large throng of settlers gathered to watch the water flow through the headgates for the first time; disaster nearly struck when a cofferdam, built during construction, collapsed and flooded part of the system. No injuries occurred and the system held. More than 125 years after its construction by pioneer settlers using local funds, the Feeder Canal System continues to deliver water for more than twenty major canal systems, divert up to one million acre-feet of water, and supply more than 100,000 acres of farmland. The Idaho Falls Register declared in 1895 that the Great Feeder's headgate was the largest built for irrigation in the United States, and today it remains one of the largest remaining pioneer projects in the American West. [35]

[32] "Transcript of the Homestead Act (1862)," Our Documents Project, United States National Archives and Records Administration.
[33] John T. Ganoe, "The Desert Land Act in Operation, 1877-1891," Agricultural History 11, no. 2 (April 1937), 142-157.
[34] John L. Powell, "Agency History of the Great Feeder Canal Company," Arthur Porter Special Collections, MSS 31, Brigham Young University-Idaho. See also Lee, Eldred, The Great Feeder Canal: A History, United States: n.p., (n.d.).
[35] Gary Wayne Gneiting, "An Economic History and Analysis of the Great Feeder Canal of Southeastern Idaho," master's thesis, Utah State University, 1972; Great Feeder Canal Financials, Cause IQ, https://www.causeiq.com/organizations/great-feeder-canal-company,820123499/#programs.

The Ridenbaugh Canal

The Desert Land Act set the stage for the creation of cooperatives and associations that pooled resources to create irrigation works for new and incorporated districts throughout southern Idaho. These cooperatives reflected local interests but relied on their ability to attract outside support and investment. As noted previously, population in Idaho prior to the expansion of irrigated agriculture clustered near mining areas, such as in the Boise Basin, where gold mining activity during the 1860s brought agricultural settlement, and along transportation routes, notably the Oregon Short Line. Irrigation projects during the Desert Land Act era depended on the investment of private capital, and with few banks and commercial businesses in Idaho, early irrigators looked to the East Coast and overseas for private investment. Idaho's early irrigation attempts were thus tied to the vagaries of international finance, market speculation, and the financial panics that seemed to rock the United States about once a decade between 1870 and 1910. [36] Moreover, questions remained about where irrigation water would be sourced. The United States General Land Office surveyed water sources in the Boise Valley during the 1860s and 1870s, finding that only three tributary creeks existed south of the Boise Rive— Five Mile, Ten Mile, and Indian— and that these did not provide a consistent flow of water since they ran seasonally dry. The main source of agricultural water for the Boise Valley, the final survey of 1875 demonstrated, would be the Boise River itself. [37]

Figure 11 - [Ridenbaugh Canal Bridge on Vista Avenue, Boise, June 22, 1947.] United States Bureau of Public Roads, MS281_06832, Box 11, Folder 22, Idaho State Archives.

Only a few years after the General Land Office surveys were completed, William B. Morris, one of the Boise area's first irrigation entrepreneurs, began construction of the Ridenbaugh Canal [Figure 11]. The Ridenbaugh project illustrates the hazards and complications that beset these early irrigation efforts. By 1878, the year of his death, Morris had constructed a seven-mile trench, which by modern irrigation standards is only a small ditch, that watered 1,200 acres south of the Boise River. Morris's widow and nephew attempted to continue the project, but by the early 1880s capital had dried up and the project passed to new owners in 1883. Between 1883 and 1900 no fewer than eight different investment companies attempted to expand and complete the Ridenbaugh Canal system. By the early 1890s, more than fifteen years after its inception, local newspapers reported that canal construction had nearly reached Nampa, Idaho, and possessed a water capacity "at its headgate of 66,000 inches." [38] The Ridenbaugh Canal became part of the Nampa and Meridian Irrigation District in 1904. Today, the 48.5-mile canal continues to provide water to users in Canyon and Ada counties. Boise neighborhoods and thoroughfares adjoining the Ridenbaugh Canal include Federal Way, Vista Avenue, Rose Hill, Crescent Rim Drive, and the southernmost tip of Capitol Boulevard. [39]

[36] The period between the Civil War and about 1900 was characterized by growing disparity between rich and poor and the rise of large corporations and financial "moguls." The United States endured significant financial panics in 1857, 1873, 1893 and 1907. For more on the U.S. economy during these decades see H.W. Brands, American Colossus: The Triumph of Capitalism, 1865-1900 (New York: Anchor Books, 2010).
[37] Jennifer A. Stevens, "Water in the Boise Valley: A History of the Nampa and Meridian Irrigation District," Stevens Historical Research Associates, https://www.shraboise.com/docs/Water-in-the-Boise-Valley-NMID.pdf.
[38] Stevens, "Water in the Boise Valley: A History of the Nampa and Meridian Irrigation District," 20.
[39] Nampa and Meridian Irrigation District, http://www.nmid.org/about_information.html; Idaho Transportation Department, Division of Highways, "Draft Combination Environmental/Section 4(f) Statement for Vista Avenue Ridenbaugh Canal - U.S. 30 Connection," November 1974, https://babel.hathitrust.org/cgi/pt?id=ien.35556030128151&view=1up&seq=7&skin=2021; Nate Green, "Lifeblood of the Treasure Valley," Idaho Press, Nampa, April 1, 2012.

Arthur DeWint and Mary Hallock Foote

During the early 1880s Arthur DeWint Foote, a civil and mining engineer with another early vision of irrigation in Idaho, proposed a diversion dam and canal to serve a greater portion of the Boise Valley than the Ridenbaugh Canal. Foote's "scheme" was the largest project envisioned for southern Idaho up to that point. The 1880 census found slightly more than 1,800 farms with 327,708 acres under cultivation, and only 32,610 people, making Arthur Foote's project a vanguard for irrigation projects that would, for the next three decades, build upon the promise of *future* settlement. [40] Foote purchased water rights on the Boise River and envisioned a vast irrigation project that would transform Boise's arid plains by using 60 miles of canal to water more than 500,000 acres. Mary Hallock Foote, a well-known illustrator and writer (who went by "Molly"), joined her husband in the Boise Valley, and Arthur and his crew built a striking house of lava rock in the Boise Canyon, near what is today the outlet for Lucky Peak Dam. Completed in 1885 with a large wrap-around porch and three chimneys, the home served as a key landmark until the early twentieth century. Nothing of it remains today, except a few of the rocks, but the Foote Park Interpretive Center maintains an interactive historical site at the home's former location. The Footes moved closer to Boise City during the 1890s to a site that is now part of the Hillcrest Country Club. [41]

Molly's writing and illustrations, which included multiple serialized novels appearing in *The Century Magazine*, a key literary publication of the Gilded Age (c. 1870s-1900), funded construction of the Footes' Boise canyon home and modest lifestyle while the couple waited for investors to support funding for Arthur Foote's Idaho Mining and Irrigation Company. "Waiting salaries leave no margin for house building," She wrote in her memoir, "but about this time we began to realize that we should need a house if we spent the winter in the Cañon….And also about this time a *Century* cheque blew in for the serial rights of 'John Bodewin's Testimony.'" [42] Molly produced some of her best work during the couple's time in Idaho, despite her ambivalence about the difficulties of Arthur's irrigation "scheme," as she referred to it, and the lack of culture she found in the fledgling town of Boise. Foote's Idaho works include *The Chosen Valley* (1892), *Coeur d'Alene* (1894), and *In Exile and Other Stories* (1894), all of which highlight the tenuous hold of human technology over the western landscape. Her story "The Watchman," from In Exile and Other Stories, focuses on a ditch rider, or "watchman," whose role it was (and still is in some irrigation districts) to oversee a canal's proper water distribution and usage. Foote's words presented water as a character with an unpredictable life of its own:

> The far-Eastern company was counting its Western acres under water contracts. The acres were in first crops, waiting for the water. The water was dallying down its untried channel, searching the new dry earth-banks, seeping, prying, and insinuating sly, minute forces which multiplied and insisted tremendously the moment a rift had been made. And the orders were to "watch" and "puddle;" and the watchmen were as other men, and some of them doubtless remembered they were working for a company. [43]

Molly's portrayal of the complexity of harnessing water reflected the small successes and ultimate failures of Arthur Foote's irrigation system. Irrigation created a strange and transformed landscape, she wrote, "a queer country along the new ditch below the head-gates; as old and sun-bleached and bony as the stony valleys of Arabia Petrea; all but that strip of green that led the eye to where the river wandered, and that warm brown strip of sown land extending field by field below the ditch." [44]

[40] United States Census Bureau, "Decennial Census Official Publications for 1880," https://www.census.gov/programs-surveys/decennial-census/decade/decennial-publications.1880.html.
[41] Foote Park Interpretive Center website, https://footeparkproject.wixsite.com/website; "The Foote Legacy in Idaho," City of Boise Parks, https://web.archive.org/web/20150906190836/http://parks.cityofboise.org/media/975728/Foote-Sign-NEW-small.pdf.
[42] Rodman W. Paul, ed., A Victorian Gentlewoman in the Far West (San Marino, California: Huntington Library, 1972), 292. The Century Magazine published John Bodewin's Testimony in volume 31, beginning with the November 1885 issue.
[43] Mary Hallock Foote, "The Watchman," in In Exile and Other Stories (Project Gutenberg: 2005). Mary Hallock Foote's views of Idaho are covered in A Victorian Gentlewoman, 24-30.
[44] Mary Hallock Foote, "The Watchman" in Exile and Other Stories (Project Gutenberg: 2005).

Arthur Foote's proposed system—was as future systems would prove to be— extremely costly and depended on a constant infusion of external, private funds for sustenance. The project required $1.5 million dollars for its first phase; even the initial surveys and marketing costs tallied up to $4,000 per month. A significant portion of the project envisioned a lengthy ditch, the New York Canal, which Foote proposed would begin in the river canyon ten miles above Boise, run "down the highest part of the divide," and "cover all the land lying between the Boise River and Five-mile Creek, amounting to about thirty thousand acres." [45] After a decade of work only ten miles of canal had been constructed. Foote's irrigation enterprise collapsed when he failed to secure the ongoing capital necessary for construction, a fate that befell hundreds of private irrigation projects during the Desert Land Act-era in Idaho and elsewhere. "A long-term project that was intended for a new and underdeveloped region," Rodman W. Paul wrote in his introduction to the reminiscences of Mary Hallock Foote, "but was dependent upon eastern [United States] or British private funds that tended to dry up every time a tremor ran through the New York or London markets, was bound to be speculative." [46]

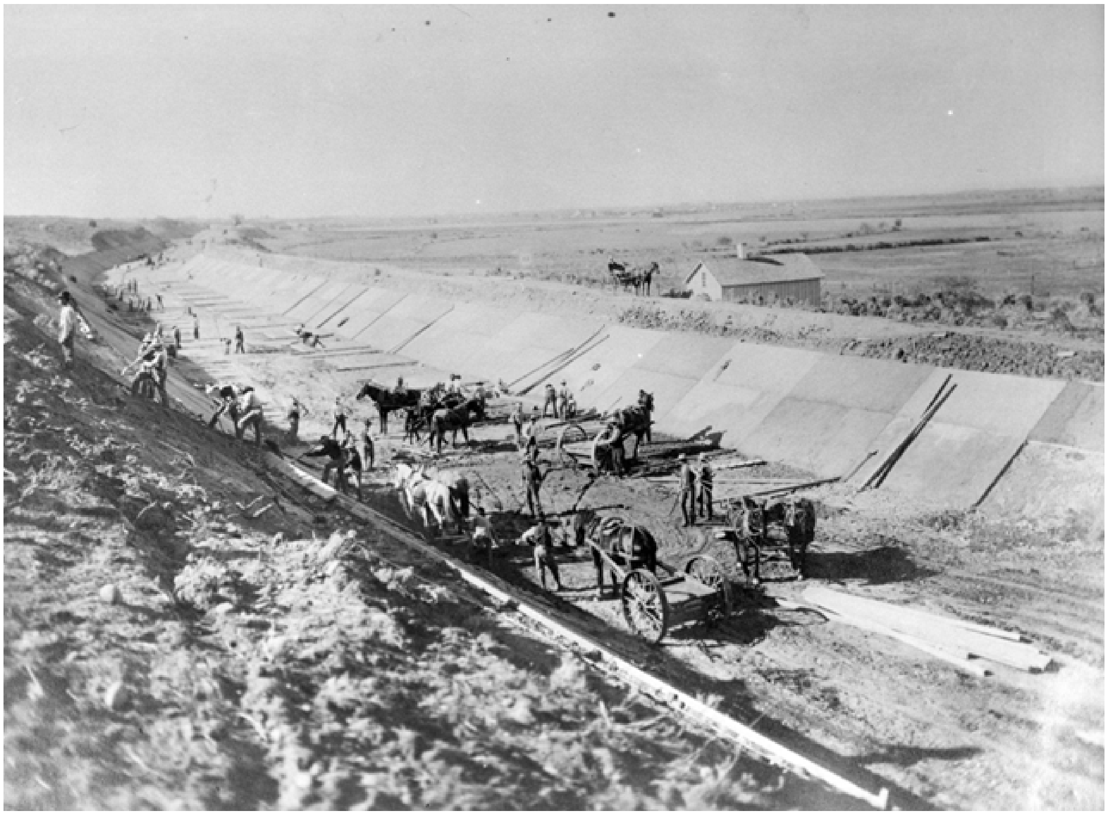
Figure 12 - The New York Canal under construction, circa 1906-1908, P1960-77-1, Idaho State Archives.

The project's demise fell hard upon the Footes. "Signs were not wanting," Molly wrote, "that our little world that had looked on at our years of futile waiting thought that the end of the New York Ditch was near." [47] She continued her writing in order to support the family, while Arthur fell into a depressive state made worse by excessive drinking. By the mid-1890s the couple had moved to Grass Valley, California, where Arthur became the resident superintendent of the North Star Mine—owned by his brother-in-law, James Hague. The couple would go on to build, with Hague's funding, the North Star House, a 10,000 square-foot mansion designed by notable Arts and Crafts architect Julia Morgan. The North Star House reflected elements of the Footes' Boise Canyon home, such as rock features and wide porches. Together, the houses tie the history of Idaho irrigation to the Arts and Crafts Movement, a significant art and architectural period of the early twentieth century that emphasized hand-crafted workmanship and a focus on nature and conservation and found expression in the western United States, particularly California. [48] Today the North Star House is maintained by the North Star Historic Conservancy and is open to the public. [49]

[45] Arthur Foote quoted in Stevens, "Water in the Boise Valley: A History of the Nampa and Meridian Irrigation District," 21.
[46] A Victorian Gentlewoman, 22; National Park Service, "Idaho: Boise River Diversion Powerplant," Discover our Shared Heritage Travel Itinerary Series, https://www.nps.gov/articles/idaho-boise-river-diversion-powerplant.htm.
[47] A Victorian Gentlewoman, 306.
[48] For more on the conservation and Arts and Crafts movements of the early twentieth century, see Chris Miele, From William Morris: Building Conservation and the Arts and Crafts Cult of Authenticity, 1877-1939 (New Haven: Yale University Press, 2005); and Douglas Brinkley, The Wilderness Warrior: Theodore Roosevelt and the Crusade for America (New York: HarperCollins, 2009).
[49] The North Star Historic Conservancy, https://thenorthstarhouse.org/.

While Arthur Foote's funding failed, his project vision eventually succeeded in bringing water and settlement to Idaho's capital city. His plans, as published in an 1887 report entitled "Report on the Irrigating and Reclaiming of Certain Desert Lands in Idaho and Other Projects Connected Therewith," formed the basis for the Reclamation Service's Arrowrock Dam, Boise River Diversion Dam, and New York Canal [Figure 12], all of which would become key components of the Boise-Payette Reclamation Project, one of the Reclamation Service's earliest projects. In 1905, following the passage of the Reclamation Act, the Reclamation Service purchased the New York Canal and related water rights and began construction of a diversion dam and new headworks for the canal, located about seven miles southeast of Boise.

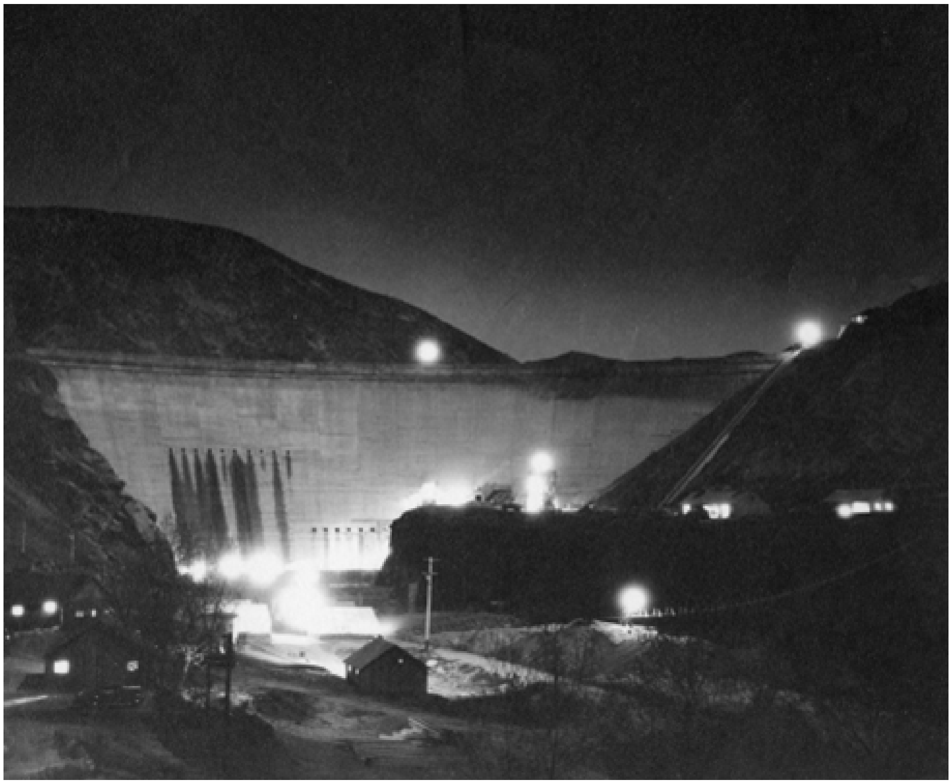

Figure 13 - "Arrowrock Dam at Night," Daniel W. Applegate Papers, MS733, Box 1, Folder 12. Idaho State Archives.

