

Montezuma Valley Irrigation
Company System
Dolores Vicinity, Colorado
Montezuma County

HAER No. CO-4

HAER
COLO,
42-DOL.V,
5-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, D.C. 20240

HISTORIC AMERICAN ENGINEERING RECORD

"The History of the Montezuma Valley Irrigation System"

HAER
COLO,
42-DOL.V
5-

Location: Montezuma County, Colorado

Date of Construction: 1885

Present Owner: Montezuma Valley Irrigation Company
60 South Cactus
P. O. Box 1056
Cortez, Colorado 81321

Present Use: Irrigation

Significance: Settlement of the Montezuma Valley was made possible in the 1880's with the construction of the Montezuma Valley Irrigation System. Organized by James W. Hanna, the complex series of tunnel (5,400 foot long), "Great Cut", headgates, and diversion dams channeled water from the Dolores River through a steep divide. The system constitutes one of the earliest large scale, privately funded and continuously operating irrigation projects in the Southwest.

Historian: Maureen Gerhold, August, 1981

Irrigation in southwestern Colorado began long before anyone imagined there would be a Montezuma Valley irrigation system. The arid climate made irrigation an absolute necessity. The crude stone terraces or check dams of the Anasazi cliff dwellers, the first to practice irrigation in this area, can still be seen in Mesa Verde National Park. The Navajos also used a primitive form of irrigation to adapt to the climate and geography.¹ In 1852 the Spanish American settlers in the San Luis Valley began the oldest continuously operating irrigation system in Colorado.² This mastery over the environment was an important technological advancement that aided settlement of the arid western slope of the Rocky Mountains.

Irrigation projects stimulated rapid settlement between 1880 and 1890 on the western slope.³ However, the ever increasing number of settlers placed too great a strain on the limited supply of water. This was especially true in Montezuma Valley where sufficient water was not available to practice irrigation.⁴ The lack of water did not inhibit settlement for long since the valley was ideally suited to growing fruit, due to the high elevation, the southeast orientation of the valley ridges and the sunshine and cold nights.⁵ Conversely, the adjacent Dolores Valley, with only a thin strip of bottom land, was unsuitable for large scale irrigation agriculture.

Fortunately, the need for water in the Montezuma Valley was complimented by the excess in the Dolores River Valley. These geographical factors prompted the formation of the Dolores, Lost Canon, and Montezuma Ditch Company in 1878.⁷ The company began work in 1879 on a mile long tunnel to divert water from the Dolores River to the San

Juan River Basin.⁸ It was to pass under the Dolores Divide and flow into the head of Hartman Gulch. However, work was halted when it became apparent that the undeveloped area could not fiscally support such a venture.⁹

Although this first attempt at irrigating the Montezuma Valley failed, James W. Hanna organized the Montezuma Water Supply Company to try again. The company filed September 16, 1880 with a capital stock of \$200,000, much of it raised in Boston with B. L. Arbecan of Boston serving as president of the company.¹⁰ Hanna was the vice president and general manager, E. S. Turner of New York and secretary and A. B. Chamberlain of Denver the treasurer. Hanna's service as speaker of the Colorado House of Representatives (1891-1893) may have helped him to cement these contacts.¹¹ As one prominent historian noted, "with such financial help, large canals that otherwise would have been too costly for individual or cooperative efforts were built."¹²

In this speculative venture the profits came almost entirely through the Cortez Land and Investment Company.¹³ Hanna controlled this company in addition to the Montezuma Valley Water Supply Company, a common practice at the time.¹⁴ J. M. Mack served as engineer and chief designer for the irrigation system and also laid out the town site of Cortez. A conflict of interests, however, soon developed from this situation, when \$80,000 was diverted from digging the Highline ditch, to build a three mile flume to supply the town of Cortez with domestic water.¹⁵

The Montezuma Valley Water Supply Company planned to supply water to an expected population of 50,000 in Cortez, and to irrigate 200,000 acres in the area south and west of the San Juan and Dolores Divide.¹⁶ The plan was typically optimistic. Water from the Dolores River was

appropriated to supply this area and in 1892 the water court adjudicated 1300 second feet of water, an amount that is still large enough to serve the valley.¹⁷ It was the Doctrine of Prior Appropriation of water rights that made the use of Dolores River water by Montezuma Valley residents possible.

