

Precious Water: A Survey of Historical Irrigation Records in the U.S. and Their Application to Contemporary Water Resource Issues

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Abstract

The Hohokam Indians are credited with creating the first irrigation systems in the United States around 300 A.D. With the influx of European immigration and settlement in the eighteenth and nineteenth centuries, irrigation and drainage technology became more advanced. However, it wasn't until the early twentieth century and World War II that the Bureau of Reclamation developed irrigation and drainage into a modern engineering science. As a result, state and local irrigation and drainage districts and commission and hundreds of irrigation and drainage companies were created. Over time, the records of these agencies and companies were often destroyed or lost to time. Fortunately, many records were donated to, or collected by, archives and preserved for future use. This article describes key sources of irrigation and drainage records generated by federal, state and local agencies and private companies that are accessible to water resource professionals. Also described are secondary sources of historical irrigation and drainage information that may be useful in solving contemporary problems and issues.

Keywords

Irrigation, Agriculture, Historical Documents, Water Resources

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1. Introduction

Engineers have contributed to the design and development of irrigation and drainage projects in the United States since the mid-1700s (Tanji and Keyes 2002). However, it wasn't until passage of the Reclamation Act of 1902 and continuous work by Bureau of Reclamation engineers that irrigation and drainage technology developed into the engineering science we know today. Despite the continuing progress of irrigation and drainage science, problems persist—such as water re-use, reducing soil salinity, irrigation canal operation, irrigation scheduling, and irrigation system design and modeling. Other issues have recently developed in light of environmental regulations, including liability for irrigation canal and drainage ditch contamination and irrigation-

induced contamination of water, sediment and biota. Fortunately, historical irrigation and drainage records often prove valuable to contemporary irrigation and drainage issues and problems. The principal types of historical irrigation and drainage information resources available to engineers and water resource professionals include irrigation and drainage company records, state and local irrigation and drainage district and commission records, records of Federal agencies mandated with irrigation and drainage responsibilities, and technical and non-technical publications related to irrigation and drainage.

2. How the Past Has Served the Present

Although the modern archival movement is responsible for

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the collection and preservation of private and governmental historical records, that information has less value if not utilized for contemporary gain. In the first irrigation paper published by the U.S. Geological Survey in 1896 the agency stated, “It should be recognized that progress in new fields can never be as rapid as traveling over the old paths. It is only by bringing together clearly and concisely what is already known and building upon this that progress can be made in the utilization of the water resources of the country” (Wilson 1896).

A century later the editor-in-chief of *Water Policy* and a senior advisor at the U.S. Army Corps of Engineers’ Institute for Water Resources noted that “...indictment of past motivations based on current knowledge does not encourage dialogue and stands on weak ethical and historical grounds. Expanding the dialogue to include our water history will help build new ground for debate and consensus building on water and conflict” (Priscoli 1998).

Historical irrigation and drainage records are utilized for contemporary purposes in several ways. Among those are preserving and maintaining institutional knowledge, tracking policy and politics, determining pre-project conditions, and defending engineering decision making in cases of litigation. For instance, the El Dorado Irrigation District (EID), California, which serves nearly 100,000 people in northern California recently instituted the use of ColumbiaSoft © to help manage a quickly growing mountain of paperwork. The district scanned 87 boxes of records which included 79 years of board minutes and resolutions. (ColumbiaSoft 2003).

Another example is Southeast Missouri State University efforts in preserving records of the Little River Drainage District (LRDD). The LRDD was created in 1907 to administer drainage projects in the seven counties comprising southeast Missouri. As the largest drainage district in the United States, the LRDD amassed thousands of pages of records which and “the significance of the collection partly rests on the value of the drainage project itself and partly on the wealth of information available about all phases of life and activity during the engineering project” (Pracht and Banks 2002).

The value of historic irrigation records benefited the En-Joie Golf Club course in Endicott, New York in 2003 when an engineering consulting firm analyzed the historic irrigation records of the golf course in order to determine if permitting and reporting requirements could be minimized. By analyzing past and present water use, the consultant proved that historic water use was grandfathered and a local river basin commission could only levy fees on groundwater withdrawals that exceeded the grandfathered amount (2003 Walter B. Satterthwaite Associates, Inc.).