As many as 3,000 spectators attended the opening of the Diversion Dam on February 22, 1909, where they watched the weir-type structure feed the New York Canal for the first time. When the Footes received word of the New York Canal event and of the *Idaho Statesman*'s salute to the original ideas of Arthur Foote, Molly glued the *Statesman* article into her scrapbook. Her husband "was not so old when the greatest of his dreams, the broken work I speak of, came to its accomplishment, with the government behind it," she noted, "but his mind was turned to other lines of work, he was past the time of life when success lifts the heart up or failure casts it down; he had learned to 'treat those two imposters just the same." [50]

Six years after the opening of the New York Canal, the Reclamation Service completed construction of a storage dam, the Arrowrock Dam [Figure 13], located 22 miles upstream from Boise. At the time of its completion in 1915, the Arrowrock Dam was the highest concrete dam in the world, "measuring 350.5 feet high from bedrock," and is one of only two Reclamation dams constructed largely of sand cement. Its arch-gravity design, considered experimental at the time, represented a foundational technology that was perfected and utilized for larger, future dams. [51] Today the Arrowrock Dam possesses a storage capacity of over 272,000 acre feet and anchors the Arrowrock Division of the Boise Project. The Boise Project delivers "full irrigation" to approximately 225,000 acres in the Treasure Valley and in eastern Oregon. [52]

[50] *A Victorian Gentlewoman, 376.*

[51] *An arch-gravity dam utilizes components from both gravity and arched dams. The Bureau of Reclamation defines an Arch Dam "as a concrete or masonry dam which is curved upstream in plan so as to transmit the major part of the water load to the abutments and to keep the dam in compression. A solid concrete dam curved upstream in plan. An arch dam is most likely used in a narrow site with steep walls of sound rock." U.S. Bureau of Reclamation, Glossary, https://web.archive.org/web/20071225164200/http://www.usbr.gov/library/glossary/#archdam;National Park Service, "Arrowrock Dam, Residence," Historic American Engineering Record No. ID-27-D, Library of Congress, http://lcweb2.loc.gov/master/pnp/habshaer/id/id0500/id0510/data/id0510data.pdf; Bureau of Reclamation, Design Criteria for Arch and Gravity Dams, Engineering Monograph No. 19 (Washington, DC: Government Printing Office, 1977), iii-iv.*

[52] *Bureau of Reclamation Projects and Facilities, "Boise Project," https://www.usbr.gov/projects/index.php?id=530.*

Also part of the Boise Project, the Boise Diversion Dam [Figure 14] still feeds the New York Canal, which runs for 41 miles until it reaches Lake Lowell, a small reservoir also built by the Reclamation Service during the early twentieth century, and weaves through the South Boise neighborhoods along Boise River Lane, East Boise Avenue, East Gloucester Street, South Minutemen Way, East Saratoga Drive, East Lake Rim Lane, West Sunrise Rim Road, West Hillcrest Lane (near where the Footes made their Boise home), West Gowen Road, the Indian Lakes Golf Club, West Thunder Mountain Drive, and South Cole Road. From South Cole, the canal heads west/southwest until it reaches the City of Kuna and Indian Creek. It follows Indian Creek from Kuna and then branches east to cross East Greenhurst Road and Southside Boulevard, eventually draining into the Burke Lateral Canal and Lake Lowell, now part of the Deer Flat National Wildlife Refuge. [53]

Figure 14 - Boise River Diversion Dam showing flow into New York Canal, July 2017, Laura Woodworth-Ney, Photographer.

[53] *Idaho Fish and Game, "Idaho Fishing Planner: New York Canal, Boise River Drainage," https://idfg.idaho.gov/ifwis/fishingplanner/water/1167423435779. The United States Fish and Wildlife Service maintains Deer Flat National Wildlife Refuge, which includes Lake Lowell and is part of the National Wildlife Refuge System; see https://www.fws.gov/refuge/Deer_Flat.*

Irrigation Boosterism

As the failures and difficulties of private irrigation systems became clear, national and local organizations formed to lobby for direct federal and state support of irrigation projects. These organizations joined local newspapers, business clubs, and the railroads to promote what they called the New West, "where agricultural riches were yet to be extracted and where man could still create 'gardens' from 'lava dust.'" [54] William Smthye, a journalist who migrated from Massachusetts to Nebraska to become the editor of the *Kearney Expositor* in 1888, became one of the nation's foremost irrigation advocates after enduring drought as a homesteader on the Great Plains and later touring drought devastation in New Mexico and Arizona. Smythe established the National Irrigation Congress in 1890. The Irrigation Congress drew a large membership and national press coverage and disseminated its ideas through its publication, *The Irrigation Age*, which frequently featured stories about Idaho irrigation projects [Figure 15].

Figure 15 - Irrigation Congress members, including a smattering of female delegates, gather for the 1894 Denver meeting. "Irrigation Congress," Hotel Metropole and Broadway Theatre, Denver, Colorado, 1894. Denver Public Library.

Newspapers throughout the United States, including *The New York Times*, covered the Irrigation Congress's meetings and platform positions. In 1891, *The New York Times* reported that the Irrigation Congress had opened its first meeting to 450 delegates in Salt Lake City, where Utah Governor Arthur Lloyd Thomas "welcomed them on behalf of Utah in an extensive speech, in the course of which he referred to the fact that the Mormon settlers in 1847 began the first system of irrigation in the West." [55] On the opposite coast, the *Los Angeles Herald* opined in 1893 that "the platform of the irrigation congress, which is in the form of an address to the United States, reads like an emanation from men who fully realize the importance of the subject they are dealing with." The "great problem of conquering the arid regions," continued the *Herald*, "should no longer be left to individual effort and local enterprise." [56] *The Pacific Rural Press* covered the 1894 Congress meeting in Denver, where delegates heard reports from seventeen state-level irrigation commissions and proposed "a national policy and code of local laws to be submitted to the Federal Congress and the Legislatures of the Western States." [57]

[54] *Hugh T. Lovin, Complexity in a Ditch: Bringing Water to the Idaho Desert (Pullman: Washington State University Press, 2017), 53.*
[55] *"The Irrigation Congress," The New York Times, September 16, 1891, 3.*
[56] *"Arid Lands and Their Use," Los Angeles Herald 41, no. 57, December 17, 1893.*
[57] *"The Irrigation Congress at Denver," Pacific Rural Press 48, no. 5, August 4, 1894.*

In 1899 William Smythe published *The Conquest of Arid America*, a treatise on the social and economic benefits of irrigation. With irrigation, Symthe argued, the arid West could be the "better half of America" and its settlement would protect the United States against the "overgrown cities and over-crowded industries" of the eastern states. One of Smythe's adherents, George Hebard Maxwell, played a significant role in the passage of reclamation legislation. After attending an Irrigation Congress meeting in Phoenix in 1896, Maxwell founded the National Reclamation Association, which became an important lobbying instrument for federal irrigation support. Maxwell would become known as the "father of reclamation." [58]

New Plymouth, Idaho

William Smythe did more than write and talk about the value of irrigation and the settlement of the Arid West. He also founded irrigation communities, including New Plymouth Colony in Idaho. The establishment of New Plymouth [Figure 16] near Payette, Idaho, was one of the more unique irrigation developments in the state of Idaho and the nation. Incorporated in 1895 as a utopian community, New Plymouth was intended by Smyth to be a showplace for the promotion of the irrigated West as the ideal place for democratic, family-based settlement and "a high social and industrial ideal." Smythe located New Plymouth in the Payette Valley because of the proximity of the Payette River and rail transport. The community was platted in a horseshoe shape with its open end facing the railroad and the Payette River, an innovative design that the community exhibits even today. According to its founder, "the pioneers of New Plymouth...represented a rather unusual quality of settlers [and] were drawn principally from urban and professional life," by which Smythe meant that they were white and middle-class. [59]

Figure 16 - Aerial view of New Plymouth demonstrating its horseshoe shape, the only town with this configuration in the United States. "Aerial View of New Plymouth, Idaho," United States Geological Survey, April 23, 2008.

The original town plat consisted of 325 acres patented to the New Plymouth Farm Colony under the Desert Land Act of 1877. New Plymouth colonists purchased stock in the community at $30 per share; twenty shares entitled a settler to twenty acres of irrigated land and a village lot for a home. The community became a village in 1908 and a city in 1948. Early settlers cleared sagebrush, built houses, and initially planted fruit orchards, including peach, plum, and pear trees. The McBride pioneer family founded a fruit-packing enterprise in New Plymouth, which shipped its first carload of pears by rail in 1902. [60]

[58] *William E. Smythe, The Conquest of Arid America (New York and London: Harper and Brothers Publishers, 1900), 19-20.*
[59] *Smythe, The Conquest of Arid America, 181.*
[60] *Ron Marlow, "Pioneers of New Plymouth," The Independent-Enterprise Newspaper, Payette, Idaho, June 20, 2001.*

The Carey Act of 1894

Lobbyists and western legislative interests succeeded in passing a new, state-focused land law in 1894, the Carey Act. Sponsored by Joseph Maull Carey, United States Senator from the arid state of Wyoming, the law was first introduced in 1892 but was not passed until 1894. It "permitted states to acquire from the public domain up to 1 million acres of undeveloped arid land within their boundaries" under the directive that the land be made productive, or reclaimed, through the development of irrigation projects. [61] The law's intention was to shift some of the difficulties of homesteading from individuals to states and thus expand irrigation projects through the power of state government. The responsibilities of partnering with private enterprise for investment, recruiting settlers to new projects, and managing the construction of irrigation works moved to those states that accepted land grants. The Act also directed that "if actual construction of reclamation works" was "not begun [by states] within three years after the segregation of the lands or within such further period not exceeding three years," then the Secretary of the Interior was authorized to restore such lands to the public domain. [62]

Proponents argued that states were better positioned to handle the complexities and financial demands of western irrigation projects. Nine western states— New Mexico, Arizona, Nevada, Colorado, Montana, Oregon, Utah, Wyoming, and Idaho— accepted land grants under the Carey Act, but only the grants in Idaho and Wyoming reached the million-acre mark, and Idaho and Wyoming also sought supplemental acres. Among states that participated in the Carey Act, Idaho experienced the greatest success, particularly by the measure of continuous, modern irrigation projects— such as those surrounding Twin Falls— that today support significant agriculture and population. While relatively successful, Idaho's Carey Act projects were (and are) not without controversy. Contemporary ranchers and sheep interests complained that the Carey Act would absorb grazing lands and push out the stockgrowers. Even among project settlers there were skeptics, but for the most part new pioneers accepted the rosy portrayals of irrigation advocates, despite southern Idaho's desert terrain, arid climate, and endless sagebrush. Under the Carey Act and two supplemental allocations, "Idaho authorities offered settlers prospective Edens on over three million acres of supposedly reclaimable land." [63] Would-be irrigation land sold for fifty cents per acre, and by 1910 irrigation companies had mapped fifty Idaho projects and proposed an estimated $68,000,000 worth of irrigation works. [64]

Irrigation boosters continued to promote an optimistic future vision for towns in southern Idaho after the passage of the Carey Act. The town of Richfield, for example, came of age in the Carey Act era. Settlement at Richfield began in the 1880s with the arrival of the Oregon Short Line spur north from Shoshone to Ketchum. However, it was the Carey Act-funded construction of the Magic Dam on the Big Wood River, built between 1908 and 1910, that reinvigorated the town's development. The Idaho Irrigation Company, which managed the dam's construction, also built the luxurious Richfield Hotel that opened in 1909 [Figure 17]. Touted as "a really new, modern, first-class hotel, with beauty, comfort, everything that is not in the typical city hostelry," the hotel was designed to attract tourists and investors from across the country as the Idaho Irrigation Company sold off surrounding land parcels. [65]

[61] *Hugh T. Lovin, "The Carey Act in Idaho, 1895-1925," Pacific Northwest Quarterly 78, no. 4 (October 1987), 122.*
[62] *"Grant of Desert Lands to States Authorized," United States Code, Title 43, Chapter 14, § 641.*
[63] *Hugh T. Lovin, "'Duty of Water' in Idaho: A 'New West' Irrigation Controversy," in Complexity in a Ditch: Bringing Water to the Idaho Desert, Adam Sowards, ed. (Pullman: Washington State University Press, 2017), 54.*
[64] *Lovin, "'Duty of Water' in Idaho," 54.*
[65] *"Hotel Almost Ready," Richfield Recorder, 6 May 1909, 1.*

Initially, it was also used to house engineers, construction workers, and their families as the dam was built. The hotel quickly became Richfield's business and social hub in addition to a tourist destination: throughout the 1910s, the hotel hosted countless ladies' club meetings, political rallies, banquets, and luncheons and served as the offices for the town's physician. By the 1930s, the hotel had been converted into part of Richfield High School. For a town of just a few hundred people, it may seem surprising that the irrigation company invested in such an opulent facility. However, given how much boosters stood to gain from the anticipated agricultural boom and local development, the hotel must have seemed well worth the cost. [66]

Figure 17 - "No 5 Hotel Richfield, Idaho" date unknown, City of Richfield, Idaho.

Twin Falls Area Carey Act Projects

Ira Burton Perrine, an immigrant to Idaho from Indiana, saw the fertile potential of the blue lakes of the Snake River Canyon while looking for a location to winter cattle during the fall of 1884. Over the next ten years he established a homestead in the canyon; planted poplar trees; dug a ditch system and a small reservoir; planted peach, apple, plum, and pear trees; built a road up the north side of the canyon, a route still in use today to access Blue Lakes Country Club; and established an ice business to preserve his fruit during transit. In 1892 Hortense A. McKay married Perrine at the home of her parents in Shoshone, Idaho. The couple built a hotel at Blue Lakes, where Hortense Perrine hosted travelers on the daily stage line from Shoshone, Idaho to the Snake River Falls (Shoshone Falls). In 1895 Perrine took on a project with the Oregon Short Line Railroad to survey a bridge site between Lincoln and Cassia counties. His work led him to a spot in the Snake River characterized by a mid-stream rock known as Clappine Rock.

[66] *Alice Crane Behr and Maureen Hancock Ward, The History of Richfield, Idaho: 'The Biggest Little Town in Idaho,' 1995.*

The location was suited to a railroad bridge, but as Perrine later told the *Twin Falls News*, he recognized that it was also ideal for a dam that could provide water for adjacent desert lands, and an irrigation plan was hatched. [67] Perrine gathered investors—including J.H. Lowell, from Parma, Idaho; Stanley B. Milner, a wealthy mining leader from Salt Lake City; and Frank Knox, a banker from Salt Lake City— and filed articles of incorporation for the Twin Falls Land and Water Company (TFLWC) in 1900 under the Carey Act. The company's purpose was to create an irrigation system that would provide water for the south side of the Snake River starting at Milner. Several iterations of the company occured as investors came in and out of the project. Like the Boise River projects of the time period, the massive capital expenditures that would be needed to complete the Milner Dam and irrigation system turned some investors away. Frank Henry Buhl and Walter George Filer, two investors whose names would eventually be echoed in the names of new townsites, joined the project during a reorganization in 1902.

Construction of the Milner Dam [Figures 18 and 19] began in 1903 under the direction of the Faris and Kesl Construction Company of Boise. Plans called for a dam structure formed by earth and rock embankments "thereby forcing the water over two islands of solid lava rock, which will give a free waterway of 815 feet," a power plant, a reservoir, a townsite (Milner), and a South Side Canal of "about sixty-five miles" from "point of diversion to Rock Creek." [68] The contract specified that all canal headgates would be built of solid rock. A reporter for the *Salt Lake Tribune*, C.E. Arney, visited the project during the dam's construction and in 1910 published a detailed account of the construction environment:

> There was a large tent town for the housing of the men, the teams and the provisions for man and beast. Beyond was the large area over which large teams of horses and mules were moving the dirt from surface and pit to the enormous dam, two miles in length, 200 feet in width at the bottom and 40 feet in width at the top. Nothing which I had ever seen so clearly represented a battle as this scene, with the 600 men, hundreds of teams, wagons, rollers, scrapers, and four or five large steam shovels and traction engines drawing ploughs with elevator attachments for carrrying the dirt into the wagons; men lacing the upper face of the dam with solid rubble, others digging ditches and building solid cement core walls in them as an additional precautionary measure in resisting the force of the large body of water which this reservoir must hold. It was, in fact, a battle royal with the dirt, the prime object of which was the conquering of the crude elements of a desert. [69]

On March 1, 1905, Frank Buhl turned a wheel to close the gates of the dam for the first time and diverted the river's flow as a small crowd looked on. Milner Dam raised the Snake River thirty-eight feet in order to allow it to feed the newly constructed canal system, which was not completed until 1909. While the original plans called for one large canal, the South Side, it became clear during the years after Milner's opening that the complex topography of the region necessitated two canals. The South Side Canal became known as the Main Canal and project engineers divided it into two canals, the Low Line and High Line, at the "Forks," located about ten miles west of Murtaugh Lake. The Low Line Canal travels 38.7 miles west through the tract south of Twin Falls and Buhl before emptying into Deep Creek. The High Line Canal follows a meandering line of more than 60 miles west and turns south of Castleford before it drains into Salmon Falls Creek. On the north side of the Snake River, the North Side Main Canal traverses 33.6 miles westward, north of Hazelton and Eden, before joining the P Canal north of Flat Top Butte. [70] The irrigation tracts on either side of the Snake River became known as the North Side and South Side.