Until the settlement of the arid West, water rights in America were determined by English Common Law or Riparian Rights. This permitted the use of running water by the owners of the land bordering streams provided they did not diminish or alter the flow.¹⁸ This system of water rights was well suited to the humid East, but proved to be impractical in the arid West. Therefore, Colorado and other states west of the 100th meridian adopted the doctrine of Prior Appropriation whereby water was diverted from rivers and streams without regard to ownership of the land along the stream banks. "It endowed the first users with a permanent right to water so long as they needed it and continued to use it beneficially. Priority of diversion established rights, regardless of the geographical location on the stream where the diversion was made."¹⁹ This made it possible to build canals across unsettled land without the threat that the water would later be claimed by a newcomer.²⁰ The priority of appropriation method of water diversion was made law in the Colorado Session Laws of 1861.²¹

Disputes between settlers necessitated the regulation of water use in a state where water was so valuable. Voluntary cooperation was not enough. Moreover, water use agreements between states sharing the same river had to be enforced. Therefore, in 1879 the state established ten water districts. Southwestern Colorado was not included until 1887.

when twenty-four of the seventy districts were in this corner of the state.²² Each district, defined by drainage basin pattern, had a commissioner to regulate water use by the priority system. The Montezuma Valley drainage was not assigned a commissioner until after 1940.²³

Local regulation was not received without some initial tension. The Dolores River Valley received its first water commissioner, Mr. Wilford Speer, in 1962, when the ranchers met him with shotguns.²⁴ He was responsible for enforcing the eighty-one decreed water rights on the Dolores and West Dolores Rivers. Even today, John Reed, the gatekeeper for the Montezuma Valley Irrigation Company, maintains that he would "trust 'em (water commissioners) with my wife, money, anything, but not water."²⁵ Mr. William H. Blake, with the company from 1886 to 1910, claimed to have a callus on his hip from carrying his gun on the job. He also spent a great deal of time riding to Denver to testify for disputes in the state water court.²⁶ Although water regulation now runs more smoothly, many court cases over water rights still occur.²⁷

When construction of the mile long Montezuma Tunnel began in 1885, it was considered "one of the greatest irrigation enterprises, not only in the state, but in the West."²⁸ The construction of railroad tunnels, was a common phenomenon throughout the 19th century, but the construction of irrigation tunnels was rare. The Montezuma Valley Irrigation Company Tunnel was one of the first in the West.²⁹ Moreover, irrigation engineering was in its infancy. The results of field experiments were empirical and difficult to relate to a specific problem.³⁰ Nevertheless, in 1889, upon the completion of the tunnel,

Colorado ranked second in irrigation development. Ten years later the state moved into first place where it remained until 1919.³¹

Construction on the tunnel began November 25, 1885. Although the tunnel began with a four foot diameter, the design soon was enlarged to a diameter of seven by nine feet to carry water at 700 cubic feet per second.³² Water flowed for a distance of 5400 feet at a one percent grade through a hard sandstone ridge.³³ At the outlet of the tunnel, however, the rock was soft and crumbly, and in the winter of 1963-64 after repeated cave-ins steel arches were installed.³⁴ There was no lining in the remaining 4200 feet of the tunnel, which made repair work very dangerous.³⁵

All the materials and manpower used to construct the tunnel had to be brought in or enticed to the undeveloped area.³⁶ Drilling and blasting occurred at four headings, from either end and from a vertical shaft sunk mid-way in the tunnel.³⁷ Sergeant drills powered by 20 x 24 air compressors helped to construct the tunnel.³⁸ Patented in 1878 and manufactured by the Norwalk Iron Works Company in South Norwalk Connecticut. Rock loosened by black blasting powder was carried out by carts on narrow guage rails, with dirt elevators and dump wagons used later.³⁹ Slip scrapers and wheel scrapers were used on the canals and ditches in addition to animal teams and plows. Water had to be hauled to the site, but animal feed was readily available.⁴⁰ Local ranchers who needed money to improve their farms worked on the tunnel, canals, and ditches. The company also hired a few transients of German and Russian origin, but no Mexicans or Indians worked on the project. Construction crews worked twelve hour tunnel shifts and received one