Yet another example of the value of historical records was a 2008 study of the effect of irrigation on regional temperature in California between 1934 and 2002—a principal source of data was U.S. Department of Agricultural census irrigation data (Lobell and Bonfils 2008).

In 2015, the U.S. Department of Agriculture’s Natural Resources Conservation Service “Environmental Quality Incentives Program” (EQUIP) offers financial and technical assistance to implement conservation practices on eligible agricultural lands. One of the program opportunities applies to irrigated cropland and participants are required to fill out a “Producer self-certification of irrigation history” on which they identify acres of crop irrigated in the previous five years using the following historical resources: irrigation pump records and/or other supporting documentation; irrigation water management plan documentation; and map and/or aerial photographs showing the field(s) with irrigation history.

Although the aforementioned examples show that historical information can benefit contemporary situations it will be interesting to see if such information can be utilized in regards to the global issue of climate change. A detailed literature search conducted by the author did not reveal pertinent examples. However, recently published journal articles and governmental and non-governmental reports suggest that climate change will impact irrigation on a global scale. That assumption is primarily based on water-resources modelling. A recent issue of *Science* (McDonald and Girvetz 2013) examines potential impacts of climate change on U.S. irrigation and notes “the central assumption when making climate change projections...is that past is prologue: how agricultural irrigation changed in response to past climate events is indicative of how it will respond in the future.”

3. The Historical Record

3.1. Records of Irrigation & Drainage Companies

Although government agencies were primarily responsible for the development of the nation’s irrigation and drainage infrastructure, irrigation and drainage companies were also critical to the development of our modern irrigation and drainage system. Typical records generated by these companies included correspondence, incorporation records, stock subscriptions, property records, water applications and water records, right-of-way files, field notebooks, and operation and maintenance records. These records are important to the history of irrigation and drainage because they tell the day-to-day story of irrigation and drainage in the United States.

One such company was the Hawaiian Irrigation Company which was incorporated in 1904. Originally known as the Hamakua Ditch Company, its purpose was to provide irrigated water to plantations located on the Hamakua Coast, including the Honokaa Sugar Co., Pacific Sugar Mill, and Paauihau Planation. The company constructed two ditches which relied on local streams and watersheds as their water source. Records of the irrigation company include corporate records, correspondence, financial records, personnel and payroll book, and water statistics providing daily use records

for 1935-1938. The collection is available to researchers at the University of Hawaii, Manoa library. (Campbell and Ogburn 1989).

Table 1 provides a sampling of historic irrigation and drainage company records that are available to engineers and other water resource professionals. This information was obtained through a search of the Library of Congress's National Union Catalogue of Manuscript Collections (NUCMC)

Table 1. Irrigation & Drainage Companies

State	Entity	Records Location
California	Commonwealth Club of California, Section on Irrigation 1919-1928	California State Archives
	Santa Anna Valley Irrigation Company Records, 1877-1948	California State Library, California History Room
	Spring Valley Mining & Irrigation Company, 1857-1937	California State University, Chico
Colorado	Sutter Mutual Water Company Records, 1881-1954	California State Archives
	Montclair Lateral Irrigation Company Records, 1910-1911	Denver Public Library
	Montezuma Valley Irrigation Company	Colorado State University, Archives & Special Collections
Idaho	North Poudre Irrigation Company Oral History Collection, 1992-1994	Colorado State University, Archives & Special Collections
	Snake River Irrigation Company, 1910-1918	Idaho State Archives
Louisiana	New Orleans Draining Company, 1835-1868	Louisiana State Archives
Minnesota	Adrian Irrigation Company Records, 1899-1901	Minnesota Historical Society
	Northern Pacific Irrigation Company Records, 1883-1914	Minnesota Historical Society
Montana	North Fork Mutual Irrigation Association, 1895	Montana Historical Society
New Mexico	Hagerman Irrigation Company Records, 1904-1983	New Mexico State University, Archives & Special Collections
	Middle Rio Grande Flood Control Association, 1943-1950	University of New Mexico, Center for Southwest Research
	Middle Rio Grande Valley Association, 1922	University of New Mexico, Zimmerman Library
North Dakota	North Dakota Water Users Association, 1959-1983	North Dakota State Historical Society
Oregon	Western Land & Irrigation Company, 1908	Whitman College and Northwest Archives
Utah	Casto Spring Irrigating Company, 1901-1986	Utah State Historical Society
	Draper Irrigation Company, 1903-1977:	Utah State Historical Society
	Dry Creek Reservoir and Irrigation Company, 1951-1988	Utah State Historical Society
	Farmer's Cooperative Irrigation Company, 1902-1932	Utah State University
	Haight's Creek Irrigation Company, 1970s	University of Utah, Marriott Library
	Huntsville Mountain Canal Irrigation Association Records, 1889-1965	Utah State Historical Society
	Melville Irrigation Company, 1907-1930	Utah State University
	North Willow Irrigation Company Records, 1890-1961	Brigham Young University
	Salem Pond Irrigation Company, 1851-1979	Utah Division of State History
	Seventh Ward Irrigation Company, 1924-1950	Utah State University
	Springdale Irrigation Company, 1906-1976	Utah State Historical Society
	Steed Creek Irrigation & Water Company, 1920-1985	Utah State Historical Society
	Tooele City-Settlement Canyon Irrigation Company Records, 1873-1972	Utah State Historical Society
	Union and Jordan Irrigation Company, 1895-1951	Utah State University
	West Cache Irrigation Company Secretary's Papers, 1894-1919	Utah State University
Washington	Okanogan Land & Irrigation Company Records, 1910	Washington State University, Holland Library

