

HAER No. CO-43-A

High Line Canal, Sand Creek Lateral  
Beginning at the intersection of Peoria Street and  
the High Line Canal in Arapahoe County (City of  
Aurora), the Sand Creek Lateral extends fifteen miles  
in a northerly direction through Arapahoe County, the  
City and County of Denver, and Adams County to its  
end point, approximately one-quarter mile southeast  
of the intersection of D Street and 9th Avenue in  
Adams County (Rocky Mountain Arsenal, Commerce City  
Vicinity)

Commerce City Vicinity  
Adams County  
Colorado

HAER  
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1-COMCI,  
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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

HISTORIC AMERICAN ENGINEERING RECORD  
Rocky Mountain System Support Office  
National Park Service  
P.O. Box 25287  
Denver, Colorado 80225-0287

**HISTORIC AMERICAN ENGINEERING RECORD  
HIGH LINE CANAL,  
SAND CREEK LATERAL  
ADAMS COUNTY, COLORADO  
HAER No. CO-43-A**

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COLO  
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**Location:** *Commerce City vicinity*  
Beginning at the intersection of Peoria Street and the High Line Canal in Arapahoe County (City of Aurora), the Sand Creek Lateral extends fifteen miles in a northerly direction through Arapahoe County, the City and County of Denver, and Adams County to its end point, approximately one-quarter mile southeast of the intersection of D Street and 9th Avenue in Adams County (Rocky Mountain Arsenal).

**UTM Coordinates:** Headgate of the Sand Creek Lateral (at High Line Canal)  
Zone 13 Easting 513140 Northing 4396680

Terminus of the Sand Creek Lateral (in Sec. 25, T2S, R67W)  
Zone 13 Easting 513590 Northing 4411380

Note: The High Line Canal, Sand Creek Lateral, is located in Adams and Arapahoe counties and the City and County of Denver, Colorado. However, for shelving purposes at the Library of Congress, Adams County, Colorado, was selected as the "official location."

**Quadrangle Maps:** Commerce City, Colorado (1965, revised 1994)  
Fitzsimons, Colorado (1965, revised 1994)  
Montbello, Colorado (1965, revised 1994)

**Date of Construction:** 1882-83

**Present Owner:** United States of America  
Rocky Mountain Arsenal Wildlife Refuge

**Present Use:** Not in use

**Significance:** The Sand Creek Lateral was constructed by the Northern Colorado Irrigation Company as part of its High Line Canal irrigation system created on the plains northeast of Denver in 1879-1883. The fifteen-mile lateral, a component of the largest canal system completed in Colorado, stimulated settlement and

agricultural development of the area. The creation of the Rocky Mountain Arsenal in 1942 brought the northern part of the Sand Creek Lateral within its boundaries. The lateral carried waste generated by the Arsenal's South Plants' chemical and incendiary weapons production between 1942 and 1956. The lateral also provided irrigation for asparagus crops raised by prisoners of war during World War II. During the 1950s, these same irrigated lands were leased by farmers for cattle grazing and for the production of wheat and barley. In the 1960s, the lateral was used to irrigate fields of experimental wheat rust spores and to transport contaminated water. While the portion of the ditch on the Arsenal no longer carries water, the waterway still retains many original features which represent late nineteenth and early twentieth century irrigation technology in Colorado. This project recorded the bifurcation point of the Sand Creek Lateral from the High Line Canal and the 5.8 miles of the lateral within the Rocky Mountain Arsenal.

**Historians:**

Thomas H. Simmons and R. Laurie Simmons, Front Range Research Associates, Inc., Denver, Colorado, August 1998.

## Historical Background

### Introduction

Early travelers through the eastern high plains of Colorado found little promise that the region would support widespread settlement. This concept achieved general acceptance after the Great Plains were described by explorer Zebulon Pike as "sandy deserts" in 1810 and included as part of a "Great Desert" identified on an 1822 map drawn under the supervision Stephen H. Long. Gradually, a new vision of the area as a western prairie of vast untapped potential was introduced and popularized by writers such as John C. Fremont and William Gilpin. Settlement of Colorado came rapidly beginning with 1859 mineral discoveries, but agricultural development lagged as farmers were forced to invent and employ new techniques of production adapted to the untested climate and terrain. Developers and businessmen believed that the success of mining rested partially upon the creation of a flourishing agricultural sector and sought ways to encourage its growth. The largest and most ambitious of the nineteenth century projects which attempted to bring agricultural settlement to Colorado was the High Line Canal, of which the Sand Creek Lateral was an integral component.<sup>1</sup>

Colorado's early promoters asserted that irrigation systems would turn the state into a veritable garden spot by providing a reliable source of water. They also believed that readily available water would allow the establishment of smaller farms and attendant denser settlement. The first irrigated farming in the state had been undertaken by Spanish colonists in the San Luis Valley in the early 1850s. In 1859, David K. Wall of Golden made the first successful attempt at irrigated farming in the Denver area, ushering in a period of trial and error by farmers who were used to conditions in more humid sections of the country. Organizations such as the Colorado Agricultural Society aggressively promoted the state's irrigated farming possibilities and enterprises such as Greeley's 1869 Union Colony further tested and developed irrigation techniques. The colony purchased 12,000 acres of Denver Pacific Railroad land along the Cache la Poudre River in northern Colorado and constructed ditches from the river to its agricultural fields in the early 1870s. Inspired by the success of the Union Colony, the 1870 Chicago-Colorado Colony bought 55,000 acres of land to be irrigated by St. Vrain, Left Hand, and Boulder

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<sup>1</sup>William H. Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York: W.W. Norton & Co., 1966), 51 and 62; and Carl Abbott, Stephen J. Leonard, David McComb, *Colorado: A History of the Centennial State*, rev. ed. (Boulder: Colorado Associated University Press, 1982), 165.

Creeks, built canals, and established the town of Longmont. In 1872, a colony was established at Fort Collins and a ditch was constructed in 1873-1874 to serve the settlement.<sup>2</sup>

In October 1873, a Denver irrigation convention with participants from the western states and territories petitioned Congress to pass laws supporting the construction of irrigation systems in the West, thereby increasing the value of land, encouraging settlement, supporting mining, and providing a market for railroads. President Ulysses S. Grant, who visited Colorado in 1873, became an early advocate of irrigation development, urging federal endorsement of western water interests. Grant promoted a plan to encourage settlement in arid parts of Colorado and beyond through the construction of an irrigation system extending from the eastern slope of the Rocky Mountains to the Missouri River. He suggested that government and private interests could work together on an immense project which would benefit many. Although the enormous system was then beyond the financial capabilities of the federal government, the general concept validated the belief that western agricultural development was an important national goal and it won many proponents.<sup>3</sup>

The proliferation of canal systems during the early 1870s soon led to attempts to create an organized system of water ownership. Following the completion of the Fort Collins ditch, the Cache la Poudre Valley experienced a drought and there was not enough water in the river to supply the ditches already created. A conference in Fort Collins discussed methods of equitably distributing the waters of the stream by establishing water rights and a commission to oversee their protection. Colorado irrigators were confronted with the reality of a limited water supply which required careful apportionment.<sup>4</sup>

The 1876 Colorado constitution addressed concerns about western water development by establishing the state's legal framework for water appropriation.