dollar a day.⁴¹ Big Bend probably served as a major camp for these workers, although the main office was in Cortez.⁴² To complete the ditches ranchers formed small groups and contracted for a certain amount of work.⁴³ During the summer months, camps formed near the work site for each major ditch and the men used a sheep wagon for cooking.⁴⁴

Unfortunately the ranchers, occupied with digging ditches, failed to prepare their lands for irrigation. Therefore, when the water began to flow, the irrigation company had few customers and a very limited income at a crucial time. The strain proved too great for the young company and it folded.

The Colorado Water Supply Company took over between 1888 and 1890.⁴⁵ Financial complications persisted under the new management. Additional problems complicated the situation. A mile stretch of road soon came to be called Usher's boghole, due to frequent flooding and irrigation seepage.⁴⁶

As the Colorado Water Supply Company struggled, a new company, the Dolores Number Two Land and Canal Company formed April 12, 1887 headed by Mr. B. S. Lagrange of Greeley, Colorado.⁴⁷ Although the areas it served, Yellow Jacket, Hovenweep Trail, Alkali, and McElmo Canyon, differed from the first company, the two companies competed for new settlers to increase revenues. Morton flume and the Dolores Number Two Canal carried the Dolores River water through a "Great Cut" across the Dolores Divide to supply these new areas with irrigation water. This cut extended 4,000 feet and descended forty feet into the saddle of the divide. The wooden Morton flume had unusually large dimensions of eighteen feet wide, seven feet deep, and 5,850 feet long.⁴⁸ It was located south of the Dolores River between present-day Highway 145 and

the town of McPhee.⁴⁹ Because of the continuous maintenance costs, the Morton flume was replaced eventually by a metal ditch that carried 350 second feet of water, twice the capacity of the old flume.⁵⁰

The Dolores Number Two Land and Canal Company and the Colorado Water Supply company decided to join forces and in May, 1889 they formed the Colorado Consolidated Land and Water Company. Henry N. Tuttle of Chicago was president, and the general manager was S. W. Carpenter, a native of Denver. This company continued the tradition of administrative and financial mismanagement of Montezuma Valley irrigation, and after 1894 they passed on the tradition to the next company, the Montezuma Water and Land Company.⁵¹

The Board of County Commissioners set the rates for the company and after 1901, the Montezuma Water and Land Company filed a complaint against them. The court case demonstrated that rates, inadequate to pay the minimum expenses of the company, resulted in a loss of over \$10,000 from 1890 to 1901. In spite of the financial problems, the system's vital maintenance operations continued. Many others, however, were neglected due to lack of funds. For example, in 1904 breaks in the ditches delayed water delivery, which contributed to poor crops that year.⁵² In addition, the farmers payed for water they never received due to the lack of storage capacity.⁵³ Customers directed their frustration at Mr. Freeman, the newly appointed receiver of the bankrupt Montezuma Water and Land Company.⁵⁴ Their concerted efforts also spurred the formation of the Montezuma Valley Irrigation District.

The Montezuma Valley Irrigation District formed under the premise of operating in interest of it users.⁵⁵ It was also considered a means of densely populating the county.⁵⁶ Although the first meeting of the

board of directors occurred January 7, 1902, negotiations for the sale of the company were not completed until April 30, 1907.⁵⁷ The district acquired the irrigation system from the Denver National Bank, Colorado State Bank of Durango and John V. Farwell of Chicago.⁵⁸ Elected by the taxpayers, the board of directors composed of R. R. Gordon, president, H. H. Smith, and John S. Wilson, developed the irrigation system according to the District Irrigation Law of 1901.⁵⁹ This law allowed the organization of irrigation districts that could purchase, construct, and maintain canals and reservoirs, issue bonds to raise capital, and levy taxes on the land irrigated. It also created the position of State Irrigation Engineer to regulate water use.⁶⁰