[67] J. Howard Moon and Russell M. Tremayne, A History of the Twin Falls Canal Company, 1905-2005 (Twin Falls, ID: Blip Printers, 2005), 17-20.
[68] 32-33.
[69] C.E. Arney, "North Side Twin Falls Project Great for Idaho Development," Salt Lake Tribune, October 4, 1910, University of Utah
[70] For routes of the Twin Falls canals, see Idaho Fish and Game, "Low Line Canal," "High Line Canal," and "North Side Main Canal," Idaho Fishing Planner, https://idfg.idaho.gov/ifwis/fishingplanner/water/1149392425325.

Figure 18 - Front of a photomechanical Print (postcard), "Milner Dam and Milner Falls," circa 1918, showing Milner Dam and Milner Hotel. Laura Woodworth-Ney personal collection.

Figure 19 - Back of a photomechanical Print (postcard), "Milner Dam and Milner Falls," circa 1918, Laura Woodworth-Ney personal collection.

By 1909, enough of the Twin Falls system had been completed that the Idaho Land Board accepted the project and the Twin Falls Canal Company was incorporated. The Twin Falls Land and Water Company transferred the operations of the South Side system to the new canal company, which has been in continuous operation since the transfer. The townsite of Milner, which at its height boasted a population of 1,500 and a multi-story hotel, was eventually abandoned, but the South Side communities of Twin Falls, Murtaugh, Hansen, Kimberly, Filer, Buhl, and Castleford grew up around Milner Dam's irrigation waters. The dam also cultivated the North Side towns of Jerome, Hazelton, Eden, Perrine, Gooding, and the Greenwood District.

Today the Twin Falls North Side and South Side projects are managed, respectively, by the North Side Canal Company and the Twin Falls Canal Company. Based in Jerome, Idaho, the North Side Canal Company serves 160,000 acres with a water diversion of 1,000,000 acre. [71] The Twin Falls Canal Company operates a massive water enterprise, serving nearly 203,000 acres with 110 miles of major canals and 1,000 lateral canals. In 2019 Alan Hansten, the General Manager of the North Side Canal Company, echoed the past when he told the *Irrigation Leader* that his greatest future challenge was maintaining "our concrete structures [that] date back to the original construction of our system in the early 1900's, and some have degraded to the point that they need to be replaced." [72] Today, the Twin Falls Canal Company estimates that it serves 4,000 water users. Its water rights date to Ira Perrine's original 1900 claim of 3,000 cubic feet per second of natural flow and today include storage rights of 151,185 acre-feet in the American Falls Reservoir (completed in 1927 for irrigation storage as part of the Bureau of Reclamation's Minidoka Project) and 97,183 acre-feet in Jackson Lake. Located in Wyoming, Jackson Lake Dam was built in 1907 and replaced in 1911 to augment the natural lake as part of the Minidoka Project prior to the creation of Grand Teton National Park. [73]

Figure 20 - J.R. Field standing in old-growth sagebrush, representative of the southern Idaho landscape, on his farm near Emmett, Idaho (background), circa 1906-1907. The area is served by the Canyon Canal Company. P1970-95-1, J.R. Field Photograph Collection, Idaho State Archives.

[71] A measure used to calculate stored irrigation water. One acre-foot is enough water to cover an acre (about the size of a football field) to a depth of one foot of water, or approximately 326,000 gallons. See "What's An Acre-Foot," Water Education Foundation, https://www.watereducation.org/general-information/whats-acre-foot.
[72] "Interview with Arlan Hansten," Irrigation Leader, December 5, 2019.
[73] A cubic foot per second, or cfs, is an Imperial unit / U.S. customary unit volumetric flow rate, equivalent to a volume of 1 cubic foot flowing every second. For more about the North Side Canal Company, see the group's Facebook page at https://www.facebook.com/NorthSideCanalCompany/; for the South Side Canal Company, see the Company's website at https://twinfallscanal.com/.

SIDEBAR

Irrigation in Northern Idaho/Dalton Gardens Project

This study focuses on irrigation projects in central and southern Idaho, where nearly all of today's irrigation projects reside. However, northern Idaho also possesses a history of irrigation development, though much smaller in scale. [1] Northern Idaho's climate made irrigation less necessary, feasible, and attractive in that part of the state, where natural rainfall makes possible the cultivation of one of the world's most impressive wheat regions, the Palouse, without irrigation. Irrigated agriculture did develop in some of the more arid prairie regions in the late nineteenth century, but agriculture predated any irrigation attempts in northern Idaho, a testament to the significant difference in climate between the northern and southern portions of the state.

According to explorer and fur-trading accounts, members of the Coeur d'Alene Tribe (also known as the Schitsu'umsh) cultivated potatoes along the Coeur d'Alene River, in the region that became known as the Rathdrum Prairie, as early as the 1840s— well before any non-Indian attempts to settle the area. The establishment of a Jesuit Mission among the Coeur d'Alene people by Father Pierre DeSmet during the early 1840s helped contribute to expanded agricultural enterprises by members of the Coeur d'Alene Tribe. By the 1870s many tribal members, including Chief Andrew Seltice, cultivated hundreds of acres and ran some of the most successful farms in northern Idaho. [2]

The discovery of gold on the Clearwater River during the 1860s led to an onslaught of non-Indian migration to northern Idaho and the growth of the supply town of Lewiston. As newcomers arrived to seek gold, some chose to stay and farm, particularly in lush prairies such as those near Grangeville and Rathdrum. The establishment in 1878 of a United States military camp on the northern shores of Lake Coeur d'Alene (later known as Fort Sherman) further encouraged non-Indian settlement in the Coeur d'Alene Lake and River regions, including the Rathdrum Prairie. Moreover, the presence of a military fort spurred local agricultural development by creating a market for the feed needed to support the camp's dozens of horses and mules. [3] Fur traders in the region established the town of Rathdrum in 1861, naming it after a town in Ireland; newcomers to the area engaged in fruit growing, livestock raising, and wheat cultivation.

By the 1890s small-scale projects were advanced to stimulate land sales on the Rathdrum Prairie, but these efforts failed to achieve funding or to influence non-Indian settlement. Fruit-raising and orchard expansion led to the creation of the Hayden-Coeur d'Alene Irrigation Company in 1907.

[1] For an extensive study of irrigation in Northern Idaho, see Karen Trebitz, "Irrigation History in the Rathdrum Prairie and Spokane Valley; thirty years of developing water delivery and fifty years of system rehabilitations," Idaho Department of Water Resources, https://idwr.idaho.gov/wp-content/uploads/sites/2/projects/spokane-valley-rathdrum-prairie/trebitz-irrigation-history-in-the-rathdrum-prairie-and-spokane-valley.pdf.

[2] Laura Woodworth-Ney, Mapping Identity: The Creation of the Coeur d'Alene Indian Reservation, 1805-1902 (Boulder: University of Colorado Press, 2004), 21, 45, 111.

[3] Christopher Gibbons, "Fort Sherman on Lake Coeur d'Alene," Intermountain Histories, https://www.usbr.gov/projects/index.php?id=442; Bureau of Reclamation, "Dalton Gardens Project," Today the only remaining buildings linked to Fort Sherman are part of North Idaho College; see https://www.nic.edu/history/.

The company named its land plat "Dalton Gardens," which it supported with an irrigation system using water from Hayden Lake. In 1916 a reorganization created the Dalton Gardens Irrigation District, which by then "consisted of a pumping plant on Hayden Lake, a discharge line, and a low-pressure pipe distribution system, designed to deliver water at the high point of each tract in order for the water to be applied by gravity." [4]

The Dalton Gardens Project typifies some of the challenges experienced by small, pioneer-based enterprises. The system's main pipeline was constructed of porous concrete that could not hold up to the needs of the system. Failures of the system became so frequent that by the 1950s water users on the project appealed to the Bureau of Reclamation for support to rehabilitate the project. Two other area projects, Avondale and Hayden Lake, also appealed for assistance in modernizing their irrigation works. The three systems submitted a joint request to the Bureau in 1953. Reclamation rehabilitation of these water systems was authorized in 1954, under an Interior Appropriations Act, and again in 1961. [5]

Figure 1 - Rathdrum Prairie as seen from space and showing irrigated agriculture, 2009. Earth Science and Remote Sensing Unit, Lyndon B. Johnson Space Center, JSC Gateway to Astronaut Photography of Earth.

Today the Dalton Gardens project remains under the jurisdiction of the Columbia-Pacific Northwest Region of the Bureau of Reclamation. Located two miles north of the city of Coeur d'Alene, Idaho, and about thirty miles east of Spokane, Washington, the project delivers water to 980 acres of land and possesses a "drainage area of 62 square miles with an estimated average annual inflow of 45,000 acre-feet." [6] This area has seen explosive urbanization and growth throughout the late-twentieth and early twenty-first centuries and reflects the dramatic changes that many of Idaho's pioneer projects have experienced. Most of the irrigated farms in the area are currently managed by part-time owners and are used primarily for pasture, truck vegetables, or hay crops. The old orchards are largely gone, though fragments of some of the historical irrigation works remain. Dalton Gardens is now a small city suburb of Coeur d'Alene with parks, golf courses, approximately 2,800 residents living in suburban neighborhoods, and more than 140 small businesses. [7]

[4] *Tina Marie Bell, "Dalton Gardens Project," Historic Reclamation Project Book (Denver, CO: Bureau of Reclamation), 4.*
[5] *ibid., 7*
[6] *Bureau of Reclamation, "Dalton Gardens Project."*
[7] *2020 U.S. Census, Census Reporter, https://censusreporter.org/profiles/16000US1620350-dalton-gardens-id/.*

Irrigation in the New Century and the Reclamation Service, 1902-1923 [74]

Reclamation (Newlands) Act of 1902

Most proponents of irrigation viewed the Carey Act as a step forward, and the Twin Falls projects became nationally known as examples of Carey Act successes. Many other Carey Act enterprises failed, however, and none of the western states other than Wyoming and Idaho fully utilized their allotments. State-sponsored projects had a better chance of success than the former individual-investor-backed efforts, but Carey Act projects were subject to speculation through invisible investors who had no intention of settling projects and the vagaries of Gilded Age finance. In southern Idaho residents complained of investors, or "silk hatters," who claimed land under the Carey Act long enough to "prove up," but never intended to actually build irrigation works. [75]

Even in Idaho, only two Carey Act projects, Twin Falls South Side and American Falls, were completed as planned. According to irrigation historian Hugh Lovin, Idaho's Carey Act experiment peaked in 1913, although smaller projects continued to be proposed well into the twentieth century. By 1914, the Idaho Land Board had authorized twenty-five projects; the majority of these would not be completed. Some were built but could not sustain long-term operations. The American Falls Canal and Power Company, which managed canals in Blackfoot, operated for eighteen years until competition forced it to declare bankruptcy in 1914.

The Carey Act was only eight years old when the U.S. Congress passed the Reclamation Act, or Newlands Act, in June of 1902. In his 1902 address to Congress, President Theodore Roosevelt outlined the reasons he supported using federal funds to establish large-scale irrigation projects in the Arid West:

> Few subjects of more importance have been taken up by the Congress in recent years than the inauguration of the system of nationally-aided irrigation for the arid regions of the far West.... The sound and steady development of the West depends upon the building up of homes therein. Much of our prosperity as a nation has been due to the operation of the homestead law. On the other hand, we should recognize the fact that in the grazing region the man who corresponds to the homesteader may be unable to settle permanently if only allowed to use the same amount of pasture land that his brother, the homesteader, is allowed to use of arable land. One hundred and sixty acres of fairly rich and well-watered soil, or a much smaller amount of irrigated land, may keep a family in plenty, whereas no one could get a living from one hundred and sixty acres of dry pasture land capable of supporting at the outside only one head of cattle to every ten acres. [76]

[74] This demarcation is due to the change in name of the Reclamation Service to the Bureau of Reclamation in 1923.
[75] American Falls Canal and Power Company Records, 1894-1923, MSS 109, Special Collections and Archives Division, Merrill-Cazier Library, Utah State University; Lovin, "Carey Act in Idaho," 128.
[76] Theodore Roosevelt, State of the Union Address, December 2, 1902, Project Gutenberg EBook #5032, https://www.gutenberg.org/files/5032/5032-h/5032-h.htm#dec1902.

With President Roosevelt's backing, several western legislators and leading irrigation proponents worked on the legislation that placed the federal government's funding and power behind western irrigation projects. Chief authors of the Reclamation bill included Representative Francis Newlands of Nevada (later a Senator from Nevada); George Maxwell, leader of the National Irrigation Association; and Frederick Haynes Newell from the United States Geological Survey (USGS). Named the Newlands Act after Francis Newlands, the legislation "passed Congress with relative ease." [77] The Act authorized the Department of the Interior to identify project locations and construct irrigation works in sixteen western states and territories (later legislation added Texas to the list) in order to advance the settlement of arid lands. In July 1902 Interior Secretary Ethan Allen Hitchcock created the United States Reclamation Service to oversee the federal irrigation projects, locating it within the United States Geological Survey. Charles Walcott, then Director of the USGS, became the first Director of the Reclamation Service while Frederick Newell became its inaugural Chief Engineer.

The Reclamation Act also created the funding mechanism for federally backed irrigation projects through the sale of public lands in the Western states [Figure 21]. The Act set aside funds from public land sales for the "Reclamation Fund" and required settlers on the projects to pay back the cost of irrigation construction within ten years, although the Secretary of the Interior was authorized to determine the amount and repayment schedule. The repayment provision would become a controversial aspect of the Reclamation Act, and repayment timelines were ultimately extended for decades into the twentieth century. An additional Reclamation Act of 1906 (the Town Site Act) expanded the mission of the Reclamation Service by adding the development and sale of hydroelectric power to the bureau's mission, along with the authorization to "withdraw from public entry any lands needed for town-site purposes in connection with irrigation projects...and survey and subdivide the same into town lots, with appropriate reservations for public purposes." [78] The first five projects authorized under the Reclamation Act included the Salt River Project in Arizona; the Uncompahgre Project in Colorado; the North Platte Project in Nebraska and Wyoming; the Milk River Project in Montana; and the Newlands Project in Truckee, Nevada. The Secretary of the Interior authorized twenty-five projects during the first five years of the Reclamation Service, including the Minidoka and Boise projects in Idaho. Reclamation Service projects had three main goals: irrigation for agriculture; the promotion of settlement of the Arid West through irrigation; and eventually power generation through the creation of power plants on irrigation projects.

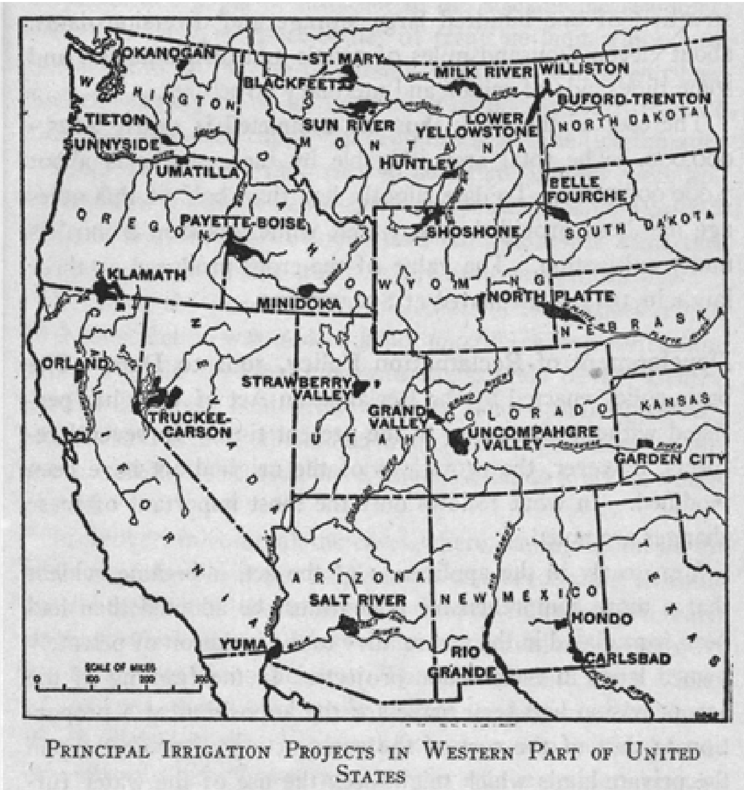

Figure 21 - Map showing Reclamation Projects in place or under construction by 1919, an illustration in the Institute for Government Research's history of the United States Reclamation Service. The United States Reclamation Service: Its History, Activities and Organization (New York: D. Appleton and Company, 1919).

[77] *Toni Rae Linenberger, Dams, Dynamos, and Development: The Bureau of Reclamation's Power Program and Electrification of the West (Washington, D.C.: Government Printing Office, 2002), 21.*
[78] *United States Bureau of Reclamation, "Town Sites and Power Development," April 16, 1906, https://www.usbr.gov/power/legislation/twnsites.pdf.*

The town of Rupert, Idaho, located on the Minidoka Project [Figure 22 and 23], was created under the provisions of the Reclamation and Town Site Acts and even today is representative of all three of the Reclamation Service's goals of irrigation, settlement/town building, and power generation. One of the Minidoka Project's main canals winds through Rupert's downtown core, and the town's layout reflects the values of the community's founders, including its well-watered, tree-lined town square. The Minidoka Project also illustrates the path that the Reclamation Service traveled to ultimately become a major player in power generation. The Reclamation Service built Minidoka Dam—an 86-foot high earthfill structure with a 2,300-foot concrete spillway— in 1906. Minidoka Dam was the Reclamation Service's first embankment dam, and its reservoir, named Lake Walcott after USGS Director Charles Walcott, began to fill in November 1906. Dam workers came to the project from throughout the United States, as well as Greece, Italy, Austria, Ireland, and Spain. The project included a Gravity Division (North Side and South Side), where the natural topography propelled the water through the main and lateral canals constructed during 1905 and 1907, and a South Side Pumping Division, where the Reclamation Service installed three pumping stations to lift the water to 50,000 acres of higher land on the south side of the Snake River. In 1909, the Reclamation Service built the Minidoka Power Plant, one of the first federal power operations, to provide the power needed to run the Pumping Division. [79] The power plant provided more power generation than was needed to run the pumps on the project, enabling the Reclamation Service to sell excess power to local residents for domestic use. The area powered by the Minidoka Plant thus became an unlikely early adopter of electricity. In 1913 Rupert's high school received national recognition when it, using power generated by the Minidoka Project, became the first electrically heated high school in the United States. [80]

Figure 22 - "B Canal" of the Minidoka Gravity Division, Rupert, Idaho, with Mount Harrison in the background, November 2021. Laura Woodworth-Ney personal collection. This canal, along with all of the main and lateral canals on the Minidoka Project and other active irrigation projects, fill with water in April and drain by the end of the irrigation season.