3.2. Records of State and Local Irrigation & Drainage Agencies

At the state and local level irrigation and drainage records were primarily generated by irrigation districts, conservation districts, drainage districts, reclamation districts, water conservancies and associations, and water improvement districts. Typical records generated by these agencies included correspondence, field notes and drawings, photographs, maps and plans, and reports. These records are important to the history of irrigation and drainage because they show how irrigation and drainage occurred at the state and local level. Moreover, these records shed light on the economic, political

and social aspects of irrigation and drainage.

One such agency was the Montana Irrigation Commission which was created in 1919 and abolished in 1929. The purpose of the commission was to assist in the organization and management of irrigation districts throughout the state and provide jurisdiction over the sale of water, water rights, and contracting of water for irrigation. Records of the commission include correspondence, petitions, legal documents, reports, and maps relating to the founding of districts, development plans, feasibility reports, and engineering reports. Also include are project histories and surveys. The collection is available to researchers at the

Montana Historical Society Research Center in Helena.
(Arguimbau 2008).

Table 2. Government Agency Irrigation & Drainage Entities

State	Entity	Records Location
California	Madera Irrigation District, 1937:	California State Archives
	Reclamation District No. 341	University of California, Berkeley—Bancroft Library
	Reclamation District No. 551, 1893-1945	University of California, Davis—Shields Library
	Serrano Irrigation District (Orange County), 1971-1973	University of California, Irvine
	San Juan Water District, 1854-1994:	California State Library
Idaho	Ada County Drainage District No. 2, 1918-1957	Idaho State Archives
	Reynolds Irrigation District, 1903-1950	Idaho State Archives
Montana	Buffalo Rapids Irrigation Project, 1932-1954	Montana State Archives
	Montana Irrigation Commission, 1919-1932	Montana Historical Society
New Mexico	Carlsbad Irrigation District No. 1, 1892-1932	Texas Tech University, Southwest Collection
	East Grand Plains Drainage District, 1913-1967	Texas Tech University, Southwest Collection
	Elephant Butte Irrigation District, 1931-1969	New Mexico State University
	Pecos Valley Artesian Conservancy District, 1926-1984	New Mexico State University Library, Archives & Special Collections
	Rio Arriba County, 1847-1957	New Mexico State Archives
	Santa Cruz Irrigation District, 1925-1927	New Mexico State Archives
	Zuber Draw Watershed District, 1957-1970	New Mexico State University Library, Rio Grande Historical Collections
	Texas	High Plains Underground Water Conservation District No. 1, 1928-1976
Hudspeth County Water Conservation & Reclamation District, 1925-1966		Texas Tech University, Southwest Collection
Loving County Water Improvement District, 1902-1937		Texas Tech University, Southwest Collection
Pecos Valley Water Conservancy District, 1926-1984		Texas Tech University, Southwest Collection
Red Bluff Water Control District, 1928-1975		Texas Tech University, Southwest Collection
Ward County Irrigation District No. 1, 1891-1966		Texas Tech University, Southwest Collection
Wichita County Water Improvement District No. 1, 1919-1961		Texas Tech University, Southwest Collection
Wichita County Water Improvement District No. 2, 1898-1983	Texas Tech University, Southwest Collection	
Utah	Bonneville Irrigation District, ca. 1900	Utah State Archives
	Provo Bench Irrigation District, 1865-1914	Utah State University
Washington	Sevier County Drainage District No. 4, 1918-1940	Utah State University
	Middle Kittitas Irrigation District, 1890-1935	Washington State Archives, Central Region
	Priest Rapids Irrigation District, 1920-1951	Washington State University Libraries, Manuscripts, Archives & Special Collections
	Washington State Department of Conservation and Development Irrigation, Diking, Drainage, and Reclamation District Records, 1919-1955	Washington State Archives
	Yakima-Benton Irrigation District, 1934	Washington State Archives
Wyoming	Cody Canal Irrigation District, 1895-1973	University of Wyoming, American Heritage Center
	LeClair-Riverton Irrigation District, 1914-1924	University of Wyoming, American Heritage Center