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<sup>2</sup>Abbott, 157-158; Mel Griffiths and Lynnell Rubright, *Colorado: A Geography* (Boulder, Colo.: Westview Press, 1983) 216; Rodman W. Paul, *The Far West and the Great Plains in Transition, 1859-1900* (New York: Harper & Row, 1988), 236; Robert G. Dunbar, *Forging New Rights in Western Waters* (Nebraska: University of Nebraska Press, 1983), 88.

<sup>3</sup>Carl Ubbelohde, Maxine Benson, and Duene A. Smith, *A Colorado History*, rev. ed., (Boulder, Colo.: Pruett Publishing Co., 1976), 198; *Rocky Mountain News*, 1 January 1884, 1; Eerl L. Mosley, "History of the Denver Water System," manuscript on file at the Denver Public Library, 383; and James E. Sherow, "Watering the Plains: An Early History of Denver's Highline Canal," *Colorado Magazine* 4(1988): 2.

<sup>4</sup>Dunbar, 88.

Riparian rights, the product of common law doctrine regarding water, was found inapplicable for Colorado and state control of water was asserted. Under the Riparian Rights Doctrine, owners of lands along the banks of a stream or other body of water had the right to reasonable use of the waters and protection against unreasonable use of the waters by others that diminished the quantity or quality of water. The right did not depend on prior use. In areas of plentiful water, the Riparian Rights Doctrine had proven satisfactory. In Colorado too little land contacted water for the system to be fair and effective. The state favored the Doctrine of Prior Appropriation (also known as the principle of "first in time, first in right"), which held that the first person to appropriate water and apply it to a beneficial use had the first right to use that amount of water from that source. Each successive appropriator could only take a share of the water remaining after all senior water rights were filled. In Colorado, priority of appropriation was granted to domestic (urban) use over any other, with agricultural and manufacturing uses ranked second and third in priority. Each water right was to be determined by a court-adjudicated date. The owner of a water right was required to demonstrate beneficial use of claimed water or the courts could take away the portion of the right not used. In 1878, farmers proposed a system of water regulation to the Colorado General Assembly, and 1879 and 1881 legislation divided the state into three water divisions and ten districts headed by water commissioners. The entire system was regulated according to water right dates by a state engineer. This combination of governmental water regulation and adoption of the concept of prior appropriation became known as the "Colorado System."<sup>5</sup>

By the mid-1870s, the expense of successful large-scale canal construction required corporate or cooperative involvement, and a number of private enterprises formulated speculative schemes to attract agricultural settlement by building large scale water delivery systems on the plains. In 1876, the first attempt to build an irrigation network following President Grant's grand vision was initiated. A group of Denver businessmen led by real estate speculator Edward Reser incorporated the Colorado Irrigation Company after securing an option to develop 100,000 acres of railroad grant land owned by the Kansas Pacific. The irrigation company invited the public to support the project, but failed to secure sufficient capital to proceed with the venture. In 1877, the Denver Canal and Irrigation Company proposed to construct a canal which would irrigate lands and operate boats for transportation of freight. The project never progressed beyond the planning stage. Although the

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<sup>5</sup>Abbott, 163; Ubbelodde, 198; Sherow, 5; John J. Roberts, "High Line Canal," *Historic American Engineering Record*, HAER No. CO-43 (Loveland, Colorado: Fraserdesign, May 1994), 2-3; and Daniel Tyler, *The Last Water Hole in the West* (Niwot, Colo.: University Press of Colorado, 1992), 480-481.

construction of a canal system on the plains was widely discussed during the 1870s, no real progress was made until the end of the decade.<sup>6</sup>

### The High Line Canal

When railroad magnate Jay Gould moved toward merging the holdings of the Union Pacific and Kansas Pacific in 1879, he sought local participation in efforts to develop railroad grant acreage in Colorado. Gould suggested creation of a private irrigation project which would attract settlers wishing to pursue agricultural opportunities on Kansas Pacific lands. James Barclay and James Duff, vice presidents of the English-owned Colorado Mortgage and Investment Company, Ltd., known locally as "the English Company," expressed interest in the plan. Their firm was the most prominent representative of the widespread British investment in Colorado during the nineteenth century. The English Company, under the direction of Barclay and Duff, played a prominent role in the development of Denver; invested in banking, mining, and cattle; and was heavily involved in the construction of irrigation systems in the state.<sup>7</sup>

The English developers proposed that a subsidiary of their company construct and operate a canal from the South Platte River which would turn the unproductive Kansas Pacific acreage into desirable farm land. In November 1879, a newspaper article announced that "the long projected High Line Irrigating Canal" was likely to be constructed by the English capitalists. On 22 December 1879, the Northern Colorado Irrigation Company was incorporated in Colorado to construct the High Line Canal. On 12 February 1880, the articles of incorporation of the Platte Land Company, Ltd., a British corporation, were filed with the Colorado Secretary of State. The Platte Land Company was organized by the same people, was under the same management, and had many of the same stockholders as the Colorado

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<sup>6</sup>State Engineer of the State of Colorado, Third Biennial Report of the State Engineer of the State of Colorado for the Years 1885-1886 (Denver: Collier & Cleaveland, 1887), 218; Walter H. Graves, "Irrigation and Agricultural Engineering: Paper read before the Society of Engineers at a meeting in Denver, Colorado, June 1888" (Denver: Republican Publishing Co. Printers, 1886), 4; *Danver Republican*, 11 July 1890, 6; Sharow, 4; and Mosley, 383.

<sup>7</sup>The Colorado Mortgage and Investment Company of London, Ltd., filed its articles of incorporation with the Colorado Secretary of State in 1877. In 1880, the company was reorganized as the Colorado Mortgage and Investment Company, Ltd. Denver Water Board, "The Northern Colorado Irrigation Company History," 21 April 1928; Sharow, 4; Lyle W. Dorsett and Michael McCarthy, *The Queen City: A History of Denver*, 2nd ed., (Boulder: Pruett Publishing Co., 1986), 81; and Thomas J. Noel and Stephen J. Leonard, *Denver: Mining Camp to Metropolis* (Niwot, Colo.: University Press of Colorado, 1990), 48.

Mortgage Company. It was created to buy and sell tracts of land to farmers at a profit. The Northern Colorado Irrigation Company would sell water right deeds entitling holders to irrigation water for a specified acreage from the canal at stated periods during the growing season. An annual rent fee was also charged on a per acre basis to the water right holders. Under this system, the Platte Land Company sold 31,000 acres of land with water rights and almost 30,000 acres without.<sup>8</sup>

During the peak decade of canal building in Colorado in the 1880s, the Colorado Mortgage Company played a major role in the growth of irrigation systems in the South Platte basin and in the expansion of agriculture on the eastern plains. The company was one of the corporations whose "profit-oriented ditchdigging . . . nearly quadrupled the number of farms in the state and sketched out the basic canal system of Colorado's Eastern Slope." Through a subsidiary firm (the Larimer and Weld Irrigation Company organized in 1879) it built the Larimer and Weld Canal, popularly known as the Eaton Ditch, in the Cache la Poudre drainage in 1879. The Eaton Ditch, one of the largest canals in the state, brought thousands of acres of land into farm production. In 1881, another subsidiary (the New Loveland and Greeley Irrigation Company) built a large canal from the Big Thompson River. In 1883, another subsidiary, the Platte Valley Irrigation Company, constructed the large Platte Valley Canal.<sup>9</sup>

With the High Line, the Colorado Mortgage Company undertook the largest canal project ever completed in Colorado, a seventy-mile canal with two large laterals. With an ultimate goal of supplying water for over 650,000 acres in eastern Colorado, the Platte Land Company contracted with to purchase about 100,000 acres of Kansas Pacific land tributary to the South Platte River at \$1.25 per acre. The Colorado Mortgage and Investment Company also purchased a large amount of land which would be adjacent to the High Line. The Northern Colorado Irrigation Company supervised construction of the canal, employing local builders along segments of its route. Future Colorado Governor Benjamin H. Eaton, who had worked for the company on the Eaton Ditch, was awarded the contract for excavation of the ditch. Construction began on 18 January 1879, although the overall design was not yet final.<sup>10</sup>

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<sup>8</sup>Mosley, 384 and 561; Roberts, 5; and Sherow, 7.