While the dam, canals, and laterals on the Minidoka Project were completed by 1909, some homesteaders had filed claims as early as 1904 and ended up "waiting for water," a condition commonly experienced by settlers throughout the irrigated West. Gravity Division settlers received water as early as 1907, but those living on the Pumping Division waited at least until 1909.

[79] The other early federal power plant, which also came online in 1909, was located on the Salt River Project in Arizona.
[80] "Idaho: Minidoka Dam," Discover our Shared Heritage Travel Itinerary Series, National Park Service; Linenberger, Dams, Dynamos, and Development, 27-28.

Not until 1911 did the Pumping Division deliver water to at least 20,000 acres. While waiting for water homestead families lived in temporary shelters on dry, isolated farm plots, where food was scarce and the southern Idaho winters harsh. Settlers also expressed frustration with the annual project payments required in the Reclamation Act for the repayment of the irrigation project's construction, which were due regardless of whether the water had been delivered, and many simply abandoned their homesites or failed to meet the residency requirement. The Reclamation Service attempted to account for the heavy burden of early settlement by charging lower construction costs to initial settlers and more to those who arrived after "roads, railroads, towns, and schools had been established," leading to significant disparity between settlers. In 1914 passage of the Reclamation Extension Act extended the repayment period from ten to twenty years as government officials recognized that settlers on the projects would not be able to make the payments in a decade's time, often because it took nearly a decade for water to be delivered to some homesteads. By 1919, the annual charges for all Reclamation projects varied from $22 to $93; on the Minidoka Project, charges varied from $22 for early settlers to $57.50 in 1919. Even after the arrival of irrigation water homesteading conditions remained difficult: rabbits, rodents, grasshoppers, and hailstorms destroyed crops; drainage problems throughout the Minidoka Project necessitated the construction of miles of drainage ditches; and brutal, isolating conditions drove some settlers to suicide. More than three-quarters of Minidoka's original settlers had left the project or been replaced by new settlers by 1927. [81]

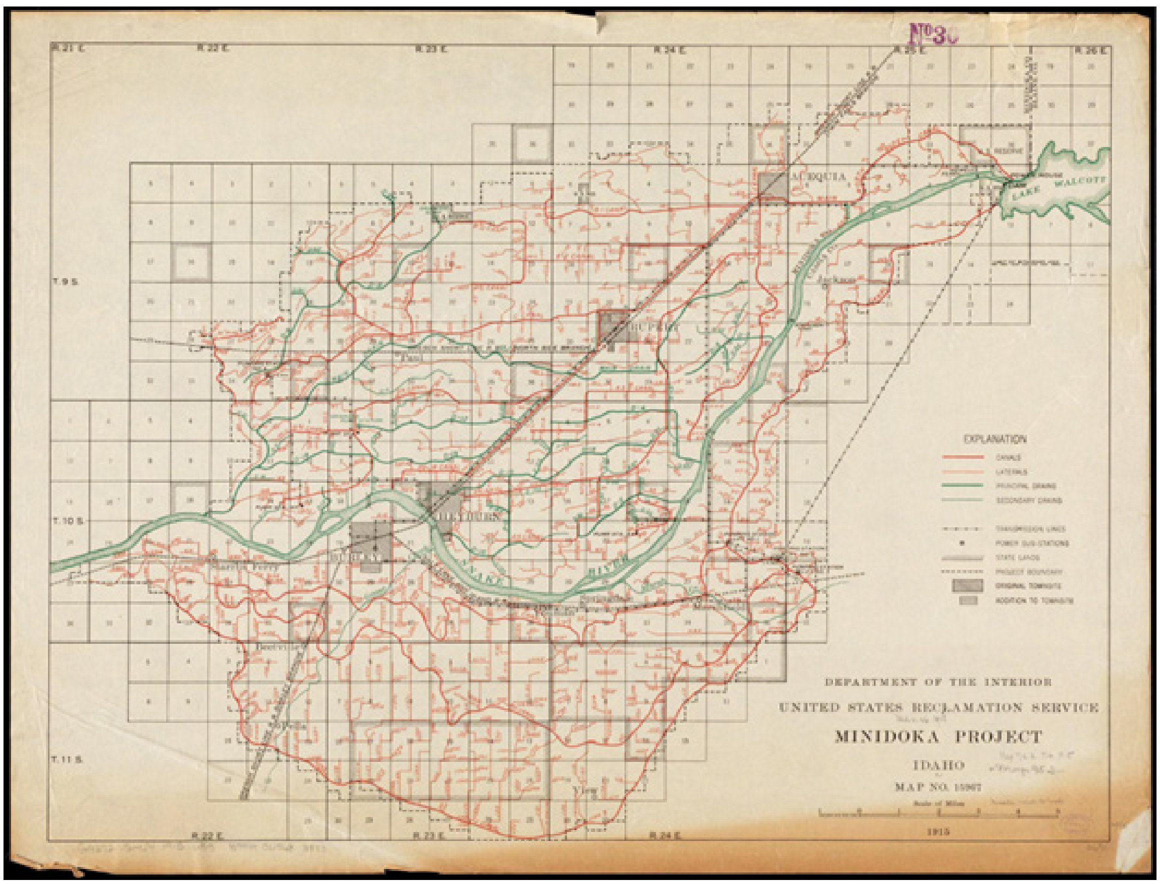

Figure 23 - United States Reclamation Service, "Minidoka Project, Idaho," 1915, Norman B. Leventhal Map Center, Boston Public Library.

[81] Quoted in Institute for Government Research, The U.S. Reclamation Service: Its History, Activities and Organization (New York: D. Appleton and Company, 1919), 60-61; "The Electric Project": The Minidoka Dam and Powerplant (Teaching with Historic Places), National Park Service, https://home.nps.gov/articles/-the-electric-project-the-minidoka-dam-and-powerplant-teaching-with-historic-places.htm.

Despite the dissatisfaction of some settlers, the Minidoka Project soon expanded to include more irrigation works and additional water storage capacity in order to meet the growing needs of remaining and new settlers on the project. Between 1911 and 1916 the Reclamation Service built the Jackson Lake Dam [Figures 24 and 25], a concrete gravity dam with earthen embankment wings, to increase the natural storage of Jackson Lake. The dam was reinforced between 1986 and 1989 for earthquake preparedness. Today, this Wyoming dam continues to provide additional irrigation capacity of up to 847,000 acre-feet for Idaho farmers on the Minidoka Project. While it may seem incongruous that a dam and reservoir store water from Wyoming to serve Idaho farmers, the Jackson Lake Dam illustrates the federal nature–as opposed to states and state boundaries–of the Reclamation Act. [82]

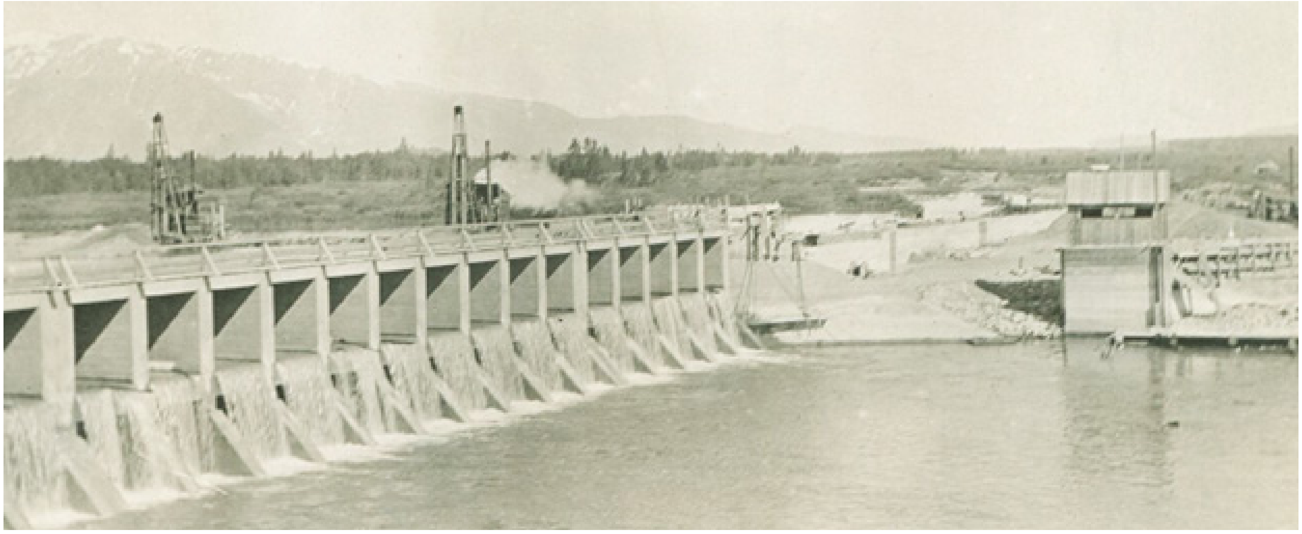

Figure 24 - Jackson Lake Dam in 1916. Floyd Bous, "Snake River," 1958.0766.001P, Jackson Hole Historical Society Collection.

Further additions to the Minidoka Project included the American Falls Dam, a 93-foot concrete and earthen structure completed by the Bureau of Reclamation (renamed from the Reclamation Service in 1923) in 1927. [83] Investigations for a dam near American Falls began as early as 1918. The site housed a railroad bridge for the Oregon Short Line Railroad over the Snake River, which was often featured on Oregon Short Line postcards, and the community of American Falls, Idaho. A 1919 proposal called for construction of the dam where the town of American Falls was then located, which would necessitate moving most of the town's structures. The Bureau of Reclamation purchased properties in American Falls in preparation for moving the town but halted the project in 1921 because of cost concerns. Local canal companies and irrigation districts worked to raise the funds necessary to cover the additional costs and in 1925 the Bureau of Reclamation resumed construction of the project, which ultimately impounded up to 1,700,000 acre-feet of water and irrigated an additional 125,000 acres. [84] The project ultimately moved most of the town's buildings to a new location, today adjacent to Interstate 86, and relocated "344 residents, 46 businesses, three hotels, one school, five churches, one hospital, six grain elevators, and one flour mill." [85] Building owners absorbed the costs of moving their structures; buildings that were left behind were razed to the ground.

[82] Samantha Ford, "Jackson Lake Dam," Jackson Hole Historical Society and Museum, https://jacksonholehistory.org/jackson-lake-dam/; USGS, National Water Information System, "USGS 13010500 Jackson Lake Near Moran, WY," https://waterdata.usgs.gov/nwis/dv?referred_module=sw&site_no=13010500.
[83] The Reclamation Service became the Bureau of Reclamation in 1923. See Bureau of Reclamation, "The Bureau of Reclamation: A Very Brief History," https://www.usbr.gov/history/borhist.html.
[84] The Idaho Statesman reported in December 1925 that private irrigation companies and districts had contributed $2,543,966.42 toward the dam's construction. Statesman Bureau, "Mead Approves Higher Dam at American Falls," Idaho Statesman, December 6, 1925, 26.
[85] Josh Franzen, "The American Falls Dam and Moving a Town," Intermountain Histories, https://www.intermountainhistories.org/items/show/77; "The Moving of a Town," https://www.cityofamericanfalls.com/history/.

National news outlets covered the town's relocation: the *Boston Globe's* headline declared "Whole Town Drowned Out," while the *Los Angeles Times* declared a "Gigantic Idaho Dam Dedicated." [86] One of the structures that did not move, the Oneida Milling and Elevator Company's grain elevator, today towers above the water line, and the town's former foundations become visible when the reservoir recedes—a reminder of the town's previous location.

Figure 25 - Kitchen crew on the Jackson Lake Dam project during construction, showing diversity of the staff but no women. 1958.0791.001P, Jackson Hole Historical Society Collection.

The Built Environment of Early 20th-Century Irrigation

The expansion of irrigation systems in these early decades of the twentieth century shaped the built environment in Idaho. As the century went on, Idaho's landscape became increasingly delineated by reclamation projects [Figure 26]. Towns grew up around railroad depots and irrigation access points. In the areas between towns, dams, reservoirs, canals, and laterals soon occupied space that was devoid of development just a few short years earlier. Irrigation left a lasting mark on the state, as evidenced in maps and the irrigation-related buildings that dotted the state.

Figure 26 - Close-up of United States Bureau of Reclamation Map, "Western United States showing location of Bureau of Reclamation projects: projects completed and under construction," Washington, DC, 1988.

[86] *"Whole Town Drowned Out," Boston Daily Globe, July 24, 1921, 49; "Gigantic Idaho Dam Dedicated," Los Angeles Times, July 14, 1925, 3.*

For irrigation companies, railroad companies, and municipal leaders alike, it became apparent that modern electrical and mechanical components needed to be shielded from Idaho's extreme weather. Pump houses were a relatively constant topic of discussion at city council meetings across the state after 1900. Pump-house structures were typically simple, nondescript structures designed to house the motor for water pumps. Because municipal water—for domestic use, firefighting, and railroad supplies— depended on local pumps, such facilities also needed to be staffed full-time. As an insurance expert explained to Caldwell's city council in 1912, "to leave the pump house unguarded allows the machinery and pump house to be at the mercy of unscrupulous parties," in addition to the liability of delayed or disrupted firefighting capacity. [87]

Idaho's major dam projects throughout the twentieth century were impressive, often hulking, feats of engineering (see, for example, Arrowrock Dam, Figure 13). Even in the early 1900s, dams were often some of the largest built structures people would have ever seen. The Minidoka Dam, for example, was over a mile wide [Figure 27]. Even smaller diversion dams churned massive volumes of water over spillways, gates, and weirs. The construction of a dam changed the very topography of its location, including massive earthen embankments holding back impounded water and dramatically altered banks of the river both above—now a reservoir— and below the dam. Most dams also included main and auxiliary diversions that redirected some of the river's flow toward canals and hydroelectric generators. But for many Idahoans, the completion of the dam (and its radical imprint on the land) was merely the harbinger of further transformation: turning Idaho's scrubby sage desert into green fields. [88]

Every dam with hydroelectric facilities also had a power house or power plant [Figure 28] to house its generator components. Power houses were large enough to contain one or more turbines, along with generators and transformers that translated the water's movement into usable electricity. Power houses also needed to be staffed by skilled mechanics and operators in order to keep the system running smoothly. Most Idahoans never saw the interior of a power house, yet their homes, businesses, and utilities soon came to depend on these facilities.

Figure 27 - Harris & Ewig, "Minidoka Project. U.S. Reclamation Bureau. Minidoka Dam, One Mile Long. Power Plant In Distance, Minidoka, Idaho," 1912, Library of Congress.

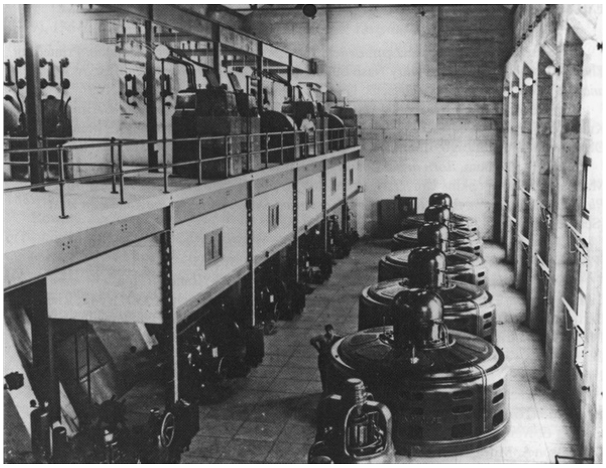

Figure 28 - "The Minidoka Dam powerplant in 1911," Denver, CO: Bureau of Reclamation; Library of Congress.

[87] "Insurance Rates Will Soon Be Lowered," Caldwell Tribune, December 20, 1912.
[88] See, for example, "Black Canyon Means Much to Caldwell City," Caldwell Tribune, May 9, 1924, 1.

The Culture of Irrigation

Irrigation projects in southern Idaho created a class of irrigation investors, managers, and engineers who not only directed the irrigation projects but also controlled the business climate and politics within the new tract towns. These white, transplanted men and their wives also presided over the social climate in the new communities; elite women founded women's clubs alongside all-male commercial clubs. Such organizations dominated the social, cultural, and political life of irrigation-settlement communities during the pioneer era. Laborers on the projects, however, were much more diverse and often included immigrant workers from Mexico and Europe; they were not welcomed as part of the elite social structure of irrigated towns. While the settlers and labor tent towns on irrigation projects reflected the diversity of immigrant communities, the commercial and cultural clubs attempted to simultaneously replicate life from the places they had left, such as Ohio, and to create a new cultural oasis based on the unique characteristics of irrigated settlement.