Table 2 provides a sampling of historic agency records that are available to engineers and other water resource professionals. This information was compiled from a search of the Library of Congress's National Union Catalog of Manuscript Collections (NUCMC).

3.3. Records of Federal Agencies

At the federal agency level irrigation and drainage records were generated primarily by cabinet level agencies with management and research mandates related to agriculture, geology, forestry, and natural resources.

Typical records generated by these agencies included open-file reports, bulletins, circulars, monographs, various regularly and irregularly issued reports and special studies, economic studies, engineering studies, and planning documents.

These records are important to the history of irrigation and

drainage because they preserve scientific and engineering information and illustrate changing theories and attitudes toward irrigation and drainage.

Records of these agencies have been collected and preserved by the National Archives & Records Administration (NARA) and are available for research in various research units ranging from the main office in Washington, D.C. to regional archives, Presidential libraries and Federal Records Centers located throughout the United States. Each federal agency has been assigned a "Record Group" number by NARA.

3.4. Bureau of Reclamation (Record Group 115)

In 1993, the Bureau of Reclamation began a project to document the history of every reclamation project in the western United States. These essays are intended to provide basic historical information about reclamation project

locations, construction history, major features, and economic effects in the area. The Bureau uses these essays for such activities as environmental statement preparation, summaries for publications, briefing presentations, and so on. These project histories can be accessed at <http://www.usbr.gov/history/projhist.html>. The Bureau also manages the National Irrigation Water Quality Program and recent documents pertaining to irrigation can be accessed at <http://www.usbr.gov/niwqp>. Although “current” by definition, these documents provide insight into irrigation contamination issues that have been studied since the mid-1980s. Consequently, this information may be of interest to engineers.

Records of Washington, DC, Administrative Offices 1891-1987

Records of interest include a large collection of maps of the western region of the United States, showing Bureau of Reclamation regional boundaries, precipitation, and locations of federal irrigation and hydroelectric projects, 1934- 87. Also included is information about river basins, including the Colorado, Columbia, Gila, Missouri, and Yakima, showing land classification, irrigable areas, and proposed irrigation and dam development plans, 1908-50. Irrigation information is also contained in specific reclamation projects (arranged alphabetically); including detailed plans of the Columbia River Basin Project, 1904-85 and farm unit plats of townships in federal irrigation project areas, 1907-55. Historic photographs of interest include irrigation projects in foreign countries, 1920-27; unsuccessful, incomplete, and small irrigation projects, 1904-31 and irrigation projects in the western and southern United States, 1914-34.

Records of the Office of the Chief Engineer, 1889-1981

Notices and applications related to irrigation projects, districts, and water rights, 1905-49

Records of Region 2, Mid-Pacific (Sacramento, CA):

Consist of correspondence; minutes of meetings of planning boards, committees, and special commissions; planning, geological, and geographical reports; final construction reports for dam foundations, canals, and pumping operations; press releases; field books and other computations relating to surveys for the Cachuma Project in California, 1935-76; reports and correspondence relating to proposed reclamation projects, 1928-80; studies and reports relating to irrigation projects in California, 1935-72; and design and construction reports for dams and other irrigation projects in California, 1947-79.