To acquire the system a bond was "floated" for \$795,000. The sum of \$325,000 purchased the water rights and the ditch system, with \$45,000 for the first year's interest. To rebuild the entire system and add two storage reservoirs \$425,000 had been allotted.⁶¹ The county treasurer collected taxes on the land in a manner similar to a school district. Once finished, the company expected to irrigate 60,000 acres of land with water priorities sufficient to supply 110,000 acres.⁶²

A contract signed late 1906 between the Montezuma Valley Irrigation District and Empire Construction Company bonded the construction company to overhaul the existing system, and construct two large reservoirs. Empire Construction Company's president, D. A. Canfield, agreed to take over the \$795,000 in district bonds and acquire the system. The contract called for the work to be completed by May 1, 1908 when they would turn the irrigation system over to the district and pay the first year's interest on the bonds.⁶³ Narraguinnep Reservoir, first begun March 15, 1888 and expected to store 6,000 acre feet of water, has since been enlarged twice.⁶⁴ A dispute in 1904 over buying the reservoir site

between the Montezuma Valley Irrigation District and the Montezuma Water and Land Company resulted in the former being awarded the opportunity to buy the site from the latter for \$3.50 an acre.⁶⁵ The enlargement, begun on October 28, 1907 by Empire Construction increased its capacity to 9,000 acre feet.⁶⁶ Narraguinnep Reservoir, located just below the mouth of the "Great Cut", is filled with storage water by the Dolores Number Two Canal. Another change in the system was in leasing the High Line or Mesa Verde Lateral in 1912 to the U. S. Government to supply the Southern Utes with water. On May 2, 1907 W. H. Crawford sent two hundred men, eighty teams, twenty dump wagons, and two dirt elevators to the headwaters of the west fork of the Dolores River to begin Groundhog Reservoir. Furthermore, Loftus and Skidmore were contracted to furnish \$80,000 to \$90,000 of lumber for fluming and piping. Unfortunately, the reservoir washed out soon after construction and was not reconstructed until the 1930's.⁶⁷

Faulty construction was just one factor that contributed to the failure of the Montezuma Valley Irrigation District. Contracts plans and specifications for the reconstruction of the ditches, flumes and tunnels, and the construction of the reservoirs proved inadequate.⁶⁸ This combined with the inexperience of the officials to produce losses "necessitating the expenditure of large sums thereafter."⁶⁹ From 1913 to 1919 the district was continually in debt.⁷⁰ Moreover, many landowners did not pay their toll charges. Finally, a "federal court in Denver held that the bonds were all inclusive and that the payment of assessments by any one person did not relieve him from having to pay as

long as claims existed against the district."⁷¹ This mutual liability held each member of the Montezuma Valley Irrigation District in debt as long as the district as a whole remained in debt. Therefore, land could not be bought and sold with clear titles. The politics involved in the irrigation district contributed to the downfall of the Montezuma Valley Irrigation District.

Members of the Montezuma Valley Irrigation District were discouraged by the continued bankruptcy of the district and the poor service and maintenance, but surprisingly their spirits lifted with the beginning of the Montezuma Valley Irrigation Company in 1920. Charlie Porter, a director of the Montezuma Valley Irrigation Company, summed up the situation. "It wasn't set up to make enough money to pay the toll, so up 'till 1920 it was a history of little companies going broke, farmers not doing well enough to pay their ditch companies and they needed water everywhere. They formed more companies and borrowed more money and went into default, and it was in the 1920's before our ditch companies got on a decent basis at all."⁷²

The plan proposed by Colorado's ex-governor Carlson for the Montezuma Valley Irrigation Company involved individual liability for irrigation debts. The plan, accepted overwhelmingly in a vote 209 for and 20 against, resulted in the incorporation on November 1, 1920. The new officers were E. H. Kittell, president, W. I. Myler, vice president, John Wesch, secretary-treasurer, and E. W. Henry, superintendent. From this time forward all shareholders of the Montezuma Valley Irrigation Company had individual mortgages that served as collateral for irrigation debts. Land could finally be bought and sold freely.⁷³ This gave residents the incentive to meet their obligations.