The Twin Falls Land and Water Company's chief engineer, Paul S. A. Bickel, represented the new engineering class that came to prominence with the creation of irrigation-settlement communities. Bickel served as chief engineer for both the North and South Side projects and was said to "know the topography of the whole of Magic Valley" better than any other person. [89] His detailed notations, surveys, drawings, reports, and diary entries provide a window into the often frenetic irrigation development and town-building effort that ensued with the opening of the Milner Dam. Bickel spent his days traveling the irrigation tracts, checking on construction progress and visiting new communities. Traveling throughout southern Idaho during the first decade of the twentieth century was arduous and time-consuming, but some days Bickel covered over forty miles as part of his day's work. His report entries for the week of July 1, 1908 indicate the rhythm he maintained:

July 1 - Jerome Office
July 2 - Jerome to Twin Falls
July 3 - Twin Falls to Buhl
July 4 - Celebrated [90]

Bickel's reports also demonstrate that even on the most successful Carey Act project, pumps failed, canals leaked, rodents invaded, and severe weather threatened to destroy all that had been accomplished. On July 11, 1908, Bickel noted that at Buhl and Hagerman, "work generally is progressing very nicely," but "there has been considerable trouble with water as the pumps have been used to their fullest capacity." This had caused "inconvenience," Bickel continued, "for the contractors and other people to get water at Jerome and Wendell." [91] It is not clear if Bickel meant "settlers" when he referred to "other people," but in other areas of his diaries he referenced the hardships experienced by settlers on the projects. On July 18, 1908, Bickel "drove from Milner to Hillsdale and looked over the First Segregation and then went around Skeleton Butte and...then along the work to Grant's Camp and arrived at Jerome in the evening." Bickel expressed dismay at the state of the farms that he observed during this tour.

[89] *Moon and Tremayne, History of the Twin Falls Canal Company, 34.*
[90] *Paul S.A. Bickel Milner Reports, July 4, 1908, Paul S.A. Bickel Manuscript Collection [BMC], MS 502, Box 1, Idaho State Archives, Boise, Idaho.*
[91] *Paul S.A. Bickel Milner Reports, July 11, 1908, BMC, MS 502, Box 1.*

"While a number of settlers have improved parts of their farms," he wrote, the First Segregation "does not look very encouraging....It seems that the upper end has had a setback in the shape of a very heavy hail storm" which had "very badly shattered" the crops. [92] A 1911 report told of a near catastrophe related to running canal water during the winter months:

> From Gooding to Jerome. Found that Bank at Dry Creek in the A Lateral had gone out and damage to settlers had been done, other places on the system had met with damage from the flood waters from the melting snow. Ice gorges formed by the flow of water which was occasioned by trying to conduct water in cold weather. Mr. Gooding's son and others took it upon themselves to relieve the town of Gooding of the flood waters and used dynamite along the BS canal. The canal was large enough to handle the water but they got frightened and instead of shooting the banks or doing nothing at all, they shot out part of the Wood River Culvert in B5 Lateral. [93]

Bickel's engineering work resulted in a political career when he became the first mayor of Twin Falls. Twin Falls also named its first permanent school, now Bickel Elementary School, after him. [94] It was not, however, the political successes and city honors that apparently mattered most to Bickel. Either Bickel or his family determined that his greatest accomplishment was the engineering role that made the Twin Falls Carey Act projects successful. When Bickel died in 1932, his headstone read simply:

Paul S.A. Bickel
1861-1932
Chief Engineer
Twin Falls South Side
Twin Falls North Side [95]

Figure 29 - North Side of Rupert, Idaho Town Square showing new buildings, 1911.

The founders of the townsites on southern Idaho irrigation projects intended for the communities to be family-based, white, and Protestant. People of color and immigrants lived in the towns or on the outskirts of the communities, often as laborers, and were the targets of racism and racist policies. White women's clubs grew up with the towns and attempted to instill cultural norms that countered the "wild West" reputations of western mining and ranching communities. The Rupert Culture Club, located in the Minidoka reclamation settlement town of Rupert [Figure 29], successfully lobbied for local ordinances, including the prohibition of the consumption and sale of alcoholic beverages; the illegalization of "sidewalk spitting," literally a ban on spitting tobacco or anything else on public walkways; and the requirement that horses be tied away from main city streets to avoid manure on main thoroughfares.

[92] The "First Segregation" refers to the inaugural land allocation that was sold to settlers. Carey Act land settlements were initially referred to as "segregations." Bickel Milner Reports, July 18, 1908.
[93] Paul S.A. Bickel Twin Falls North Side Land & Water Company Report, February 5, 1911, BMC, MS 502, Box 1.
[94] Bickel Elementary School maintains a history page at https://bi.tfsd.org/about/.
[95] Paul S.A. Bickel Headstone, Twin Falls City Cemetery, 4th Avenue, Twin Falls, Idaho.

Founded by Elizabeth Layton DeMary, who was married to the project's land commissioner, Albin C. DeMary, the Culture Club allowed only white, educated, Protestant women to join its ranks. In addition to lobbying for legislation, the group also supported city beautification efforts, including the creation of Idaho's only town square, made possible by the project's access to irrigation water. And as irrigated settlement communities stabilized and introduced labor-intensive sugar beet farms and factories, women's groups like the Culture Club also bemoaned the arrival of immigrant farm workers, particularly Mexican immigrants.

While men like Paul Bickel ran the communities fed by the Milner Dam, and women like Elizabeth Layton DeMary controlled the social life of reclamation towns, settlers on the projects often struggled to have a voice. Located on plots miles outside of developing towns, homesteaders endured excruciating isolation while they waited for water to be delivered to their plots. Rose Wilson Gibson, a daughter of Buhl area pioneers, remembered arriving at the family homestead for the first time and the isolation that her mother must have felt:

> As far as we could see in every direction were miles and miles of sagebrush. And as the first days passed, we began to realize, except for the ever-present jackrabbits and the howling of the coyotes at night, there were no signs of life. I wonder how many tears, unseen by us, our mother must have shed as she viewed this desolation. We had never lived in luxury....but this! [96]

Annie Pike Greenwood, a pioneer woman who lived not far from Buhl in the Greenwood District on the Twin Falls North Side project, wrote the most detailed account available of irrigated settlement life in her book *We Sagebrush Folks*. She came to the project with her husband, Charles Greenwood, who served a term in the Idaho State Senate where he advocated for the rights of farm families. While finding her own voice through her writing, Greenwood expressed the stories of other pioneer women in the district who did not have the option of speaking out. Greenwood wrote about the excruciating work of pioneer women and of farmers in general, of the scarcity of resources on the farm, the depression, and isolation of farm life, and the childbirth deaths of her female neighbors. One of Greenwood's pioneer neighbors, Mrs. Howe, sank into a deep illness and depression that rendered her unable to get out of bed or care for her children. Since the family had no means to obtain medical intervention, Annie Pike secured a place for Mrs. Howe at the sanitarium in Blackfoot, Idaho. When Greenwood visited the woman, who "recovered enough to enjoy sitting there, clean, well-fed, but she yearned not at all for the tar-paper shack, her five children, or her husband." [97]

The Greenwoods enjoyed a middle-class lifestyle before taking advantage of the homesteading opportunity in Idaho, and they arrived with "good furniture" and a "deep-piled velvet carpet." For Greenwood, the erosion of her household served as a metaphor for the decline of her family's fortunes. "Year after year the room changed, until at last there were but a few meager furnishings and linoleum on the floor," and when the curtains for the windows fell apart, "there was no money to replace them." "The only plenty we had," Greenwood later explained, "was mortgages." [98] By the late 1920s, the Greenwoods had lost their farm and the couple divorced.

[96] Rose J. Wilson Gibson, quoted in From Desert Brown to Valley Green: A Narrative History of the First Seventy-Five Years of the Growth and Development of Buhl, Idaho, 1906-1981 (Buhl, Idaho: Buhl Herald, 1981), xi.
[97] Greenwood, We Sagebrush Folks, 120-122.
[98] Greenwood, We Sagebrush Folks, 161.

The Greenwoods' experience mirrored that of other farmers in their district and on Idaho farms (see section on the Minidoka Project). The 1920s were difficult years nationwide for farmers as depression-level economic conditions set in prior to 1929 in agricultural areas. In Idaho, 1924 was "a bad year for farmers." [99] Drought plagued the state's irrigation projects. The Boise River ran 61 percent below normal during the summer of 1924. Low commodity prices also hit farmers in Idaho by the mid-1920s. Despite these setbacks, better transportation networks expanded the local markets for Idaho farmers as a north-south highway connecting the state was completed with the construction of the White Bird Hill grade. The grade transformed transportation between northern and southern Idaho, which prior to the new route lacked a modern highway connecting the two disparate parts of the state.

Figure 30 - The Canyon Canal Company Diversion Dam on the Payette River, circa 1910. This diversion dam served irrigators in Emmett and the Payette Valley as part of a Carey Act project prior to the construction of the Reclamation Service's Black Canyon Dam and is emblematic of the private to public transition that occurred on many irrigation projects. "Emmett Idaho – Diversion of Canyon Canal Co.," J.R. Field Photograph Collection, P1970-95-13, Idaho State Archives.

Other than American Falls Dam, the other major Reclamation project in Idaho during the 1920s was the completion of Black Canyon Dam on the Payette River [Figures 30 and 31]. The projects on the Payette River, a tributary of the Snake River, represent the pathway that many irrigation projects took in Idaho and throughout the Arid West. The Payette River Valley encompasses the communities of Horseshoe Bend, Emmett, New Plymouth, Payette, and Fruitland. As early as the 1870s settlers began creating local and individual irrigation projects in the Payette Valley under Desert Land Act of 1877 provisions. By 1900, approximately 13,000 irrigated acres had been brought under production in the valley. The 1920s Reclamation project, a 183-foot concrete gravity dam, replaced a smaller diversion dam at the same location and became part of the Boise Project. Black Canyon Dam ultimately fed more than 58,000 acres of farmland in the Payette Valley, but more than a decade passed before completion of the entire Black Canyon canal system. Today the area, known as the Payette Division, is managed by the Black Canyon Irrigation District.

[99] *"Boise Project History, 1920-1945," Idaho State Historical Society Reference Series, Number 193.*

Figure 31 - Black Canyon Diversion Dam, on the Payette River, is a concrete gravity dam that diverts water to the Payette Division, Boise Project, through Black Canyon Canal (shown in the foreground). Bureau of Reclamation, August 3, 2016.

The Bureau of Reclamation, Depression, and War, 1924-1945

The Great Depression years of the 1930s witnessed the beginning of a series of major changes that would transform the landscape of Idaho's irrigation practices. Locally, Idaho experienced an unprecedented drought in 1934, as did much of the western United States. That year, several Snake River reservoirs recorded historic lows, sometimes operating at less than half of their normal volume. Crop failures and feed shortages disrupted local economies across the state, while thousands of Idahoans lost their jobs. This 1934 drought followed another record-breaking drought just three years earlier. While geographically separate from the Great Plains Dust Bowl of the 1930s, the 1930s droughts remained in the consciousness of Idaho irrigators for many years to come.

Federal and state drought relief programs during the 1930s made a lasting imprint on Idaho's irrigation systems, just as federal reclamation projects had in previous decades. Hundreds of thousands of federal relief dollars funded the construction of municipal wells, cisterns for domestic water, and new pumps and tunnel diversions from existing lakes and rivers in Idaho.

Moreover, the Rural Electrification Act of 1936 and the Reclamation Project Act of 1939 further incentivized the construction of hydroelectric dams, which could be used for electrical power as well as water storage, water distribution, and flood control. Notable projects built during this era were the Little Wood River Dam near Carey and the Island Park Dam, both of which were completed in 1939.

The 1930s also ushered in an alphabet soup of government agencies under the Franklin Delano Roosevelt Administration, with a focus on addressing the Great Depression's crippling unemployment rate by creating government jobs. Roosevelt created the Civilian Conservation Corps (CCC) in 1933 to address unemployment for young men and to complete projects aimed at conserving the country's natural resources. CCC camps were established throughout the country, but primarily in the western United States, to support projects for the U.S. Forest Service, the U.S. Park Service, the U.S. Soil Conservation Service, and the Bureau of Reclamation. Camps assigned to reclamation projects built and repaired irrigation works; dug and repaired canals; constructed facilities for the public, such as picnic shelters, picnic tables, and camp sites; and created hiking trails. In Idaho, one of the main Reclamation CCC camps was located on the Minidoka Project, where CCC workers developed the Minidoka Wildlife Refuge and Lake Walcott Park at Minidoka Dam's reservoir [Figures 32 and 33]. The legacy of the CCC at Lake Walcott Park can be seen today in the park's lava-rock-lined canal beds; hiking trails; camp sites; massive trees; and lava-rock borders, fences, and steps.

Figure 33 - "CCC Camp BR-24 Boise Project, Marsing, Idaho: Photo of crew placing 24" concrete pipe," 14 March 1941. Department of the Interior, Bureau of Reclamation, Civilian Conservation Corps Division, 1937-1942, Record Group 115, National Archives and Records Administration at Denver. ARC #293519.

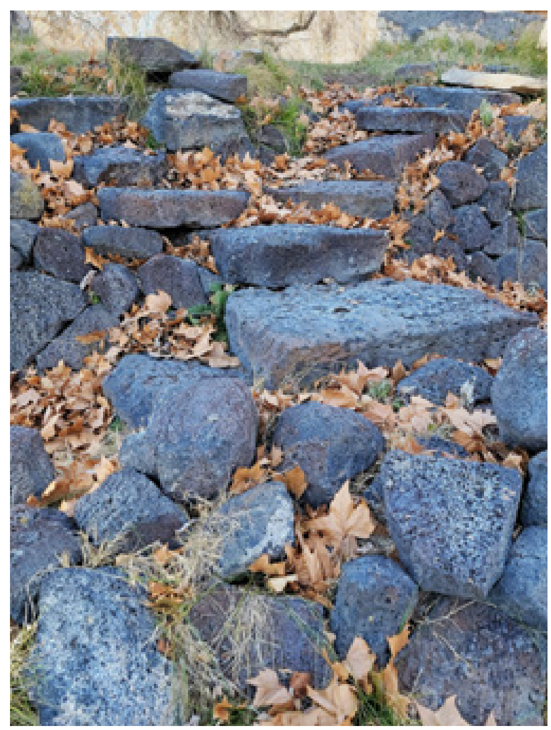

Figure 32 - CCC-built lava-rock steps at Walcott State Park, Minidoka, Idaho, November 2021. Laura Woodworth-Ney, Photographer.

Idaho Irrigation Projects and Japanese Internment: The Minidoka Relocation Center

During World War II federal lands in the arid West, including irrigation projects, found a more sinister and disturbing use. In February of 1942, President Franklin Roosevelt issued Executive Order 9066, which "authorized the evacuation of all persons deemed a threat to national security from the West Coast to relocation centers" located in remote locations throughout the United States and away from the coasts. The wartime order rested on decades of anti-Asian discrimination, including the Chinese Exclusion Act of 1882, and was precipitated by the Japanese attack on Pearl Harbor. It forcibly removed more than 110,000 Japanese American immigrants, both Issei (immigrants) and Nisei (born in the United States) from their homes and businesses to isolated, government-run camps, including one located on Reclamation Service lands in Hunt, Idaho, about six miles northwest of Eden and known as the Minidoka Relocation Center, after the Minidoka Project [Figure 34]. The external boundaries of the camp included 33,000 acres, of which 950 acres were utilized for administrative and residential buildings. The residential section of the camp was bounded on the south by the Twin Falls North Side Canal. The prison was thus serviced by Twin Falls Carey Act water. Camp detainees were enlisted to complete irrigation construction for the camp and to support federal irrigation projects and meet labor shortages created by World War II.[100]

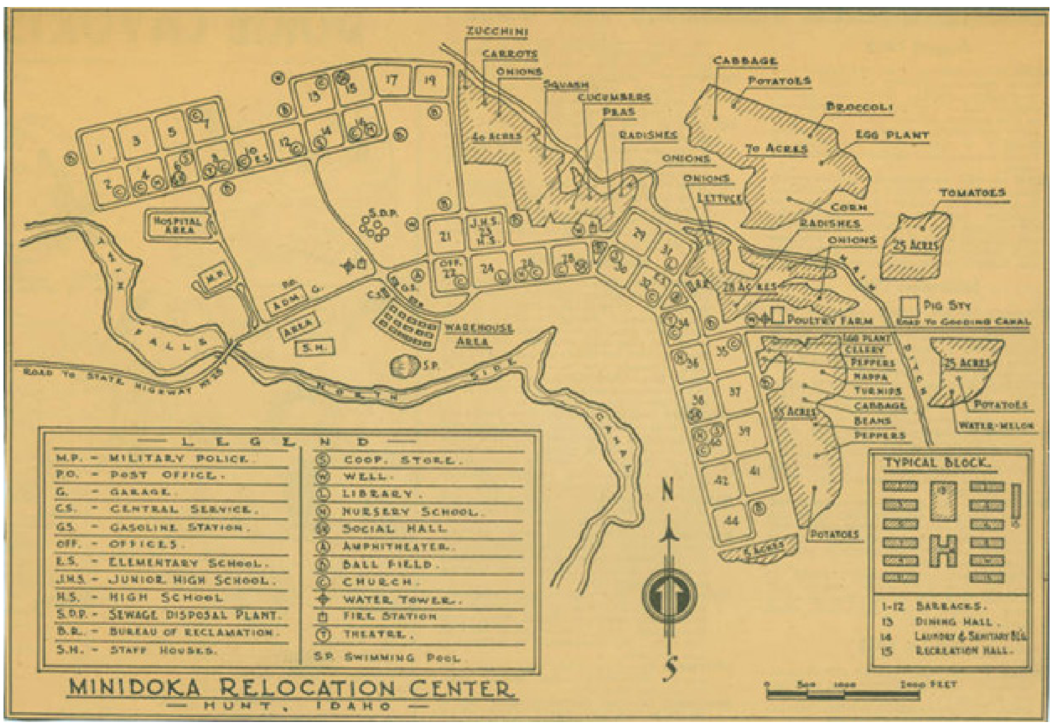

Figure 34 - Map of the Hunt Camp showing barracks, garden areas, administrative buildings and the Twin Falls North Side Canal. "Map of the Minidoka Internment Camp from the Minidoka Irrigator Newspaper," circa 1945, Iwao Matsushita Papers, Accession No. 2718-001, Box 11/14, University of Washington Libraries Special Collections.