Records of Region 4, Upper Colorado (Salt Lake City, UT)

Consist of field notes and other records pertaining to the Carlsbad, Hondo, Pecos River, Provo River, and Rio Grande

projects, 1890-1960 and correspondence relating to water user organizations and irrigation works, Rio Grande Project, 1891-1914.

Records of Region 6, Upper Missouri (Billings, MT)

Includes records of demonstration projects on the Milk River irrigation project, 1930-35.

Records of Project Offices

Records of interest include Navajo Indian Irrigation Project (Farmington, NM), 1964-65; project land classification maps for irrigation project lands in Colorado, Utah, and Wyoming, created by the Grand Junction Projects Office, 1952-66; interfiled maps, concerning the Navaho Indian Irrigation Project reappraisal, 1964-65; and construction of the Dolores River irrigation project in southwest Colorado, 1982-84.

Other Field Office Records

Includes thousands of photographs of construction of Almena, Bostwick, Franklin, Glen Elder, Kirwin, Scandia, and Superior irrigation projects in Kansas and Missouri River Basin, 1952-68.

3.5. U.S. Department of State (Record Group 59)

Records of the department relating to the *New Mexico Territory* (1851-1872) include observations made by the U.S. Army relating to irrigation, crops, trees, and vegetation. *Reports of clerks and Bureau officers* include records of negotiations with Mexico concerning the irrigation of arid lands on and near the Rio Grande in 1888. Finally, general records of the *International Waterways Commission, U.S. and Canada* (1905-1915) include Mouse River and Mil River irrigation projects records.

3.6. U.S. House of Representatives (Record Group 233)

The U.S. House of Representatives has a long tradition of dealing with irrigation and drainage issues. This is reflected in the records of the Committee on Interior & Insular Affairs and its Predecessors: *Records of the Committee on Indian Affairs, 1805-1951*: records of interest include those relating to rights-of-way for irrigation ditches, canals, and dams on Indian Territory. In addition, there are bill files containing records related to irrigation projects. *Records of the Committee on Irrigation of Arid Lands, 1893-1924*: Records of this committee relate to preemption and disposition of lands on reclaimed and irrigated projects; authorization of interstate compacts and agreements regarding irrigation projects; and disposal of drainage waters from irrigation projects. Of particular interest is a 28 page report published in 1935 that summarizes individual projects, including names

of the irrigation district, date and amount of payments, and size of the project. *Records of the Committee on Interior & Insular Affairs, 1951-1968*: this committee had jurisdiction over interstate compacts related to apportionment of waters for irrigation purposes and easements of public land for irrigation projects; and acquisition of private lands when necessary to complete irrigation projects. *Records of the Agricultural Committee, 1820-1968*: records include a transcript of an 1888 hearing on the development of arid regions of the west by irrigation. *Records of the Committee on the Census, 1901-1946*: includes statistical data on irrigation.

3.7. U.S. Senate (Record Group 46)

The U.S. Senate has also dealt with irrigation and drainage issues as reflected in records of the following committees. The *Committee on Irrigation and Reclamation of Arid Lands, 1891-1946* generated records such as committee papers, petitions, memorials, and resolutions of state legislatures, legislative dockets, and minutes. Of particular interest are petitions and memorials which reflect farmers and ranchers concerns of the Great Plains and western states (i.e. the use of irrigation and diversion projects). Also interesting are 1903 transcripts of presenting the testimony of Frederick Newell, chief engineer of the reclamation service regarding the delay of irrigation projects. The *Committee on Interior and Insular Affairs, 1947-1968* generated records relating to irrigation and reclamation projects, including the acquisition of private land to complete projects and interstate compacts relating to apportionment of water for irrigation purposes.

3.8. Bureau of Agricultural Economics (Record Group 83)

Records of the Division of Farm Management & Costs

Includes 10 maps of the Tieton irrigation district, Yakima County, Washington published in 1937.

Records of the Division of Land Economics

Includes maps of irrigation projects published between 1931 and 1946.

Records of the Western Regional Office

Includes more than 80 maps of irrigation projects in the Columbia basin, Washington published in 1939-1940.