<sup>9</sup>Abbott, 162-163; and Ansel Watrous, *History of Larimer County, Colorado* (Fort Collins, Colo.: The Courier Printing & Publishing Co., 1911), 209 and 283.

<sup>10</sup>Denver Water Board, "Northern Colorado;" *Rocky Mountain News*, 1 January 1884, 15; and Roberts, 4-7.

In January 1881, the **Rocky Mountain News** reported that from its head in the Platte Canon, the High Line Canal traveled out of the foothills and onto the prairie on a northeasterly line through lands near Littleton and south of Denver, crossing Cherry Creek about ten miles above Denver. From there, the canal traveled on an easterly course roughly parallel to the Kansas Pacific railroad until it reached Coel Creek, where it began a more northerly course, crossing the Kansas Pacific tracks just east of Schuyler and then resuming an easterly course to Box Elder Creek. The article reported for the first time on plans for laterals such as the Sand Creek Lateral from the main canal:

From the main trunk, several branches of less carrying capacity, will be led along the summits of the high lands forming the divides of various creeks. These will be diverted in a northwesterly course towards the Platte river, crossing the lands lying north and northeast of Denver along the line of the Denver Pacific railway and towards Box Elder creek.

The article also reported that it was projected that the main canal was to be about eighty miles long and "the branches or distributing ditches will be fully as much."<sup>11</sup> On 2 June 1882, the **Rocky Mountain News** reported without fanfare that water had been turned into the ditch the previous day. Forty-four miles of canal were constructed by 1882. The canal was completed on or before 30 November 1883. The main canal was then about seventy miles in length, with a fifteen-mile branch (the Sand Creek Lateral) also completed. Total cost of the project was estimated at \$650,000.<sup>12</sup>

Once the canal began operating, serious flaws in its original conception became apparent. The main problem faced by the canal operators was a weak water right. To supply the system, on 10 December 1883 the Northern Colorado Irrigation Company secured a provisional water right decree to 1,184 cubic feet per second of water with priority number 111, dated 18 January 1879. However, the High Line water right was junior to seventy-four other rights in Water District Number 8, all of which would receive water before the headgates of the High Line could be opened. The flow of the South Platte was unpredictable, varying by season and by year. Therefore, in dry years the canal received little or no water for its irrigators after water was distributed to more senior right holders. In addition, the acreage of

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<sup>11</sup>**Rocky Mountain News**, 1 January 1884, 15.

<sup>12</sup>Denver Water Board, "Northern Colorado;" Mosley, 386; and Roberts, 4-7.

owners of water right deeds to the High Line Canal often overwhelmed the amount of water available for irrigation. In 1886, the company limited the total sale of water right deeds to 30,000 acres, and it never supplied water for more than 25,000 acres during its early history. As historian Louise Ward Arps bluntly stated, "The High Line Canal would have made the plains blossom like a rose, as promised by the original company, except it was usually dry."<sup>13</sup>

The operators of the High Line immediately faced a series of drought years which lowered the flow of the South Platte. After the ditches with senior water rights took their allocations, the High Line sometimes had no river flow to divert. The lack of water for irrigators along the canal often spelled disaster for crops. During the early years of the canal's operation, angry farmers responded with lawsuits against the Northern Colorado Irrigation Company for damages due to insufficient water and on account of unpopular rules and regulations of the company. In the mid-1880s the company, desperate to produce more income, levied a per acre surcharge (called a "royalty" by the farmers) in addition to annual rental fees. In January 1887, the Farmers' Irrigation and Protective Association was formed to fight these additional charges. The association initiated a lawsuit against the irrigation company, asserting that the state constitution made water a part of the public domain. The farmers contended that the irrigation company could not charge for the value of water but only for costs of operating the canal. The Colorado General Assembly passed a law prohibiting surcharges and the Colorado Supreme Court upheld its validity. In 1888, county commissioners reduced the rent on seventeen thousand acres of land by nearly forty percent.<sup>14</sup>

Compounding these problems were design flaws in the canal. The Northern Colorado Irrigation Company had hired civil engineer Edwin S. Nettleton, who had worked on the Union Colony irrigation system, to design the structure in 1880. The earthen canal, excavated using horses and men with handheld shovels, varied widely in dimensions from forty feet wide and seven feet deep through the first forty-six miles to twenty feet wide and four feet deep thereafter. Water was to be transported by means of gravity at a grade of twenty-one to thirty-two inches per mile. This grade proved to be too steep and water eroded the bottom of the ditch. Sharp curves in the canal caused water to break through its outer banks. The upper

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<sup>13</sup>*In re Northern Colorado Irrigation Company*, District Court Fourth Judicial District, Douglas County Colorado, Adjudicating of Water Rights, 1 December 1884; Roberts, 7; *Denver Times*, 26 May 1902, 5; Sherow, 5; Mosley, 382; Louisa Ward Arps, *Denver in Slices* (Athens, Ohio: Swallow Press, 1959), 54.

<sup>14</sup>*Denver Water Board, "Northern Colorado;" Denver Times*, 19 July 1901, 1; and Sherow, 11.

wells, thinner than the lower walls, could not withstand the pressure from the amount of water which could legally be diverted into the canal. Wooden drops and siphons deteriorated under the force of water filled with sand and dirt. These problems prevented the canal from diverting as much water as its water right permitted. Since Colorado's prior appropriation doctrine required that the right to water not used be forfeited, by 1907, the High Line's water right had been reduced from 1,184 to 570 cubic feet per second.<sup>15</sup>

The Northern Colorado Irrigation Company was unable to resolve problems associated with the ditch's weak water right and its design flaws, and was thwarted in its effort to extract more money from its irrigators. Farmers along the system were dissatisfied with its management, its charges for water, and its inability to produce a reliable supply of water. Some angry farmers even threatened violence. In July 1901 a notice posted on a headgate read: "Any person attempting to close this gate will be filled full of lead." A 1902 Denver Times article reported that "gardeners and small fruit raisers have, as a rule, always been afraid of the English ditch. During several seasons in the past, crops have been partially burned up because of its inability to furnish the necessary amount of water." When the English Company failed to remedy the canal's lack of water, irrigators along the High Line assessed themselves \$40 an acre to create the High Line Reservoir Company and build storage reservoirs for supplemental water for the High Line in Park County in 1891. Although construction of the reservoirs began in 1892, the economic downturn of 1893 and death of the company's president, Cyrus G. Richardson, prevented completion of the system.<sup>16</sup>

In November 1907, a group of Denver and Greeley businessmen organized the Antero and Lost Park Reservoir Company. The company purchased the rights of the Highline Reservoir Company and finished building the reservoirs (principally the Antero Reservoir) in Park County. In 1909, the company purchased the Platte Land Company's remaining unsold land, over 10,000 acres, and attached water rights under the High Line Canal. In October 1910, following the acquisition of the land, the stock of the Northern Colorado Irrigation Company was conveyed to the Antero Company. The Antero Company offered to sell settlers land with High Line Canal water rights and separate Antero Reservoir rights. In August 1915, the City and County of Denver began the process of purchasing the Antero Reservoir and the capital stock of the Northern Colorado Irrigation Company from the Antero

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<sup>15</sup>Roberts, 8.