[100] For more about the relationship between the Bureau of Reclamation and the Minidoka Relocation Center, as well as an explanation of land distribution after the war, see National Park Service, "Report to the President: Japanese-American Internment Sites Preservation," https://www.nps.gov/parkhistory/online_books/internment/reporta6.htm.

Executive Order 9066 stripped Japanese Americans, many of them citizens, of their property, livelihoods, and homes. Most Nisei, many of whom were children during WWII, had never lived in Japan. Many Nisei ultimately served in the military during the war. Dust storms and excessive heat plagued the Hunt camp, where American citizens were forced to live in rudimentary barracks for up to three years. The first detainees arrived at Hunt in August of 1942 and the final residents left by October 1945; at its height the Minidoka Relocation Center housed more than 9,000 detainees. Japanese Americans survived the camps by growing gardens, making art, and building cultural networks within the centers, but the scars of this racist episode reverberated throughout the twentieth century.

The Hunt center also transformed the social and cultural landscape of Idaho's desert north of the Snake River. Some camp residents chose to stay in Idaho after the war and to rebuild their lives in the region, thus creating an enclave of Japanese American businesses and farms in Eden, Twin Falls, Paul, Heyburn, and Rupert. When the camp closed at the end of the war, the site was transferred back to the Bureau of Reclamation, who subdivided and distributed the lands to returning war veterans in lotteried parcels. Eighty-nine lots of approximately 90 acres each were awarded by 1949. These veteran settlers expanded irrigated agriculture in the Jerome region. They initially lived in the abandoned internment camp barracks until they could build housing; other barracks were removed to farm sites for farm buildings. Some remain on farm sites or city locations today. [101]

More than forty years after the forced incarceration of Japanese Americans, President Ronald Reagan signed the Civil Liberties Act to compensate people of Japanese descent who were held in the internment camps. The act issued a formal apology and compensation of $20,000 to more than 120,000 individuals and acknowledged the "fundamental injustice of the evacuation, relocation, and internment of United States citizens and permanent resident aliens of Japanese ancestry during World War II." [102] The Minidoka camp is now a National Historic Site supported by the National Park Service and includes trails, a visitor center, barracks, a theater, and a bookstore.

Multiple-Use Reclamation

In the years after the Great Depression, the size of large dam projects across the West often required the support of many public and private interests. As a Bureau of Reclamation official told Idaho legislators in 1947, "the federal reclamation project of today is a multiple-purpose project." Dams, he said, could improve navigation, control silt buildup, produce electricity, and support fish and wildlife. [103] As dam projects became more multiple-use, their management, funding, and regulation became more complex as well. In 1947, a controversial proposed amendment to the Reclamation Project Act exposed disagreement among irrigation boosters, electrical utilities, and federal agencies over how large publicly funded projects should be financed and repaid. [104] While the amendment did not pass, the episode revealed the degree to which irrigation projects would need to contend with multiple interests moving forward.

[101] Todd Shallat, "Return to Minidoka," in Russell M. Tremayne and Todd Shallat, eds. Surviving Minidoka: The Legacy of WWII Japanese American Incarceration (Boise: Boise State University College of Social Sciences and Public Affairs, 2013), 173–74; "Minidoka," Densho Encyclopedia, https://encyclopedia.densho.org/Minidoka.
[102] United States Congress, Public Law 100-383, "An Act to Implement Recommendations of the Commission on Wartime Relocation and Internment of Civilians," H.R. 442, August 10, 1988.
[103] "Land Group Tours Site of Cascade Dam," Twin Falls Times-News, September 11, 1947, 8.
[104] "Reclamation Act Amendment," Congressional Quarterly Almanac 1948 4th ed., (1948) 278-81 (Washington, DC: 1959.

Figure 35 - The Hells Canyon Dam on the Snake River border between Oregon and Idaho was completed in 1967. It is one of Idaho's largest hydroelectric complexes, with an installed generation capacity of 391 MW and a 188,000 acre-ft. reservoir of impounded water behind it. P2006-18-755a. Bob Lorimer, "Hells Canyon Dam, 1967-08-09" Idaho State Archives.

In particular, hydroelectric power continued to be a significant consideration for nearly all of the dam projects of the post-Depression era. For example, the Anderson Ranch Dam on the Boise River northeast of Mountain Home and the Bliss Dam east of Glenns Ferry, both completed in 1950, were some of the larger hydroelectric installations built in Idaho up until that point. Later, several much larger hydroelectric projects were completed on the Snake River: Palisades Dam (completed 1957), Brownlee Dam (1958), Oxbow Dam (1961), and Hells Canyon Dam (1967) [Figure 35]. These projects not only impounded water but contributed to an inexpensive electrical supply for Idahoans and the inland Pacific Northwest more generally. While this ready energy supply undoubtedly modernized home electrical use, it also could be used to power long-distance water transmission, well pumps, pumps to drain water-logged soil, and surface pumps to move water around one's cultivated land. Idaho irrigators would also eventually use electricity to power the motion of sprinkler systems on their fields. Hydroelectric dams thus created a feedback loop: inexpensive and abundant electricity made it easier for irrigators to use Idaho's water supplies, which were in turn made more convenient and predictable by the impounded surface water held behind dams. This symbiotic relationship between electricity and water marked an important transition in the history of Idaho irrigation in the 20th century.

SIDEBAR

The Teton Dam Disaster

Not all of Idaho's irrigation projects have ended in success. The 1976 collapse of the Teton Dam stands as one of the worst disasters in the state's history, killing 11 people and causing billions of dollars in damage. The failure fundamentally changed how Idahoans view irrigation and reclamation practices in the decades that followed.

Irrigation officials had explored the possibility of constructing a dam on the Teton River since the early 1900s, but it was not until 1964 that Congress approved a Bureau of Reclamation proposal to build a dam in a canyoned section of the river, 13 miles northeast of Rexburg. The approval came in the wake of a severe drought in 1961 and extreme flooding the following year in southern Idaho. The Teton Dam and Reservoir were intended to serve multiple purposes: irrigation, flood control, power generation, and recreation. After eight years of planning, the Bureau began construction in February 1972 and completed the dam in November 1975.

Figure 1 - Aerial photograph of the Teton Dam the day after the collapse. "549-100-215-A Teton Project, Idaho. Looking into the break in Teton Dam. The crest of the water had passed leaving debris and destruction behind. 6-6-76 Bureau of Reclamation photo by Glade Walker." Records of the Bureau of Reclamation, National Archives and Records Administration. ARC #28894688.

Throughout the winter and spring of 1976, the Bureau oversaw the initial filling of the reservoir without incident. On June 3, engineers noted small seeps downstream from the dam, though these were not judged to be serious. On the morning of June 5, around 7:00 a.m., surveyors reported a leak at the base of the dam where it met the canyon wall. By 10:00 a.m., the leak had grown, and a second leak had developed. Engineers rushed bulldozers to the site in a desperate attempt to stem the erosion. Shortly afterward, county sheriffs were alerted and began evacuating residents downstream. Despite frantic efforts, the situation deteriorated rapidly. By noon, the dam was fully breached, sending billions of gallons of water and sediment roaring downstream at a rate comparable to the Mississippi River at flood stage. [1]

[1] *U.S. Department of the Interior Teton Dam Failure Review Group, Failure of the Teton Dam: A Report of Findings (Washington, D.C.: Government Printing Office, April 1977), 42, 47.*

The flood's toll was catastrophic. Eleven people died, thousands were injured, and 25,000 were left homeless. The disaster killed at least 16,000 cattle and other livestock and stripped topsoil from as many as 100,000 acres. The torrent ripped buildings from their foundations, sparked fires, floated heavy machinery, washed out hydroelectric facilities for dozens of miles along the Snake River, and coated everything in a thick layer of silt. Reclamation engineers immediately rushed to empty the American Falls Reservoir, 100 miles downstream, which could not have safely held both its existing storage and the enormous floodwaters approaching from the northeast. Had American Falls Dam failed, it could have triggered a cascade of dam failures along the Snake River. Fortunately, the dam held, but southern Idaho remained on high alert. Today, estimates of total property damage range as high as $2 billion. [2]

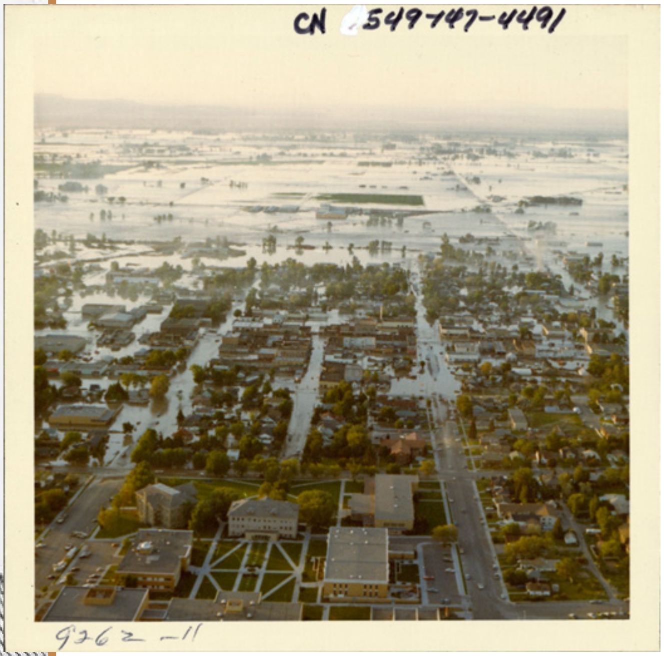

Figure 2 - Photograph of Rexburg. "CN549-147-4491 NA Teton Dam, Teton Project, Idaho. Looking north over Ricks College Campus across the center of Rexburg. Specifications June 5, 1976. Teton Dam Failure June 5, 1976. Bureau of Reclamation Photo by P. Abner." Records of the Bureau of Reclamation, National Archives and Records Administration. ARC #28894686.

In the weeks and months that followed, the geological and environmental studies conducted for the dam's siting came under intense scrutiny. National news outlets debated whether the disaster could have been predicted or prevented based on data collected before and during construction. [3] In 1977, the Department of the Interior released an 800-page report, Failure of the Teton Dam: A Report of Findings, concluding that the dam failed due to internal erosion within the embankment and that better sealing measures could—and should—have been implemented during design and construction. [4] With the benefit of hindsight, many historians have been even more critical, arguing that the dam's siting made the project inherently vulnerable. [5]

The collapse coincided with broader shifts in environmental policy and public opinion. The 1960s and 1970s saw the passage of major federal laws to improve air and water quality and to require agencies to evaluate the environmental impacts of federal projects. The memory of the Teton Dam disaster—combined with these cultural and political changes and the economic instability of the 1970s—effectively marked the end of the era of new large-scale reclamation projects in Idaho.

[2] *Department of the Interior, Failure of the Teton Dam, 42-48; Marc Reisner, Cadillac Desert: The American West and its Disappearing Water (New York: Viking Penguin, 1986, 381-410).*
[3] *See, for example: Philip M. Boffey, "Teton Dam Collapse: Was It a Predictable Disaster?" Science, July 2, 1976, 30-32; Dorothy Gallagher, "The Collapse of the Great Teton Dam," New York Times Magazine, September 19, 1976, 16-17; 95-103; 108.*
[4] *Department of the Interior, Failure of the Teton Dam, iii.*
[5] *Reisner, Cadillac Desert, 381-410.*

Technological Advancement and Farm Development, 1945-1970

In the decades after World War II, manufacturers of irrigation components also emphasized the efficiency of new forms of irrigation. Compared to field flooding, newly introduced stationary and movable pipe systems offered less runoff and less wasted water. Most of these early systems were made up of perforated metal pipe that dripped water onto fields. Sprinkler heads, gradually introduced in Idaho after the war, allowed farmers to control the flow of their sprinkler systems based on crop needs and soil absorption, variables that were harder to control with earlier irrigation methods. Given the state's struggles with drought in the 1930s, it is no surprise that water efficiency took such a central role in the decades that followed. When one sprinkler-sales company asked customers to "let us help you become a rain maker," the message was that irrigators could sidestep nature's own hydrological processes, a promise that had long dominated how irrigation boosters spoke about watering the arid West. [105] As population centers grew in the 1940s and 1950s, the responsible management of Idaho's waters took on even more importance. One water supply company president commented in 1954 that "water means more to the Magic Valley area than oil could mean to any community." [106]

The scale and speed of changes in irrigation technology created the need for continual public educational efforts. Water-supply companies, pipe and sprinkler manufacturers, horticultural societies, and extension schools alike regularly held public demonstrations about new methods and technologies. Overwhelmingly, newspaper accounts described tours, demonstrations, and new public works projects as evidence of the coming of an era of modern irrigation. But despite the fanfare, the Bureau of Reclamation often cautioned irrigators that the benefits of adopting new systems might not outweigh their steep financial costs. [107] As had been true since the earliest days of irrigation in Idaho, the state's variable landscape and hydrology meant that there might never be a one-size-fits-all solution.

The Continued Growth of Idaho's Irrigation

By the late 1950s, Idaho ranked third in the nation in total acreage of irrigated land, second only to California and Texas, and this growth would continue. [108] Between 1950 and the early 1970s, Idaho added over one million acres of newly irrigated land. [109] At the time, the press and irrigators alike credited new electrical facilities, pump irrigation, and the availability of overhead sprinklers for this unprecedented growth. Indeed, all of the midcentury dam projects referenced above had added significantly to both electrical and reservoir supplies across the state. Not only had electrical companies become unlikely boosters for Idaho's irrigation systems as a result, but they had also become important players in the politics of water management and federal improvement projects [Figure 36].

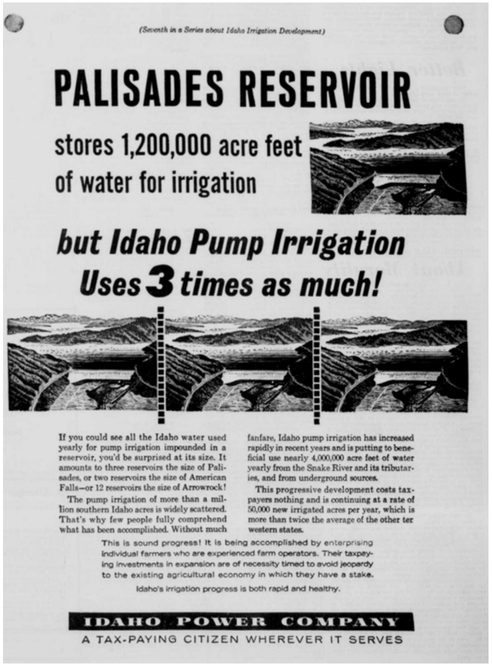

Figure 36 - Advertisement, Idaho Power Company, Nampa Free Press, October 31, 1964, 3.

[105] *Advertisement, Floy Lilly Co., Twin Falls Times-News, February 8, 1948, 8.*
[106] *"Valley's Irrigation Programs Among Nation's Greatest, Says Industrialist," Twin Falls Times-News, May 23, 1954, 3.*
[107] *For example, see: "Reclamation Bureau Compiles Sprinkler Irrigation Report," Twin Falls Times-News, September 13, 1949, 5.*
[108] *"Farm Topics— Sprinkler Irrigation," Nampa Free Press, February 23, 1957, 10.*
[109] *"Farmers Invest New-Found Wealth in Sprinklers," Idaho State Journal (Pocatello), September 3, 1973, 9.*

Modern Changes and Future Challenges, 1970s-Present

The Crisis of the 1970s

The national economic turmoil and energy crises of the 1970s did not spare Idaho's economy [Figure 37]. Price fluctuations and commodity shortages were compounded by one of the worst droughts in recent history in 1976-1977. In response to emergency-level surface and groundwater supplies, state and local officials instituted mitigation measures wherever possible. The tight correlation between water supplies and electricity also conditioned how Idahoans experienced the water shortage: because so much of Idaho's electricity depends on allowing impounded water to move through hydroelectric turbines, Idahoans were asked to curb their water use and their electrical use. Irrigators faced the difficult decision to abandon seasonal crops in order to preserve livestock and orchards. Others hauled water, drilled new private wells, and expanded existing ones. [110]

Figure 37 - The National Farmers Organization (NFO), which was founded in 1955, was an important advocacy and lobbying organization for farmers' rights. This image, from 1978, depicts the economic and political frustration of the late 1970s. P2006-18-750. Bob Lorimer, Photographer, "National Farmers Organization, 1978-08-09." Idaho State Archives.

While the nation's economy recovered in the 1980s, the economic difficulties of the 1970s stretched into the next decade for many farmers. As interest rates rose, it became more and more difficult for farmers to borrow money to pay for a variety of annual expenses, which, among other things, included irrigation technology, operation, and upkeep. Moreover, the energy-intensive practice of pumping groundwater added substantial electrical bills each month. Thus, in the exact same era that new technologies— such as advanced pumps and center-pivot sprinkler systems— were billed as the key to modern, high-output agriculture, it was becoming more difficult for irrigators to afford to purchase or use these systems in the first place. By the middle of the 1980s, the nation's farm debt was 15 times that of 1950. [111] High-output farming thus became a catch-22: in order to earn more money from increased production, farmers needed to purchase more expensive equipment and supplies on credit. The situation was extraordinarily tenuous and led to bankruptcy in some cases.