3.9. Bureau of Agricultural Engineering, Drainage Division (Record Group 8)

This series consist of photographs relating to Civilian Conservation Corps (CCC) drainage projects performed by Division of Drainage camps established in the Bureau of Agricultural Engineering's Central Division. The camps were located in Illinois, Indiana, Iowa, Kentucky, Missouri, and

Ohio. The photographs are arranged under broad subject categories. Under Clearing, the largest category, are pictures of project areas taken before and after the clearing of ditches, basins and channels of silt and other debris. Also included are photographs showing the repair and construction of levees. Emergency Work includes photographs of repair to drainage systems following emergencies, including natural disasters such as tornado cleanup assistance in Missouri (see Camp D-2) and enrollees assisting in unloading barges at flooded Harrisburg, IL (see Camp D-5). Filed under Floods are photographs of flooded fields caused by poorly functioning drainage systems and natural disasters, as well as miscellaneous flood damage. The Miscellaneous category contains photographs of enrollees, equipment, pumping plants, camp buildings, rodent control activities, fence building, rock quarrying, anniversary celebrations at Camp D-3 in Missouri, and an Illinois State Fair exhibit (see Camp D-1). Under Research are photographs of research sites and hydraulic research projects. The subject category Structures includes photographs of roads, bridges, headwalls, watergates, culverts, check dams, inlets and outlets constructed to control the flow of water. The last category is Tile and filed under this category are photographs of tile pipelines and drains.

3.10. Bureau of Indian Affairs (Record Group 75)

Case Files for Irrigation Projects on Indian Reservation in Western States, 1907-1946

The case files in this series include reports, correspondence, estimates, and work papers for irrigation projects on various Indian reservations in California, Nevada, Utah, Arizona, Oregon, and Washington. The records were maintained by a San Francisco-based district office of the Office of Indian Affairs Irrigation Division and later sent to the Portland Area Office.

Records of the Irrigation Division, 1891-1948

Included is general correspondence, 1901-31. Annual reports of the Chief Engineer, 1908-24, 1932. Annual district and project reports, 1908-40. Monthly progress reports, 1907-35. Reports and related records, 1891-1946. Summary irrigation data sheets, 1910- 29. Weekly and biweekly activity reports, 1934-36. Monthly financial statements for projects of the Bureau of Reclamation, 1918-24. Miscellaneous files relating to irrigation structures and projects, 1924-45 and Missouri River Basin reports and related records, 1946-52. Also included are maps of Indian reservations and glass lantern slides and negatives of irrigation projects on Indian lands in Montana, the Dakotas and Arizona, 1914-1917.

Irrigation Project Case Files, 1910-1960

This series is comprised of letters, reports, and other records that document irrigation projects constructed and operated by the U.S. Office of Indian Affairs, Irrigation Division, and its successor, the Irrigation Division of the Portland Area Office. Projects involved various sites, including Indian reservations, in Idaho, Oregon, Washington, Montana, and California. Some of the records in this series pre-date 1924, when the Irrigation Division of the Office of Indian Affairs (OIA) was formally established.

Edward E. Hill, in "Records of the Bureau of Indian Affairs" (National Archives and Records Service, 1965), describes a complex and shifting administrative structure for irrigation operations before 1924: "Until 1907, the Land Division was responsible for irrigation activities. In that year the Field Work Division (also known as the Cooperative Division) was established and given responsibility for irrigation; by the end of 1908 the Field Work Division had been reduced to a section in the Office of the Chief Clerk. In 1909 the section was abolished and irrigation activities were transferred to the Uses Section of the Land Division. In 1910 a separate Irrigation Section was established in the Land Division; but, later in the year, it was combined with the Forestry Section to form the Field Section. In 1912 the Field Section was again divided into an Irrigation Section and a Forestry Section, and they were no longer part of the Land Division."

Regarding irrigation operations in the field, Hill notes that the office of Chief Engineer was formally established according to an act of March 3, 1905. He says that "Irrigation districts were gradually established, and superintendents were placed in charge. Permanent districts were established by law in 1918, and the superintendents of irrigation became known as supervising engineers." Irrigation related records can also be found in relating to the Flathead irrigation project, Montana, Indian Irrigation Service District 4, Arizona, and Wapato Irrigation Project, Washington.

3.11. Bureau of Land Management (Record Group 49)

Records of Division "F" (Railroad, Rights-of-Way, and Reclamation Division)

Records of interest include canal and reservoir grants, 1891-1929, related to land granted for irrigation purposes under the Canal and Ditch Companies Right of Way Act (26 Stat. 1095). Also present are manuscript and annotated maps showing rights-of-way through public lands for, among others, irrigation ditches.