<sup>16</sup>Mosley, 563-564 and 640; Sherow, 11; Denver Times, 26 May 1902, 5.

capital stock of the Northern Colorado Irrigation Company from the Antero Company. Denver's principal objective in purchasing the High Line was to assist in controlling diversions from the Platte River by eliminating a competing interest and to provide a market for surplus water from the reservoirs owned by the City. The Antero Company retained control and management until May 1924, when, after much litigation, the capital stock was delivered to the Board of Water Commissioners of the City and County of Denver which began utilization of its system and water rights.<sup>17</sup>

#### The Sand Creek Lateral in the Rocky Mountain Arsenal

The site of the Rocky Mountain Arsenal was dedicated to agricultural purposes before creation of the military installation. Homesteading in the area began in the 1870s and intensified after completion of the High Line system in 1883. A number of the county section roads were built after irrigation arrived in the 1880s. The 1899 Willits Farm Map shows the lands adjacent to the Sand Creek Lateral to have been composed principally of fairly large tracts of land of a quarter-section or more owned by individuals and parcels still owned by the Platte Land Company. The small settlement of Independence was platted directly in the path of the lateral south of the boundary of the future Arsenal. At the terminus of the lateral, a quarter section of land had been divided into several smaller parcels in individual ownership. Several tiny plains farming communities, including Irondale, Derby, Rose Hill, Kohnville, and Berlin, were within a few miles of the lateral's path. Most of these small developments briefly flourished and their sites were later encompassed by Commerce City or the Rocky Mountain Arsenal.<sup>18</sup>

Of the approximately two hundred farms incorporated into the Arsenal in 1942, only three were over 360 acres and almost 70 percent were twenty acres or smaller. Twenty-nine owners of thirty-four parcels on the Arsenal site received water from the Send Creek Lateral and those properties averaged about eighty acres in size. The 1900 Census recorded that forty-one percent of the adults living on the land

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<sup>17</sup>Denver Water Board, "Northern Colorado;" Denver Water Board, "History of the High Line Canal and Antero Reservoir," on file in the Denver Water Board Engineering Records Room; A.D. Wall, Correspondence to E.G. Plowman, 11 October 1933, on file at the Denver Water Board Engineering Records Room; Mosley, 646; and Sherow, 11.

<sup>18</sup>Bureau of Land Management, Colorado State Office, Master Title Plats and Historical Indexes; W.C. Willits, "Willits Farm Map of Denver and Vicinity," (Denver: W.C. Willits, 1899); Adams County Commissioners, "Map of Western Adams County, 1906," in Brighton Genealogy Society, *The History of Brighton, Colorado and Surrounding Area* (Dallas, Texas: Curtis Media Corporation, 1987), 57.

within the arsenal were foreign born, with the largest group coming from Germany. Ernest Maurer, whose family purchased a farm on what would later become the arsenal, recalls that there were a large number of Swiss immigrants in the area, including his family. The community was centered around the Rose Hill Elementary School and the grange hall and had no churches or cemetery. The only business operating in the area was a small tavern, "Big Ed's," where women were not allowed. The largest landowners were Gottlieb and Rose Egli, who built a home about 1912 and raised eight children in a brick house. Among the products raised on the farms in the area were small grains, alfalfa, corn, and truck garden vegetables. Many of the farmers raised dairy cattle, chickens, horses, and hogs and most were diversified in their production.<sup>19</sup>

Ernest Maurer's family purchased a farm in the area in 1921 and remained until the government acquired the land in 1942. Maurer notes that the local residents who were serviced by the Sand Creek Lateral referred to it as the "Dry Line" as it "hed water when we didn't need it and didn't have water when we did need it." Many people abandoned their farms during the 1930s and land could be purchased for \$100 an acre or less. Maurer asserts that the ditch never provided enough water, although the family's final years on the land, 1939-1942, were the most productive. His family, like many on the Arsenal, flood irrigated their fields rather than practicing row irrigation. The Maurers raised alfalfa, oats, wheat, and barley. Dairying was an important element of the local farm economy which the Maurers participated in. The Eglis were one of the few families which raised beef cattle.<sup>20</sup>

The unlined Sand Creek Lateral was cleaned by Maurer's father using a horse and slip to remove the excess sand. Maurer recalls the headgates of the lateral being constructed of concrete and metal, each with a lock on it and a measuring device nearby to carefully control diversions. Cottonwood and willow trees lined the banks of the lateral in some places.<sup>21</sup>

Ditchrider George Swan recalled the perils of swimming in the lateral northwest of Fitzsimons Hospital:

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<sup>19</sup>Bonnie J. Clerk, "Shadows of Farms and War: Historical Archaeology at the Rocky Mountain Arsenal in Eastern Colorado," Paper presented at the Plains Anthropological Conference, 31 October 1996, 3-4; and Ernest Maurer, Interview by R. Laurie Simmons, 19 May 1998; Rocky Mountain News, 19 July 1995, 6D.

<sup>20</sup>Rocky Mountain Arsenal, "Post Diary," 1942, on file at the Rocky Mountain Arsenal Library; and Ernest Maurer, Interview by R. Laurie Simmons, 19 May 1998.

<sup>21</sup>Ernest Maurer, Interview by R. Laurie Simmons, 19 May 1998.

Montview Boulevard ever escaped serious injuries. They used to slide down the fells into a ditch loaded down with bedposts and almost anything culprits could dump. I would have thought they would be afraid of splinters, but not those kids.<sup>22</sup>

In May 1942, the construction of a new chemical warfare arsenal, the Rocky Mountain Arsenal, was approved on a reservation of approximately 27-square miles in Adams County, northeast of Denver. The site was selected for its inland location, Denver labor supply, existing highways and railroads, climate, terrain, and supply of cheap and adequate water of low temperature which could be used in the manufacture of certain chemical agents. The last chemical arsenal to be built during World War II, the Arsenal's mustard and ethylene plants began operations in December 1942 under the control of the Army's Chemical Warfare Service. The facility employed three thousand workers and was one of the largest chemical weapons plants in the country.<sup>23</sup>

The construction of the Arsenal necessitated removal of all civilian activities from the designated reservation. In July 1942, the Army announced that approximately two hundred farm families in area would be required to move by August. The farmers were not allowed to harvest their crops, but many were able to move their buildings to new locations. The Army cleared away most of the buildings left behind, including homes, barns, sheds, and silos. The Rose Hill School served for many years as an officers' club for Arsenal personnel. Rose Egli recalled that her father cried when the Army bulldozed his crops, as 1942 had been an especially good farming year. A crew of convicts was brought from the state penitentiary to pick 2,600 acres of corn.<sup>24</sup>

During the war, the Arsenal manufactured and assembled chemical, toxic, and incendiary munitions, including chlorine, distilled mustard, Lewisite, napalm, PT-1, M74 bombs, and M47 bombs. Loading and clustering of incendiary bombs became a major function of the facility. Arsenal workers also reworked M69 bombs and filled shells with phosgene gas. Although chemical weapons were never used against Germany or Japan, other weapons produced at the Arsenal were employed

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<sup>22</sup>Carl V. McFadden and Leone M. McFadden, *Early Aurora* (Aurora, Colorado: Aurora Technical Center, 1978), 90.