Idaho's Irrigation into the 21st Century

In the decades since the 1970s and 1980s, Idaho's agricultural sector has rebounded, in large part due to the state's continued emphasis on irrigation access. Compared to the first decades of the 20th century, Idaho's market share of the national supply of sugar beets, potatoes, and barley has grown significantly. [112]

[110] *Howard F. Matthai, "Hydrologic and Human Aspects of the 1976-77 Drought," Geological Survey Professional Paper 1130, U.S. Department of the Interior (Washington, D.C.: Government Printing Office, 1979).*
[111] *"1980s Farm Crisis," Market to Market, Iowa PBS, https://idahoptv.pbslearningmedia.org/collection/market_to_market_classroom/t/1980s-farm-crisis.*
[112] *Morton D. Winsberg, "Geographical Change in the Distribution of the Nation's Agricultural Production between 1929 and 1992," Agricultural History 70 (Summer 1996), 525-536.*

Today, Idaho leads the nation in the production of the latter two commodities. [113] And while the era of large dam construction has come to an end for the time being, Idaho has continued to add smaller hydroelectric substations, particularly in areas with continued population growth along the Snake River and its tributaries.

With such a complex patchwork of infrastructure, Idaho irrigation managers face the continued challenge of upkeep, modernization, and economic change. Aging canal systems have led to several major replacement projects, such as the $24-million Minidoka Dam spillway replacement project completed in 2015. Significant efforts have also been made to increase the safety of ditches, diversions, and gate systems that exist alongside residential and recreational areas. Canal gates, pumps, and lock systems have been upgraded and fenced to prevent drownings. The state has also attracted new industries in recent decades. The availability of land and agricultural commodities, proximity to shipping routes, and a ready labor supply have fueled manufacturing growth, particularly in food processing. [114] Water availability remains central to this type of economic growth, as processing plants and population growth both place additional demand on Idaho's water supply. However, as one might expect, as more commercial, industrial, and residential water users join the ranks of Idaho irrigators, water rights and access have become all the more contentious.

Today, agricultural irrigation still makes up the majority of Idaho's water usage. In 2021, Idaho ranked second in the nation in the total water withdrawn for irrigation from surface and subsurface sources. [115] Yet while the harnessing of Idaho's water resources accounts for the continued dominance of the agricultural sector in Idaho, the water-use system remains vulnerable to seasonal changes in water supplies. Idaho's most recent extreme dry spell, in 2003-2004, led to not only severely reduced surface water availability but also record low groundwater levels. [116] Thus, despite the centuries of human labor and ingenuity that built the modern irrigation infrastructure in Idaho, the system as a whole still depends on a finite and ever uncertain resource: precipitation. In the coming years and decades, it remains to be seen whether Idaho's irrigation systems and practices can withstand the effects of climate change.

A century and a half of efforts to water Idaho are still evident in today's tapestry of irrigation practices. Rivers, streams, and aquifers; dams, reservoirs, and weirs; wells, canals, and laterals; ditches, headgates, and corrugated fields; sprinklers and cisterns: these features of the Idaho landscape are all part of complex hydrology that sustains Idaho's people and economy. The management of these many moving parts is just as complex. Today, countless individuals and organizations contribute to the flow of water throughout the state. The Bureau of Reclamation and the Army Corps of Engineers manage most of the larger dams in Idaho. As of 2022, Idaho has 137 water districts, which are areas publicly administered by appointed or elected watermasters. In other areas, private canal companies manage water distribution on a fee or share basis. Electrical utilities, too, also own or manage power-generation facilities on waterways throughout the state. Several state agencies also regulate various parts of this system, including the Department of Water Resources and Department of Environmental Quality. Land management agencies like the National Park Service, Forest Service, Fish and Game, and Bureau of Land Management all at times coordinate or manage aspects of Idaho's irrigation waters as well. The vast array of legal, economic, regulatory, and managerial structures related to irrigation in Idaho is a less visible, but no less important, reminder of the astonishing effort it takes to water Idaho.

[113] Idaho State Department of Agriculture, "Crops Grown in Idaho," https://agri.idaho.gov/main/about/about-idaho-agriculture/idaho-crops.
[114] See, for example, Chris Talkington, "Reflections and Predictions for Twin Falls," reader comment, Twin Falls Times-News, December 30, 2016, 7.
[115] Sean Ellis, "Idaho Ranks No. 2 in Total Irrigation Withdrawals," blog, Idaho Farm Bureau Federation, March 9, 2021, https://www.idahofb.org/News-Media/2021/03/idaho-ranks-no-2-in.
[116] NOAA National Centers for Environmental Information, "State of the Climate: Drought for February 2004," https://www.ncdc.noaa.gov/sotc/drought/200402.

Irrigation Technology Overview

Above and Below the Ditch

Water has been the single most limiting factor in the history of agriculture and development in the North American West. In other parts of the continent, farmers can rely on rain, humidity, local waterways, and seasonal weather predictability to assure harvests. As the United States colonized larger and larger swaths of the continent over the course of the 19th century, settlers encountered geographies with little rainfall, few rivers, hot sun, and dry air. Established farming practices from the East simply did not succeed in the arid West. Western farmers had two choices: make a go at dryland farming, which relied exclusively on precipitation, or incorporate increasingly sophisticated methods of capturing water resources and delivering them to field; As was quickly apparent, farming "below the ditch," or with manmade irrigation systems, substantially increased yields over farms situated "above the ditch." The technological history of irrigation in Idaho mirrors that of many other states west of the Mississippi River: an ongoing quest to water thirsty crops.

For much of Idaho's early irrigation history, farmers depended entirely on gravity to direct surface water—snowmelt, spring water, and rainwater that enters rivers, streams, and lakes—to their fields. In the 19th century, Idahoans built diversion ditches using homemade tools and vernacular knowledge of local landforms. This was never a one-size-fits-all process. Variations in the porousness of the earth, soil composition, elevation and grade, and seasonal weather patterns all meant that communities of early irrigators built diversion systems largely by trial and error. Even the most sophisticated ditches and diversions needed constant maintenance and modification.

In those early days, fields also needed to be improved and modified in order to best utilize water through flood irrigation. Early irrigators had to carefully grade their fields to a uniform slope that could evenly distribute water from a ditch at the highest point of the field. Every field had a gate, an on/off mechanism that allowed water to enter a field at the user's control. Depending on the crop cultivated, some irrigators utilized furrows, corrugations, and rills, all of which are ridges cut into a field between rows of crops. Ridges allow for more on-field control of the water, although erosion and even application of water were and are challenges for all varieties of flood irrigation. Well into the 20th century, Idahoans improved their irrigated land using manual, and often improvised, farm tools. Later, motorized equipment made some of these tasks less labor-intensive, but the basic field engineering remained the same.

The Journey from Raindrop to Field

The early 20th century witnessed significant growth of larger irrigation projects in Idaho. Coordinated reclamation works such as the Minidoka Project were responsible for the construction of dams, canals, and laterals, all of which greatly expanded the reach of irrigation in southern Idaho. As large-scale projects grew in size and number, so too did the internal conveyance mechanisms. In the long journey from precipitation to cultivated field through a conveyance system, irrigation water encountered dams, weirs, and spillways that altered the level of a natural waterway; a large headgate that regulated the initial flow of water from a body of water into a canal system; a series of checks, gates, and flumes, also designed to control the water level and flow in canals and laterals; a variety of methods of dividing irrigation water into smaller and smaller branches; and, finally, mechanisms that diverted water onto a cultivated tract of land. Along the way, the water likely would have flowed through at least one hydroelectric turbine and past multiple pump houses and power houses. Both structures were designed to protect critical machinery from weather and trespassers, and many housed round-the-clock technicians.

In the early 1900s, only the largest, most necessarily robust, parts of these systems were built with durable materials such as stone. Instead, most of each conveyance system consisted of open-air earthen ditches that needed regular maintenance. Ditch riders–so named for covering dozens of miles of canals on horseback–employed by the Bureau of Reclamation and other organizations cleared the canals of weeds and other debris, watched for excessive erosion and washout, and monitored and adjusted water flow. Today, these tasks are still managed by ditch riders, although today's workers tend to favor all-terrain vehicles (ATVs) over horse transport.

Depending on local topography, early-20th-century conveyance systems also sometimes incorporated elevated wooden flumes (open-air troughs) and wooden pipes to convey water across variable elevation. However, like earthen ditches, wooden structures require significant upkeep. By the 1950s and 1960s, the managers of several of Idaho's largest irrigation systems began to retrofit their canals and larger laterals with concrete lining, as well as metal and concrete weirs, gates, and checks. Many components were also re-engineered or rebuilt after the catastrophic 1976 Teton Dam collapse washed out many downstream structures in the eastern part of the state. Despite continual modernization over the intervening decades, many smaller branches remain earthen-lined today.

Subsurface Water and Electricity

At the same time federal works were expanding surface-water irrigation networks in Idaho, two simultaneous technological developments were influencing the nature of irrigation in Idaho. First, the introduction of steam-powered pumps in the second half of the 1800s increased farmers' ability to access groundwater in areas with little or no surface water. Over time, steam pumps, and the wind-, gasoline-, and electricity-powered pumps that would replace them, improved in both efficiency and the depth from which the water could be extracted. Although underground pumps provided an important supplemental water source, early models were limited in how much volume they could pump. As late as the 1930s, Idahoans viewed pumped water as a resource primarily used for household purposes, not as crop irrigation. But even as access to irrigation canals increased, many Idaho farmers continued to rely, to at least some extent, on pumped water that did not depend on seasonal precipitation, complex water rights, harmonious relationships with neighboring property owners, or the maintenance of ditches.

Second, and related, the growth of hydroelectricity gradually transformed the landscape of Idaho irrigation in the early to mid-1900s. Federal public-works programs embarked on large-scale hydroelectric dam-building projects, which made electricity cheaper and easier to access for Idahoans. And while the availability of electricity incentivized the adoption of high-volume electric pumps and sprinklers as they became available, the most important consequence for Idaho irrigation was what was behind dams: the captured impounded water, contained in a reservoir. The water impounded in reservoirs had a mitigating effect on the seasonal fluctuation of available irrigation water, making water supplies more predictable and reliable.

Water Application

Several other 20th-century changes in watering technologies made it possible for farmers to fine-tune their water application, maximize efficiency, and minimize labor. In particular, movable sprinklers, introduced after World War II, promised benefits over open ditches and gravity-based irrigation. Early versions of sprinklers dispersed water via a perforated metal pipe and would need to be manually moved multiple times a day. The postwar introduction of aluminum alloy, a much lighter material, to pipe components made this task less difficult but still labor-intensive. Irrigation-parts manufacturers further popularized sprinkler systems by developing interlocking and interchangeable fittings that made maintenance and repair easier for non-specialist farmers. Despite this, irrigation systems remained complex; while sprinkler systems could use either groundwater or surface water, they both required pumps and significantly more machinery than flood irrigation.

By the early 1950s, pipe manufacturers introduced wheel-move sprinkler systems to the Mountain West. Wheel-move sprinklers have gone by many names over the years—wheel line, side roll, lateral move, linear move, wheel move, side roll, or lateral roll—but generally speaking they consist of an elevated irrigation pipe that can be moved over a field via a series of large wheels. Wheel-move systems typically have a diesel or gasoline engine placed every quarter-mile along the irrigation pipe. The engine powers the system's linear movement across a field, further minimizing the amount of human effort necessary to irrigate an entire field. One can see this type of irrigation system still in use today across the state.

Perhaps the most important innovation in water application came to Idaho in the late 1960s: center-pivot overhead sprinkler systems. Center-pivot sprinklers have a stationary center point with water and electrical access, connected to an "arm" of wheeled sprinkler pipe that is typically a quarter of a mile in length. As the arm slowly sweeps around its pivot, it can apply calibrated water volumes as well as liquid pesticides, fungicides, and fertilizers. By the 1970s, more than 40 companies in the United States manufactured center-pivot systems. [117] These manufacturers advertised heavily in Idaho, promoting their systems as modern, clean, efficient, and cost-effective. Since the 1970s, center-pivot sprinklers have continued to grow in popularity, especially as the technology has become more automated.

Triumph over Gravity and the Dry Land

In sum, technological change has contributed as much to the history of Idaho's irrigation practices as have federal settlement programs, reclamation projects, and market forces. Although Idaho's irrigated lands today rely on a patchwork of different types of conveyance, delivery, and application systems, several interrelated trends have resulted from the extraordinary expansion of irrigation since the earliest era of water management in the state.

First, today's irrigated lands are more dependent than ever on electricity. While many wheel-mounted lateral-roll sprinkler systems use gasoline or diesel engines to power their linear motion, center-pivot sprinklers by and large use electrical motors. Moreover, because any kind of sprinkler system requires pumping water from a ditch or an underground well, these systems have an additional need for electricity. The movement of water around the state is also increasingly automated by electrical systems.

Second, the widespread adoption of new irrigator technologies—notably groundwater pumping and center-pivot sprinkler systems—has had the net effect of making irrigation less reliant on human labor. The same technologies have also lessened the need for cooperative operations; irrigators that pump some or all of their water from below their property have less need for the financial and logistical support of their neighbors to maintain canals.

Third, as irrigators adopted more technologically complex systems, both in the course of delivering water to users and in terms of the application of water onto fields, the systems became more complex to maintain and repair. Communal maintenance of earthen ditches and homemade tools have yielded to highly specialized experts trained in proprietary systems. Similarly, over the years local cooperative water-management strategies have been eclipsed by the need for much more complex legal and economic structures.

Finally, all of these technological shifts have had the cumulative effect of vastly increasing Idaho's agricultural output, all the while enabling continued population growth in the state. Yet correspondingly, increased production and increased population have continued to put pressure on the state's above- and below-ground water supplies.

[117] *"Water Experts Predict Increased Irrigation," Idaho Free Press (Nampa), February 12, 1975, 9.*

SIDEBAR

Domestic Irrigation and the Pursuit of a Lawn

The concept of a large expanse of cultivated and groomed grass for private spaces and recreation evolved in colonial North America among the upper class during the late18th century. The English elite in the colonies borrowed landscaping design from the estates of the English gentry, where the term "lawn" originated. Cultivated at such estates as George Washington's Mount Vernon and Thomas Jefferson's Monticello, "by the mid-19th century [lawns] were firmly established as a signature of the prosperous American homeowner's landscape." [1] The invention of the mechanical lawnmower in 1830 made the cultivation of well-groomed grass accessible to the middle classes, who began to seek gardening advice from a burgeoning literature related to the home and lawn. [2]

Idaho's early irrigation projects were intended for agricultural use, and agriculture remains the dominant water user in Idaho— employing about 97 percent of all the water withdrawn for irrigation. [3] Irrigation for domestic use, however, rose in importance in Idaho during the latter half of the twentieth century as Idahoans expanded their desire for water for lawns, gardens, golf courses, and neighborhood parks. Housing developments in Idaho's cities, including Boise, Twin Falls, Idaho Falls, and Pocatello, drove residential water usage throughout the late twentieth century. The post-World War II housing boom in the United States and Idaho created an explosion of middle-class lawns and gardens, both of which became ubiquitous adornments of suburban life.

Boise's Cherry Lane Subdivision, located in the Vista Neighborhood, provides an example of Idaho's postwar housing boom. The Day Realty company built 60 homes in the subdivision during the early 1950s. The homes boasted modern, one-story ranch or contemporary styles with swaths of irrigated green turf and fenced back yards and were located near Vista Village, one of Idaho's first planned shopping areas. [4] Early types of lawn watering included "flooding," a method of moving canal water onto the lawn at a depth of several inches and then returning the excess water to the canal. The development and expanded accessibility of residential sprinklers after World War II eventually replaced lawn flooding during the late twentieth century, but lawn flooding remained in use in many Idaho reclamation communities because canal access was initially more economical than the installation of expensive sprinkler systems. [5]

[1] *"Lawn," History of Early American Landscape Design, National Gallery of Art, https://heald.nga.gov/mediawiki/index.php/Lawn.*
[2] *Virginia Scott Jenkins, The Lawn: A History of an American Obsession (Washington, DC: The Smithsonian Institution, 1994), Kindle Edition, n.p.*
[3] *Sean Ellis, "Idaho Ranks No. 2 in Total Irrigation Withdrawals," Idaho Farm Bureau Foundation, https://www.idahofb.org/news-room/posts/idaho-ranks-no-2-in-total-irrigation-withdrawals/.*
[4] *TAG Historical Research and Consulting, "Vista Neighborhood Context," Prepared for the City of Boise Planning and Development Services, September 2015, https://www.cityofboise.org/media/7073/vista-neighborhood-context-with-illustrations.pdf; Preservation Idaho, Idaho Modern Field Guide: The History, Care and Keeping of Your Mid-century Home (Boise: Idaho Modern, 2016).*
[5] *Even after my grandparents installed a mechanized domestic sprinkler system at their Burley, Idaho, ranch-style house, they used the neighborhood canal for flood irrigation to avoid the cost of using the sprinkler system (Laura Woodworth-Ney). See also Robert M. Morgan, Water and the Land: A History of American Irrigation (Fairfax, VA: The Irrigation Association, 1993), 32-34.*

In Idaho and elsewhere, turf watering has retained a socio-economic correlation. Mowing, fertilizing, and caring for lawns and gardens present a significant expense for homeowners. A 2008 study of residential water use in Alaska, Idaho, Oregon, and Washington found that 78 percent of households with incomes over $80,000 reported watering their lawns once a week or more. [6] A huge lawn-and-garden industry fuels household lawn expenditures; a research report published in 2019 valued the global lawn and gardening consumables market size at $19.50 billion with an expected compound annual growth rate of 3.6 percent from 2020 to 2027. [7]