3.12. Bureau of Plant Industry, Soils and Agricultural Engineering (Record Group 54)

Records of the Division of Fruit and Vegetable Crops and

Diseases

Records of interest include photographs of irrigation methods, 1901-34.

Records of the Division of Western Irrigation Agriculture

Textual Records pertaining to irrigation include general correspondence, 1901-37; annual and miscellaneous reports and notes relating to experiment farms, 1907-32, and weekly bulletins, 1911-37.

3.13. Farmers Home Administration (Record Group 96)

Records of Region 9, San Francisco, CA (CA, NV, UT, and AZ)

Records of interest include photographs of irrigation and agricultural projects in Ventura, CA 1935-42.

Farm Irrigation Division

This division was established in 1939 and abolished in 1953. Records of interest include maps of the western United States showing irrigation assistance, irrigation maps of California and Texas as well as architectural and engineering plans that include construction plans of irrigation ditch sand traps.

Records of the Northwest Region (Region 9)

This region was established in 1935, with jurisdiction over MT, WY, ND, and SD. Records of interest include photographs taken between 1935 and 1939 of irrigation systems.

3.14. Geological Survey (Record Group 57)

Records Relating to the Powell Irrigation Survey

John Wesley Powell, the second director of the Survey is legendary as a civil war soldier, scientist, and pioneering explorer. These records concern field operations, 1889-90, irrigation reports, 1893-98, disbursement ledgers, 1888-89, and journals of expenditures, 1894-99.

Records of the Quality of Water Branch

Among the files are the results of the analyses of surface waters for irrigation purposes, 1947-48.

3.15. Secondary Sources of Interest

Although primary records are a desirable source of historical irrigation and drainage information, secondary sources such as publications are useful as well. The professional journals, trade magazines, and conference proceedings published between the 1830s and the end of the 20th century profile, characterize and track the evolution of irrigation and drainage science, technology, politics, and economics. Other

irregularly published documents such as bibliographies and government reports (bulletins, monographs, and circulars) prove valuable as well. The diversity of these publications is interesting as well, not all come from the engineering or agricultural perspective, but from other disciplines such as medicine, economics, and the law.

The following are examples of specific publications the author has utilized in documenting historic land uses of agricultural, farming and arid lands in the American west or in understanding general issues related to irrigation.

Journals and Magazines

Agricultural Water Management

Since 1976 this journal has published articles focusing on policies, science, and the economics of managing agricultural water. An excellent review article was published in 1994 (v. 25) by a USDA employee that examined the benefits and inherent problems related to irrigation from prehistoric times to the present.

Journal of Irrigation and Drainage Engineering

Although the focus of this journal is on engineering, the 2002 November/December issue included a fine historical review of irrigation and drainage activities as related to the charge of the American Society of Civil Engineers in its jubilee year.

Journal of the West

This journal has been published since 1962 and is perhaps the best source of historical information about all aspects of development in the western states. A 1990 article by M. Catherine Miller (v29n4) examined the 20-year history of litigation between a large privately owned irrigation company and the farmers who depended on the water source and the rates they were forced to pay the company.

Scientific American

This stalwart science publication has published numerous articles relating to irrigation and drainage. In July 1923 the article "Draining Land with Gasoline" (v. 129 n. 1) described the use of machinery for marshland ditching which was brought about by a scarcity of labor. Thus fulfilling the old saw "necessity is the mother of invention."

The American Economic Review

The standard bearer of economic journals, a March 1911 article (v. 1 n. 1) examined problems related to irrigation, including...

The Engineering Magazine

Defunct magazines are a treasure trove of irrigation and drainage history. An 1896 issue of this magazine (v.11n1)

examined pump irrigation on the Great Plains and include photographs of actual pump systems in Kansas and Nebraska.

The Irrigation Age

This journal was published between 1891 and 1919 by the American Irrigation Federation and was a major source of irrigation news in the United States. In just one issue in July 1896 were articles about practical irrigation in Kansas, the art of irrigation, irrigation and subsoiling, water supplies for irrigation, and legislation relating to irrigation. In addition to feature articles each issue include regular columns about farming, the irrigation industry, and critical topics of the day. It is one of the best sources of historical information about U.S. irrigation and drainage.