<sup>23</sup>Army Service Forces Chemical Warfare Service, *History of Rocky Mountain Arsenal* (Denver: Rocky Mountain Arsenal, 1945), vol. 1, part 1, 3-11.

<sup>24</sup>Ernest Maurer, interview by R. Leurie Simmons, 19 May 1998; *Rocky Mountain News*, 19 July 1995, 6D; Brighton Genealogy Society, 93.

effectively. Incendiary bombs produced at the Arsenal caused 83,000 deaths in a March 1945 raid on Tokyo, and the *Denver Post* boasted that "69 cities were reduced to smoldering ash heaps with compliments of the Rocky Mountain Arsenal." The arsenal also served as a prisoner of war camp housing German and Italian prisoners and was the site of the Western Chemical Warfare School.<sup>25</sup>

The creation of the Rocky Mountain Arsenal brought the northern 5.8 miles of the Sand Creek Lateral under the military facility's operation. The section of the Sand Creek Lateral between Fitzsimons Hospital and Derby Lake was abandoned. Thereafter, the Arsenal and the section of the Sand Creek Lateral north of Derby Lake were supplied by the Derby (or Arsenal) Lateral further to the east. Between 1942 and 1956, aqueous wastes from South Plants' chlorine plant, white phosphorous plant, and M-74 plant were discharged into the Sand Creek Lateral.<sup>26</sup>

The Arsenal also continued to use the Sand Creek Lateral for agricultural purposes. During World War II, the lateral supplied water to an asparagus field near Quebec Street worked by about one hundred German prisoners of war. Certain parts of the Arsenal were leased to farmers during the 1940s and 1950s and the Sand Creek Lateral continued to deliver water for grazing and the production of wheat and barley fields. Robert M. Pyle lived as a boy near the Sand Creek Lateral in Aurora during the early 1950s. He recalled the lateral as the High Line's "broad side ditch off to the north. Its headgates were closed, so the lateral was dry, but it was lush with growth from the sloss of its full flow against the banks." Pyle and his brother explored the banks of the lateral and the High Line, noting the still rural areas through which the waterways flowed, the many tall cottonwood trees along the banks, and the recreational possibilities offered.<sup>27</sup>

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<sup>25</sup>Micheel G. Schene, "Addendum to Rocky Mountain Arsenal, Historic American Engineering Record, HAER No. CO-21," (Denver: National Park Service, January 1997), 90, 96-97; Leonard and Noel, 223-24 and 351-52 and Rocky Mountain Arsenal Contamination Control Program Management Team, *Selection of a Contamination Control Strategy for Rocky Mountain Arsenal*, final report, prepared for the U.S. Army Toxic and Hazardous Materials Agency and the Rocky Mountain Arsenal (N.p., September 1983), vol. 1, 1-1.

<sup>26</sup>Rocky Mountain Arsenal, "Post Diary," 1942, on file at the Rocky Mountain Arsenal Library; Army Services Forces Chemical Warfare Service, "History of Rocky Mountain Arsenal," 34; Foster Wheeler Environmental Corporation, "Miscellaneous Northern Tier, Miscellaneous Southern Tier, and Lake Sediments Project, 60% Design Package," June 1998, 1-6.

<sup>27</sup>Jim Green, Engineer, Rocky Mountain Arsenal, Interview by Thomas H. Simmons, 21 May 1998; and Robert M. Pyle, *The Thunder Tree: Lessons from an Urban Wildland* (Boston: Houghton Mifflin Company, 1993), 8 and 34.

A project conducted by the Arsenal in 1964-68 studied wheat rust spores which were planted in two sections through which the lateral ran. Contaminated water that accumulated in the basement of Building 422 between 1967 and 1974 was pumped into a ditch connected to the Sand Creek Lateral. The Sand Creek Lateral was last used to carry water north from the lakes about 1992. Today, the only segment of the Sand Creek Lateral carrying water is the southern 1.75 miles, between the head works at the High Line Canal (HAER photo CO-43-A-1) and U.S. Army Garrison Fitzsimons. Most of this section of the lateral was placed underground in concrete pipes in the mid-1950s; a short section through Del Mar Park in Aurora remains above ground and relatively unaltered.<sup>28</sup>

## Physical Description

### Alignment

The Sand Creek Lateral was the major lateral of the High Line Canal (See Figure 1). It branched from the High Line in the lower reaches of that canal in Section 11, Township 4 South, Range 67 West, approximately 51.9 miles from its mouth.<sup>29</sup> The main branch of the High Line Canal continued in a northeasterly direction for another 18.5 miles, while the Sand Creek Lateral flowed northward for approximately 14.8 miles, passing through parts of Adams County and the City and County of Denver.<sup>30</sup> A 1907 engineering report on the High Canal system described the bifurcation point, noting that a few miles east of Denver the main canal terminated

in two branches of about equal capacity. One of these branches is a continuation of the main canal, extending in a northeasterly direction for an additional distance of about sixteen and one-half miles to its terminus. The other branch known as the Sand Creek Lateral upon leaving the main canal takes a much lower course and

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<sup>28</sup>Jim Green, Engineer, Rocky Mountain Arsenal, Interview by Thomas H. Simmons, 21 May 1998; Foster Wheeler, 1-6; end Schene, 128.

<sup>29</sup>Today, the site lies within the City of Aurora, County of Arapahoe, at the intersection of Peoria Street with the High Line Canal.

<sup>30</sup>The description of the alignment is based on historic maps: O'Brian and Rhoades, "Irrigable Lands under High Line Canal, the High Line Irrigation District" (Denver, Colorado: O'Brian and Rhoades, October 1903) and "Map of the High Line Canal of the Northern Colorado Irrigation Company," March 1928, in the files of the Denver Water Board, Engineering Records, Denver, Colorado.