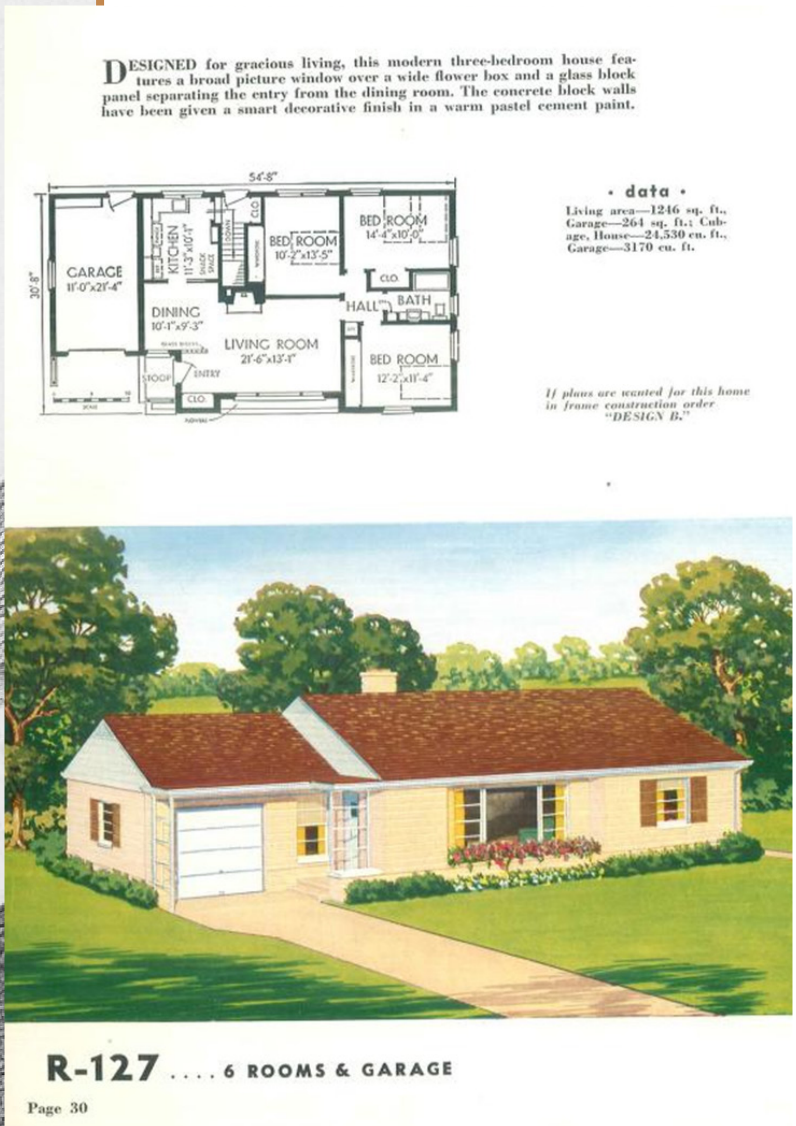

Figure 1 - Example of Ranch Style Home with green lawn, 1951. "Modern Ranch Homes Designed for Town or Country Living," National Plan Service, Inc., 1951.

In recent decades grassy lawns have come under fire for high water usage, interfering with biodiversity, and fertilizer, pesticide, and herbicide use. Extreme drought conditions throughout the American West have led municipalities to limit domestic water use, particularly in relation to lawn watering and golf-course consumption. [8] In 2022 the Idaho Department of Water Resources issued a drought declaration for more than 75 percent of the state's counties, highlighting the severity of the state's water shortage. [9] Idaho's fast-growing population has further strained water supplies and created shortages for new residential subdivisions. In the Treasure Valley, for example, some residential homeowners have had to "pay tens of thousands to drill new wells because theirs have dried up." [10] As climate change and population growth continue, Idahoans will be forced to make choices between domestic and agricultural water use.

[6] Barbara Jane Andersen, "Residential Landscape Water Use and Conservation," 2008, Theses and Dissertations Collection, Digital Initiatives, University of Idaho Library, https://www.lib.uidaho.edu/digital/etd/items/etd_87.html.
[7] Grand View Research, "Lawn and Gardening Consumables Report, 2020-2027," https://www.grandviewresearch.com/industry-analysis/lawn-gardening-consumables-market, accessed December 30, 2022.
[8] The National Weather Service's drought outlook shows "drought persisting" for most of southern Idaho. National Weather Service, Climate Prediction Center, "U.S. Seasonal Drought Outlook," https://www.cpc.ncep.noaa.gov/.
[9] Rachel Cohen, "Idaho's Widespread Drought Declaration Could Mean More Temporary Changes to Water Rights," Boise State Public Radio News, May 3, 2022.
[10] Quoted in Anteia Elswick, "Exploding Population Boom in Idaho is Affecting Domestic Water Supply," Idaho Capital Sun (Boise), August 18, 2022.

Glossary of Terms

Canal (commonly, Ditch). An artificial channel constructed to transport water. See Conveyance System and Figure 38 (below).

a. Main Canal. The primary canal in an irrigation system, which conveys water from the main intake at the water source to a general location closer to the agricultural area. See main intake.
b. Lateral Canal (also Branch Canal). A secondary canal that diverts water away from a main canal and conveys it to the desired location. A lateral canal might convey water to a specific field or group of fields, or be diverted into smaller sub-lateral canals.
c. Distributary Canal. A tertiary canal that diverts water away from a lateral canal and conveys it to the desired location. A distributary canal might convey water to a specific field or group of fields or be diverted into smaller sub-distributary canals.
d. Field Channel. Delivers irrigation water to a water user's Field Application System (Flood Irrigation, Sprinkler System, etc.)

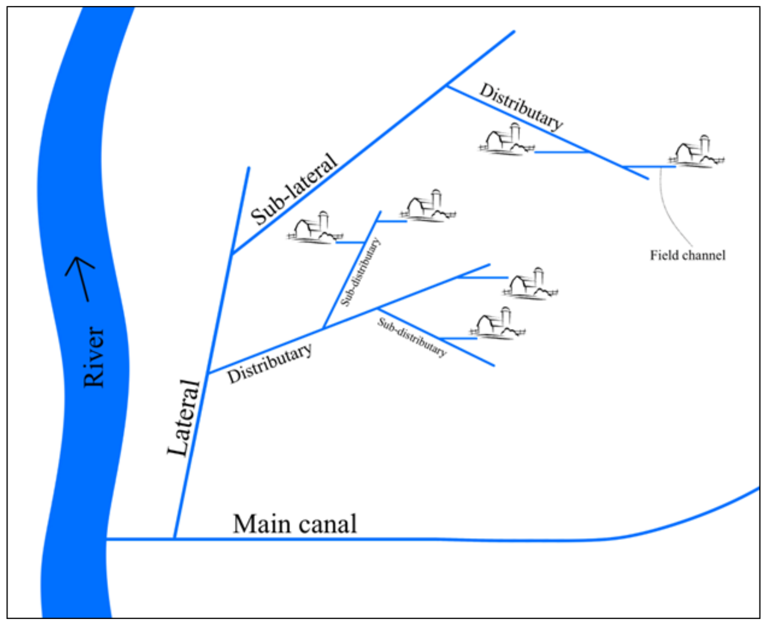

Figure 38 - Canal system: river, canals, laterals, distributaries, and field channels. Illustration Sarah E. Robey.

Center-pivot Overhead Sprinkler System. A sprinkler system in which a wheeled sprinkler line rotates around a single water-access pivot point in the center of a circular field. The length of the line is equal to the radius of the field. When operational, one end of the line stays at the pivot point, while the other travels the circumference of the field. Movement is typically powered by electric motors.

Check. A barrier used to temporarily seal off a portion of a ditch so as to raise the water level above the barrier. This is often used to aid with flood irrigation.

Cofferdam. A small enclosure that is constructed in a body of water to temporarily create an area of dry land. These are often used in the construction of bridges and other structures, as they allow workers to access the bed.

Conveyance System. The series of canals and other waterways that transports water from the water source to the field. This consists of main canals, branch canals, ditches, etc.

Corrugation. A type of furrow in which a series of closely spaced shallow channels is dug into a field for flood irrigation. Corrugation irrigation uses channels that are narrower and placed closer together than those used in typical furrow irrigation. Water is released into a head ditch or pipe on the uphill side of a field, and the water is transferred into the channels. The water then travels downhill along the channels until it has reached the end of the field. These systems are often used to irrigate fields with steep slopes that would be unsuitable for either deeper furrows or sprinkler systems.

Dam. A barrier built along a river or other waterway to control the flow of water. Common types include detention dams, diversion dams, and storage dams. For purposes of irrigation, a storage dam may be used to create a reservoir, or a diversion dam may be used to redirect water into a canal system. In the context of field irrigation, small temporary tarp dams are sometimes installed in ditches for flood or furrow irrigation. See Dam Types.

Dam Types

a. Arch dam. A type of dam with a curved wall that is typically made of concrete. The river presses against the outside of the arch, which is held in place by reinforced abutments. This design allows an arch dam to have relatively thin walls. Arch dams are often used in narrow gorges.
b. Buttress dam (flat slab dam; multiple-arch dam; massive-head dam). Similar to a gravity dam, except that there are supporting buttresses on the downriver side of the dam.
c. Debris dam. A naturally occurring barrier formed by fallen trees and other vegetation. These may block or divert waterways, especially after severe storms and flooding.
d. Detention dam. A dam that regulates water flow, especially for flood control. Detention dams work by capturing flood water and then releasing it at a safe rate.
e. Diversion dam. A dam that redirects water away from a river. Unlike a storage dam, diversion dams do not create a reservoir. Common uses would be to divert water into an irrigation system or into a hydroelectric power plant.
f. Gravity dam (earthen dam; rockfill dam). A type of dam in which the building materials which are held in place by their own weight. Typically they are made of concrete or stone and are constructed in a straight line across the waterway. Because they rely on weight, gravity dams usually require more building materials than arch dams. However, they are simpler to construct and maintain.
g. Saddle dike. A raised barrier built around a low-lying edge of a reservoir to contain water and prevent flooding. A saddle dike allows for more water to be impounded behind a dam. They may be made from a variety of materials, including concrete, earth, and stone.
h. Steel dam. Rare in the United States, steel dams are constructed using steel beams and plating rather than more traditional concrete.
i. Storage dam. A dam that impounds water and creates a reservoir. Common uses would be to store water for purposes of irrigation or hydroelectric power generation.
j. Timber dam. Dams constructed from wooden beams. These are typically small in size, and are often found in the mountains.

Distribution System. The system of canals and pipes that takes water from the main intake and conveys it throughout the irrigation system. See Conveyance System.

Ditch Rider. Someone who manages irrigation systems and regulates water use. They ensure that each farmer is given the proper percentage of water as determined by water rights.

Drainage System. A system used to prevent water buildup in low-lying areas of fields. This water might be the result of irrigation, precipitation, or groundwater. Water is conveyed away from the area of concern using ditches, buried pipes, and sometimes pumps.

Dryland Farming. Also commonly known as dry farming. A type of farming in which irrigation is not used and crops are dependent on naturally occurring water. Typically practiced in areas with suitable rainfall.

Earthen Ditch. An open conduit for water in irrigation systems, earthen ditches are typically large trenches dug into the ground and do not have supports to shore up the banks. Ditches are typically smaller than canals, and earthen ditches may be temporary. Ditches may be used to convey water from canals to fields and may also be used in a field itself for flood and furrow irrigation.

Field Application System. The final step in an irrigation system, where water is applied to a field. Common systems include flood irrigation and sprinkler systems.

Flood Irrigation. An irrigation system in which water is released from a ditch or pipe on the uphill side of a field and allowed to flow downhill across the field. Sometimes furrows are utilized to provide some control over the waterflow. Flood irrigation is simpler but less efficient than sprinkler irrigation, and the water buildup can be detrimental to some crops. See Furrow.

Flume. A shaped channel, typically made of metal or wood, that conveys water from a canal to a specific field or other location. Flumes can be designed to control water flow and play a role in the proper distribution of water shares. Unlike a pipe or culvert, flumes are open at the top.

Furrow. A shallow channel dug into a field for flood irrigation, usually in parallel with other furrows so as to provide coverage for an entire field. Furrow irrigation and corrugation irrigation are very similar, but the channels prepared for furrow irrigation are deeper and placed further apart than those used in corrugation irrigation. Water is released into a head ditch or pipe on the uphill side of a field, and the water is then transferred into the furrows through the use of weirs, gates, or siphon tubes. The water then travels downhill along the furrows until it has reached the end of the field.

Gate. An opening in a canal with a sluice or sliding door that can be opened to allow water to pass through. These are often operated by a hand-wheel, although electric gates are becoming more common. Gates are used to control both water access and water levels in canals. They often have an accompanying metal mesh filter to prevent debris from entering the irrigation system. Smaller gates are installed in ditches and irrigation pipes for some types of flood and furrow irrigation. See Headgate.

Grade. The slope of a waterway or field. This determines flow and water pressure in canals and is a significant factor in the design of canal systems. Grade is also a significant factor in flood irrigation, as it impacts the speed at which the water travels across the field.

Groundwater. Freshwater stored naturally below the surface, often in the form of aquifers. This water may be accessed via wells and provides a significant portion of the water used for irrigation.

Headgate. The primary gate of an irrigation system, and often located at either the main intake or the junction of a main canal and a lateral canal. See Gate and Main Intake.

Impounded Water. Water that is detained by a dam or other obstacle to create a reservoir. This is often done for use in irrigation and to control the flow of water.

Irrigation Company. A privately owned irrigation system in which all water rights are owned by a company, and individual members control shares within the company. Members typically elect a board of directors who make decisions for the company. Companies regulate water allocation, collect fees, and maintain infrastructure.

Irrigation District. A special district created to regulate public irrigation systems within a specified geographic area. Irrigation districts are public and are governed by an elected board of directors. These boards regulate water rights, taxes, and infrastructure.

Main Intake. The point at which water is diverted from a source such as a lake or reservoir and introduced into the main canal of an irrigation system. This will often entail a structure with gates and filters. If needed, a pumping station will be used to overcome an increase in elevation. See Headgate, Main Canal, and Water Supply Source.

Pivot Sprinkler. A type of wheeled sprinkler system that rotates around a central pivot in a circular field. See Center-pivot Overhead Sprinkler System.

Power House. See Power Plant.

Power Plant. A facility used to produce electricity. A common type of power plant is a hydroelectric power plant, which uses flowing water to turn turbines. Some hydroelectric plants rely on a dam to create a reservoir so as to have a stable supply of water.

Prior Appropriation Water Rights. A system of water rights in which the first chronological users to take water from a source for approved beneficial use will retain the right to future use. Subsequent users will retain water rights in the order that they first used the water source. Crucially, in a year with a limited water supply, the first users will be able to obtain their full allotment of water while later users might not have any water at all. A user who does not use their full allotment may lose the difference, creating a "use-it-or-lose-it" system. Unlike in a riparian water-rights system, in a prior appropriation water rights system water rights are not tied to land ownership. See Riparian System.

Pump (also: pumping system). A mechanical device used to move water or to pressurize it. Pumps are often located at the main intake from a reservoir or well, where they are used to move the water uphill. Pumps are also used to increase water pressure for use in sprinkler systems. Pumps may be connected to the electric grid, or they may be powered by gasoline engines.

Pump House. A structure containing a pump. See Pump.

Rill. A type of furrow irrigation. See Furrow and Corrugation.

Riparian System. A water rights system in which water rights are allotted to those who have waterfront property along a water source such as a lake or river. Such water rights do not need to be exercised to be retained. Riparian systems may also allow for rights to use the water source for activities such as fishing in the water source adjoining the property.

Spillway. Part of a dam used for the controlled release of water. Spillways often resemble a ramp or chute. Spillways are typically used when there is excess water behind a dam, such as during spring floods.

Sprinkler. A water applicator, typically attached to a segmented sprinkler line. Some sprinkler heads are stationary, while others rotate or have adjustable movement. Water is conveyed to sprinkler lines from field risers or pivot points, depending on the type of irrigation system in use. Wheel-line and hand-line sprinkler systems are used in rectangular fields, while central pivot systems are used in circular fields.

Surface Water. Freshwater stored above the surface, often in the form of rivers, lakes, and reservoirs. This water may be accessed via canals,

United States Reclamation Service. The former name of the United States Bureau of Reclamation. This agency is part of the Department of the Interior and oversees water resources including irrigation and hydroelectric dams in many states.

Watchman. (See Ditch Rider)

Water Supply Source. The source of freshwater for irrigation or other purposes. It may consist of surface water such as in a river or lake or groundwater such as an aquifer. The irrigation water is diverted at a main intake and then conveyed to an irrigation system. See Surface Water and Groundwater.

Weir. A dam-like structure that regulates water flow along a waterway or at outlets. The height of the weir is designed such that water will pass over the weir if a certain water level is present, allowing for controlled flow. Weirs may be used in irrigation canals and ditches for water allocation and measurement. Often they are made of concrete or metal. Weirs with known dimensions may be used to calculate outflow. See Weir Type.

Weir Type. Weirs with differently shaped outflow notches are used depending on the situation. Common notch shapes include triangular, rectangular, and trapezoidal. See Weir.

Wheel-line Sprinkler System. A wheeled sprinkler line that is moved back and forth across a rectangular field. Movement is typically provided by gasoline engines that power drive wheels. Water is conveyed along the uphill side of the field by a pipe and is then accessed via regularly placed riser valves, which are connected to the wheel line by a removable hose.

Wheel-move Sprinkler. A wheeled sprinkler line that is moved back and forth across a rectangular field. See Wheel-line Sprinkler System.

Wooden Flume. A wooden channel used to convey water. These are often found in mountains where they are used to convey water from dammed streams into irrigation systems.

Wooden Pipe. An early type of pipe used to convey liquids. Wooden pipes may be made from hollowed out logs, or they may be crafted by joining staves together in a manner similar to a wooden barrel. In modern times these have largely been replaced with metal or plastic pipes.

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