The Journal of Political Economy

Published since 1892, this journal examined economics through the lens of politics. An article from 1904 (v.12n2) profiled the organization of irrigation companies in the United States, which was pertinent to water rights research I was conducting in Washington State for agricultural land located near Yakima, the center of fruit growing in the state.

Transactions of the American Society of Agricultural Engineers

Transactions of the ASAE include numerous articles on irrigation and drainage. An excellent article in 1998 (v. 41 n.5) examined the history of surface drip irrigation from its inception in the 1960s.

Technical Publications

U.S. Department of Agriculture

This agency has published more than 2,000 technical bulletins since 1927. Technical Bulletin No. 379 *Irrigation Requirements of the Arid and Semiarid Lands of the Pacific Slope Basins* published in 1933 detailed irrigation needs of the watersheds of the Columbia and Colorado Rivers, as well as most of the state of California and southwest Oregon. The agency also published an annual yearbook between 1894 and 1992 and their contents often included irrigation and drainage related information. For example, in 1900 staff from the department's Office of Experiment Stations wrote a chapter on practical irrigation which included detailed drawings and tables intended to assist farmers with irrigation system design.

In the early 20th century, the agency published a series titled *Reports of Irrigation Investigations*. The report for 1900 noted that it contained "the results of one year's study of the problems which confront irrigators in conserving, distributing, and using water "(Mead 1902). The report included reviews and discussions of investigations in general as well as specific sections relating to seepage losses,

pumping, and water sampling, among others. Also included were reports of special agents and observers for all states and territories in which the department was conducting investigations. Lastly, was a report on the progress of silt measurements in various rivers and reservoirs.

The department has collected census related irrigation data in one form or another since 1890. Specific surveys of irrigation in humid areas were conducted in 1954 and 1959. The most recent Farm and Ranch Irrigation Survey (FRIS) in 2013 is the eighth survey to focus solely on farm irrigation data. Surveys conducted in 1979, 1984, 1988 and 1994 were conducted by the Bureau of the Census, however surveys since then have been conducted by the department. According to the department (National Agricultural Statistics Service 2014) “survey data are used by producers, farm organizations, businesses, State departments of agriculture, elected representatives and legislative bodies at all levels of government, public and private sector analysts, the news media, and colleges and universities.” The FRIS is perhaps the best source of information on irrigation and water use by farms, ranches, and horticulture operations in the United States.

U.S. Geological Survey

A treasure trove of historical irrigation and drainage information is available from the U.S. Geological Survey’s publication warehouse at <http://infotrek.er.usgs.gov/pubs>. For instance, a simple title keyword search using reveals that 428 documents have been published since 1896 relating to all aspects of irrigation and drainage. The publications that include this information are Circulars, Bulletins, Monographs, Open-File Reports, Professional Papers, Scientific Investigation Reports, and Water Supply Papers. Water-Supply and Irrigation Paper No. 1 was published in 1896 and concerned pumping water for irrigation. In its preface F.H. Newell, Hydrographer in Charge of the Survey noted “In a new and rapidly developing country, such as the arid region, where methods of raising water for agriculture are constantly being modified and improved, it is desirable to have in mind all of the ways which have been found of value in the past.”

4. Conclusions

The success of American agriculture has been dependent on steady and reliable sources of water. In the arid lands of the western states the lack of this resource prevented the development of farming and associated infrastructure. However, with the advent of successful irrigation and drainage technologies and processes in later half of the 19th century, the success of farming in the west was more assured.

Because irrigation and drainage issues continue to arise and there is often a need to revisit the past to determine how the present was achieved. Historical irrigation and drainage records are an important resource in that regard and we can thank archivists for maintaining, collecting, and preserving these records.

A recent article in the *Journal of Western Archives* (Rettig 2012) examines the importance of Colorado Ditch Company collections in archival repositories and its author observes that “Understanding the history of irrigation is crucial as organizations, communities, and individuals make water-related choices and decisions about the West’s future.” That is wise counsel and the historical information in this article may provide the impetus for contemporary engineers and water resource professionals to seek out the past to help contemporary and future issues related to irrigation and drainage in the United States. From a global perspective, similar records are available in archives in other countries. Therefore, this U.S. overview may serve as a template for those seeking historical irrigation records in developed and developing nations.

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