\*by a long succession of timber drops reaches and supplies water to those lands lying directly north and east of Denver and tributary to the South Platte River; the length of this branch being about fifteen miles.<sup>31</sup>

The report estimated that the Sand Creek Lateral had a maximum capacity of 150 to 200 second feet but noted that it diminished "rapidly in size as the distance from the head works increases."<sup>32</sup>

Leaving the High Line, the alignment of the Sand Creek Lateral proceeded northward, through the site of today's Del Mar Park, and along the west side of Peoria Street (HAER photos CO-43-A-2 and CO-43-A-3). The lateral supplied water to Mount Nebo Cemetery at East Colfax Avenue and Nome Street, as well as to Fitzsimons Hospital at East Colfax Avenue and Peoria Street. Passing north of East Colfax Avenue, the canal entered Adams County and then curved northwesterly to cross Sand Creek. The path of the High Line-Sand Creek section of the lateral followed a slight ridge with the land sloping away in both directions.<sup>33</sup>

The ditch crossed Sand Creek via the most imposing structure on the waterway, a 30-inch diameter, 892-foot wood stave syphon and 72-foot wooden flume.<sup>34</sup> The lateral then proceeded in a northwesterly direction, passing under the Union Pacific Railroad tracks at Roydale and continuing through Section 22 to the northeast corner of Section 21. The structure headed northward through the eastern edge of Section 16 and then turned northeastward. The canal ran northeasterly through Sections 15, 10, and 11 (HAER photos CO-43-A-4 and CO-43-A-7) to the vicinity of Ladora and Derby Lakes in Section 2. The lateral then turned northwesterly and flowed along the eastern edge of Ladora Lake (HAER photos CO-43-A-12 and CO-43-A-13). In the northwestern corner of Section 2, the lateral began curving northeasterly through Section 35. Turning northward through the eastern portion of Section 26, the ditch curved northeasterly to its terminus in the northwest quarter of Section 25

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<sup>31</sup>Field, Fellows, and Hinderlider, "Report on the (English) High Line Canal System" (Denver, Colorado: Field, Fellows, and Hinderlider, 19 October 1907), 1, Michael Creed Hinderlider Collection, in the files of the Colorado Historical Society, Denver, Colorado.

<sup>32</sup>Field, Fellows, and Hinderlider, 3.

<sup>33</sup>A.D. Wall, Denver Board of Water Commissioners, letter to George F. Hughes, 31 March 1939, in the files of the Denver Water Board, Central Records, Denver, Colorado.

<sup>34</sup>The lateral apparently was named for Sand Creek, a tributary of the South Platte River, although the lateral did not historically take or deliver water to that stream. Sand Creek was the first major stream crossed by the lateral after its departure from the High Line Canal. The flume is no longer extant.

(HAER photo CO-43-A-30).

Lands irrigated by the Sand Creek Lateral were estimated at 6,000 acres in 1916 and 6,600 acres in 1932. A 1932 study which examined expanding the amount of land watered by the lateral concluded that much of the remaining land in the vicinity was "secondary land, being mostly quite sandy and somewhat rolling."<sup>35</sup>

### Characteristics

The Send Creek Lateral was an unlined, earthen ditch. According to an 1886 description, the lateral was considerably smaller in dimensions than the main canal: "On the first 5 miles of the branch canal, the dimensions vary greatly, the grade being very steep. For the remainder of the distance, the dimensions are from twenty to fifteen feet in width and from 5 to 4 1/2 feet in depth with a uniform grade of 3 1/2 feet per mile."<sup>36</sup> By contrast, the upper portion of the High Line Canal was forty feet in width and seven feet in depth. A cross-section of the canal showed sloping sides and a relatively flat bottom. Figures 4 and 5 are 1938-41 photographs showing the ditch in operation in the area north of Montview Boulevard in Adams County.<sup>37</sup>

The total elevation drop for the canal was approximately 215 feet, from 5,455 feet at its headgate to 5,240 feet at its northern terminus. This equals an overall gradient of roughly fourteen feet per mile. More than a dozen drops were located on the first 4.5 miles of the lateral, lowering the ditch by about 155 feet by the time it crossed Send Creek.<sup>38</sup>

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<sup>35</sup>A.D. Well, memorandum to George M. Bull, "The Northern Colorado Irrigation Company: Acres Irrigated under Various Sections of the High Line Canal," 29 January 1932, in the files of the Denver Water Board, Denver, Colorado.

<sup>36</sup>Denver Society of Civil Engineers, booklet issued for the annual convention of the American Society of Civil Engineers, July 1886, cited in Mosley, 121.

<sup>37</sup>U.S. Geological Survey, "Denver and Vicinity, Colorado," topographic map (Washington: U.S. Geological Survey, 1957); "Profile of the Highline Canal Sand Creek Lateral of the Northern Colorado Irrigation Company," rolled profile graph, March-April 1928, in the files of the Denver Water Board, Engineering Records, Denver, Colorado; S.T. Weller, "Side Notes and Structures: Highline Canal Head Gate to Plum Creek Flume, Send Creek Lateral, City Lateral," Denver Municipal Waterworks, March 1928, in the files of the Denver Water Board, Engineering Records, Denver, Colorado. No historic photographs of sections of the ditch on the Rocky Mountain Arsenal were located.

<sup>38</sup>Computed from U.S. Geological Survey, "Denver and Vicinity, Colorado," topographic map (Washington: U.S. Geological Survey, 1957).

Structures on the lateral included devices to control, carry, divert, and measure the flow of water. A 1928 survey of the ditch enumerated and located various types of structures then present on the lateral.

Head Works. The head works diverting water for the Sand Creek Lateral from the High Line Canal were originally constructed of wood. A 1907 engineering analysis of the High Line system concluded that "complete rebuilding is immediately necessary" for the head works of the Sand Creek Lateral. By 1928, the works had been replaced by a large reinforced concrete intake structure with thick wooden gates (no longer extant). The present-day diversion point for the canal is a headgate located in the northern abutment of the Peoria Street bridge over the High Line Canal (HAER photo CO-43-A-1).<sup>39</sup>

Drop Checks and Check Dams. Drop checks (HAER photos CO-43-A-3 and CO-43-A-6) and check dams (HAER photos CO-43-A-15) served to slow the flow of the water in the ditch, curb erosion, and drop its path to a lower level. A 1907 report pointed out that the system's numerous wooden drops, "some of which are quite extensive and expensive to maintain, should also be replaced with concrete structures." There were approximately forty-six numbered reinforced concrete drop checks on the Sand Creek Lateral in 1928.

Headgates. Headgates (HAER photos CO-43-A-5, CO-43-A-14, CO-43-A-16, CO-43-A-17, CO-43-A-18, CO-43-A-20, and CO-43-A-22) permitted water to be diverted from the lateral via clay pipes (HAER photos CO-43-A-19, CO-43-A-21, and CO-43-A-23) into smaller ditches serving landholdings. In 1907, Field, Fellows, and Hinderlider reported that "all the outlets from the canal are through vitrified clay pipe of varying sizes ranging from 6 inches to 20 inches all controlled by light iron lift gates which are provided with locks for the water commissioners use."<sup>40</sup> Headgates were set in reinforced concrete by the late 1920s. Each gate was equipped with a wheel that raised and lowered a shut-off gate that supplied a clay tile pipe to the field ditch. Shut-off gates were round or rectangular in shape and composed of metal or wood. Wheels were equipped with padlocks to prevent tampering. A 1928 survey found forty-two numbered headgates on the lateral.

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<sup>39</sup>Field, Fellows, and Hinderlider, 6 and Weller, 33-34.

<sup>40</sup>Field, Fellows, and Hinderlider, 5-6.

The largest diversion structure on the recorded portion of the lateral is located between Derby and Ladora lakes in Section 2, Township 3 South, Range 67 West (HAER photos CO-43-A-8 through CO-43-A-11). The structure was installed at the time of the creation of the Rocky Mountain Arsenal in 1942. Taking the form of a large concrete reinforced box, the structure has a headgate supplying water to Ladora Lake via a long, concrete chute and an outlet controlled by planks opening onto a measuring flume and the northern section of the lateral. Other large, concrete diversion structures on the lateral include three locations in Section 26: one east of former Basin F in Section 26 (HAER photos CO-43-A-25 and CO-43-A-26); one west of D Street (HAER photo CO-43-A-27); and one on the west side of D Street a quarter mile south of 9th Avenue (HAER photos CO-43-A-28 and CO-43-A-29).

Culverts. Reinforced concrete pipes or corrugated metal culverts carry the lateral under roads (HAER photo CO-43-A-24). Many of these culverts have reinforced concrete headwalls and some have concrete wingwalls. The lateral passes underneath railroad tracks on the Arsenal in Section 2, Township 3 South, Range 67 West, by means of a large, square, reinforced concrete box culvert.

Siphon and Flume. The lateral's crossing of Sand Creek necessitated a long siphon and flume. In 1928, the siphon was composed of a 30" diameter, 892' wood stave pipe. The northern end of the siphon was connected to a flume constructed of two-inch thick wooden planks. The flume was 4' wide and about 72' feet long. This structure is no longer extant.

Measuring Flumes. A measuring flume was located near the end of the Sand Creek Lateral to gauge the flow and depth of the waterway. The 1928 survey noted the location of this device on the section line between Sections 25 and 26, Township 2 South, Range 67 West. A few nonhistoric measuring devices housed in corrugated metal pipes are present along the lateral (HAER photo CO-43-A-11).

#### Alterations

An analysis of historic maps showed no observable change in the alignment of the

Sand Creek Lateral from the 1880s through 1942.<sup>41</sup> Figure 2 depicts the entire length of the lateral in 1899, while Figure 3 provides a good view of the Adams County portion of the lateral and its environs in 1906. By late 1942, after the creation of the Rocky Mountain Arsenal, the end of the lateral was extended about half a mile eastward to First Creek.<sup>42</sup> At the same time, the 7.7-mile segment of the canal between Fitzsimons Hospital and Lake Ladora was abandoned. Water was provided to the lower reaches of the Sand Creek Lateral after that date by the Derby (or Arsenal) Lateral further to the east. The section of the ditch north of Derby Lake was used for agricultural purposes on the Arsenal until the early 1990s.<sup>43</sup> Today, the only section of the lateral which carries water is the 1.75-mile segment between the High Line Canal and U.S. Army Garrison, Fitzsimons (formerly Fitzsimons Hospital). With the exception of a short section through Del Mar Park, this segment was placed in underground concrete pipes in the mid-1950s.

The Sand Creek Lateral's structures (e.g., headgates, check dams, drops) were originally constructed of wood. A 1907 report recommended that the structures be replaced with reinforced concrete, and, by 1928, the structures were so constructed.<sup>44</sup> A number of headgates and drops display 1938 and 1939 dates of construction inscribed in concrete.

### Project Description

This documentation of the Sand Creek Lateral of the High Line Canal was produced for the U.S. Fish and Wildlife Service (USFWS), Rocky Mountain Arsenal Wildlife Refuge, Commerce City, Colorado. The project recorded those parts of the Sand Creek Lateral within the boundaries of the Rocky Mountain Arsenal (approximately 5.8 miles) and the junction of the lateral with the High Line Canal in Aurora. Laurie Shannon was the liaison for USFWS. Gregory P. Kendrick supervised the project for the National Park Service, Intermountain Support Office. The historical narrative was researched and written by Front Range Research Associates, Inc., Denver,

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<sup>41</sup>U.S. Geological Survey, "Denver, Colorado," reconnaissance topographic map, 1901 ed. (Washington: U.S. Geological Survey, 1888); W.C. Willits, "Willits Farm Map of Denver" (Denver: W.C. Willits, 1899); O'Brian and Rhoades (1903); Brighton Genealogy Society, 57; and "Water Rights," map showing water rights by parcel on Rocky Mountain Arsenal (1942), in the files of the U.S. Fish and Wildlife Service, Rocky Mountain Arsenal Wildlife Refuge, Commerce City, Colorado.

<sup>42</sup>U.S. Army, Chemical Warfare Service, "Rocky Mountain Arsenal, General Plan of Reservation," map (Rocky Mountain Arsenal, Colorado: Civil Engineering Section, 4 December 1942).

<sup>43</sup>Jim Green, Rocky Mountain Arsenal Wildlife Refuge, Commerce City, Colorado, telephone interview, 21 May 1998.

<sup>44</sup>Field, Fellows, and Hinderlider, and Weller.

Colorado, with R. Laurie Simmons and Thomas H. Simmons serving as project historians. The drawing sheets of the lateral were produced by Andrews and Anderson, Golden, Colorado, with Cynthia Pougiales and Robert Ward principal delineators. Steve Miller of DP Associates, Rocky Mountain Arsenal GIS Department, provided technical information for the production of the drawing sheets. Lisa Lynch of the National Park Service, Curecanti National Recreation Area, performed the large format archival photography for the project.

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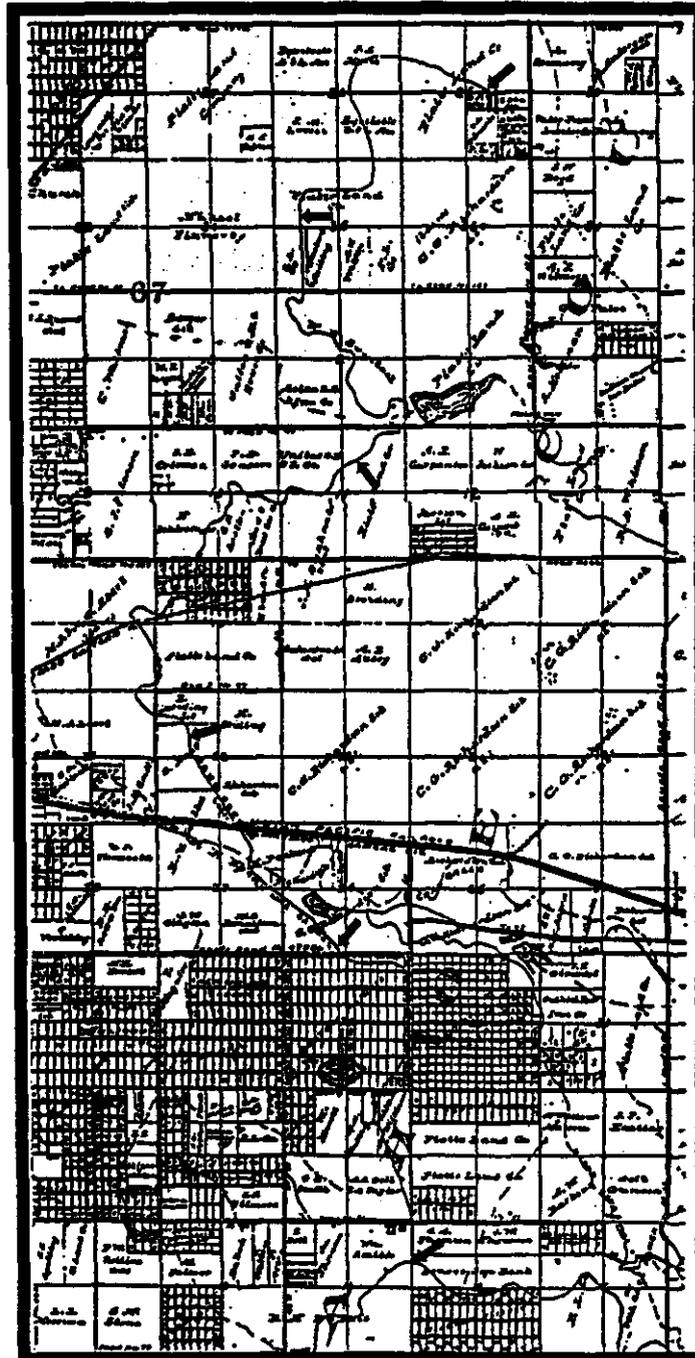


Figure 1. This extract of an 1899 regional map shows the full extent of the Sand Creek Lateral (indicated with arrows) from its departure from the High Line Canal to its terminus. SOURCE: W.C. Willits, "Willits Farm Map of Denver and Vicinity" (Denver: W.C. Willits, February 1899) in the files of the Denver Public Library, Denver, Colorado.



Figure 2. Geographic Location Map. This extract of a topographic map shows the current extent (dashed line) of the Sand Creek Lateral of the High Line Canal on the Rocky Mountain Arsenal, Adams County, Colorado. SOURCE: U.S. Geological Survey, "Montbello, Colorado," 7.5 minute topographic map (Reston, Virginia: U.S. Geological Survey, 1965, revised 1994).

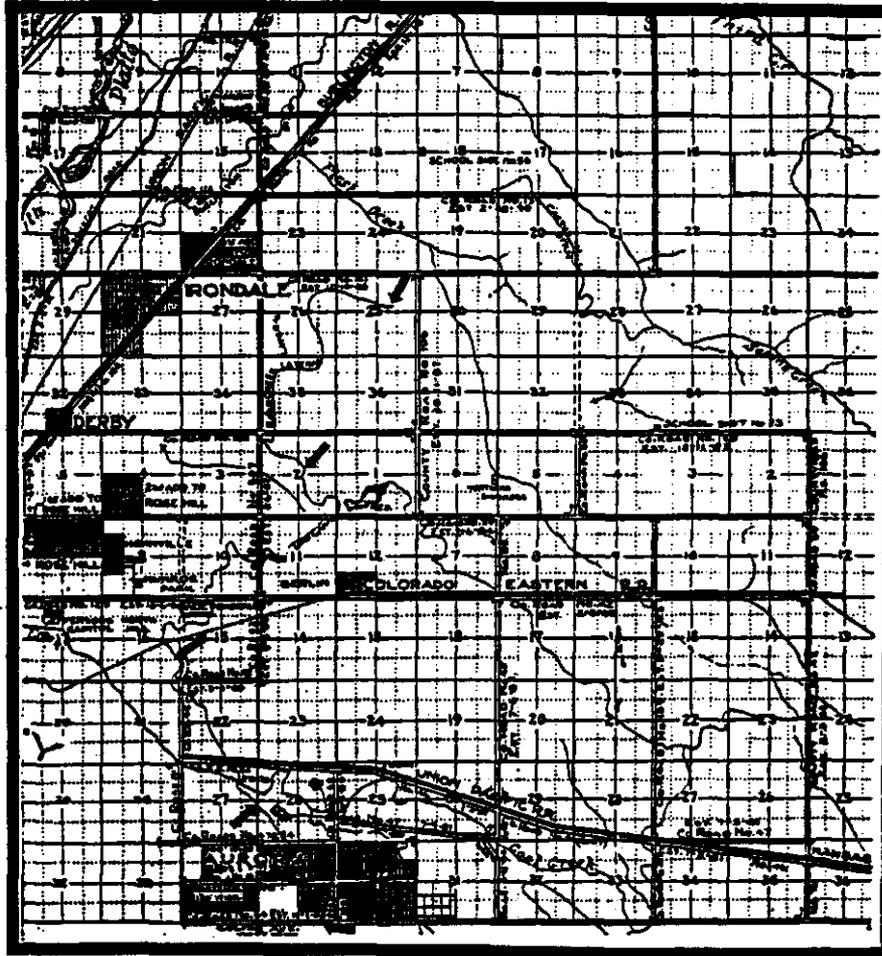
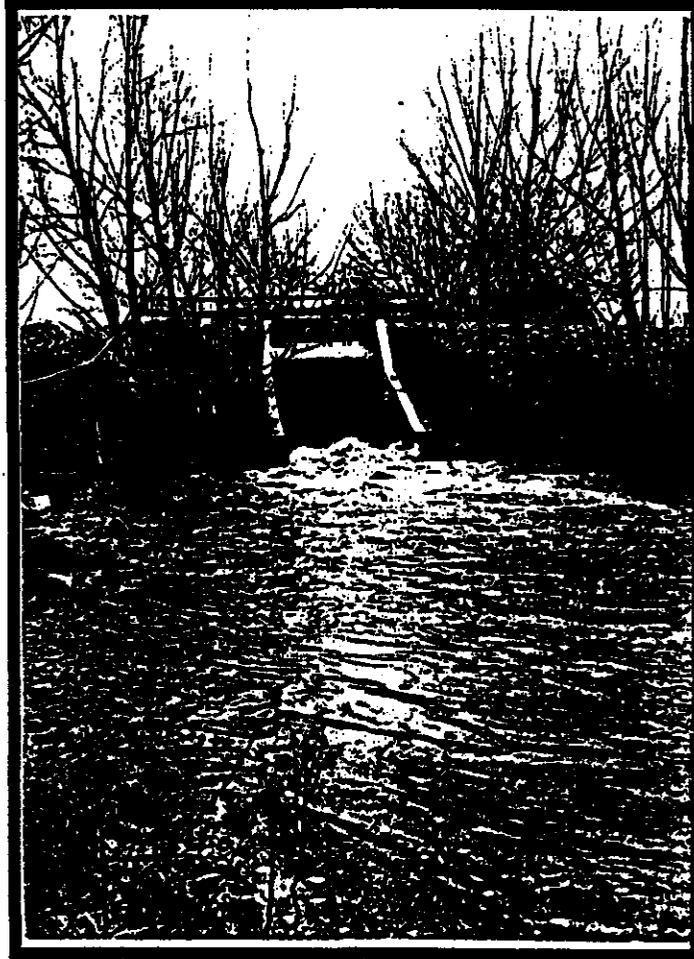


Figure 3. This extract of a larger county map shows the Sand Creek Lateral (arrows), county roads, and platted developments in 1906. SOURCE: Brighton Genealogy Society, *The History of Brighton, Colorado and Surrounding Area* (Dallas, Texas; Curtis Media Corporation, 1987), 57.



**Figure 4.** Sand Creek Lateral at East 6th Avenue, 1938. The downstream side of a drop check installed during the winter of 1937-38 is shown in this April 1938 photograph (view south). SOURCE: Denver Water Board, photographic collection, scrapbook 42, photograph number 5589, 20 April 1938, in the files of the Denver Water Board, Engineering Records, Denver, Colorado.



**Figure 5. Sand Creek Lateral North of Montview Boulevard, 1941.** This April 1941 photograph shows the lateral carrying water through the rural area of Adams County near station 116 (view south). SOURCE: Denver Water Board, photographic collection, scrapbook 42, photograph number 6575, 14 April 1941, in the files of the Denver Water Board, Engineering Records, Denver, Colorado.