The Montezuma Valley Irrigation Company has continued successfully up to the present time. The board of directors is elected by the shareholders. Each share entitles the owner to one eightieth of a second foot of water to irrigate an acre of land and each share has a vote. Extra water may be bought by the acre foot if one share per acre is not enough. Each year in December, the 975 shareholders with their 33,284 shares vote on an assessment per acre for the coming year.⁷⁴

Although federal legislation such as the Carey Act of 1894, and the Newlands Act of 1902 existed to assist Western irrigation projects, the administrators of the Montezuma Valley Irrigation System chose not to seek federal aid until the 1930's when the Montezuma Valley Irrigation Company formed the Montezuma Valley Public Irrigation District. This was done to obtain Public Works Administration (PWA) money, since only political subdivisions were eligible.⁷⁵ The Montezuma Valley Public Irrigation District received a \$135,637.65 grant and a \$165,779.35 loan from the PWA in 1938.⁷⁶ The Montezuma Valley Public Irrigation District was created by mortgaging all the assets of the Montezuma Valley Irrigation Company to the Montezuma Valley Public Irrigation District. As security for the money the Montezuma Valley Irrigation Company agreed to cover the interest and principle on the bonds and maintenance fees.⁷⁷

The Montezuma Valley Public Irrigation District used the PWA funds to rebuild Groundhog Reservoir, (the dam failed when it was first constructed in 1907.)⁷⁸ The reservoir was fed by eight miles of feeder ditches from Little Fish and Beaver Creeks and added 5,000 to 6,000 acre feet of water to the irrigation system each year.⁷⁹

The Montezuma Valley Irrigation System was enlarged and improved in other ways over the years. With maintenance of wooden equipment proving exorbitant, the board decided to replace deteriorated wooden headgates with steel in 1949. Similarly, wooden flumes were replaced by arroyos. In 1921, 105 wooden flumes existed, in 1936 only 43 and by 1972 only 7 remained. Now, 3 flumes are still in use and only 1 is wooden. In 1952 the siphon at Alkali Draw was enlarged from 22 to 26 inches and a similar alteration was made to a siphon at Brumey Draw in 1969. The Highline and Rocky Ford canals were also both enlarged. The enlargement of these siphons and canals illustrates the continual growth of the system.⁸⁰

Narraguinnep Reservoir was also enlarged and an additional reservoir constructed. In 1956 the addition to Narraguinnep Reservoir increased the capacity from 9,000 to 19,000 acre feet. Morrison-Knudsen Company of Boise, Idaho received the contract for \$485,367.⁸¹ This project, financed by a loan of \$500,000 from the Wichita Bank for Cooperatives, received construction aid from the Soil Conservation Service.⁸² The State Highway Department also contributed to the cost of the construction because Highway 147 crosses the main reservoir fill.⁸³ The Lone Pine Canal that circles the reservoir had to be moved to higher ground because of the raised water level, making the total cost of the project \$562,287.⁸⁴

Totten Lake was the most recent reservoir completed by the Montezuma Valley Irrigation Company. It, too, washed out shortly after it was constructed in 1907.⁸⁵ On September 1, 1965 work began again on a 29 foot high dam that restrains over 3,000 acre feet of water. Coe Construction of Albuquerque completed the job for \$200,000.⁸⁶

The Montezuma Valley is, by no means, Colorado's most financially successful irrigation system. However, it did fare better than other irrigation projects in the southwestern part of the state. The Paradox Valley Land and Development Company project, for example, has been described as one of the greatest failures in southwest Colorado.⁸⁷ The La Plata Project, on the other hand, is still operating successfully and plans to build a dam in the near future.⁸⁸

The Montezuma Valley and Uncompahgre Valley irrigation systems have much in common. Both began in private ownership, but the Uncompahgre Project was taken over by the Bureau of Reclamation in 1903.⁸⁷ The construction of the 30,645 foot long Gunnison Tunnel that diverts the Gunnison River into the Uncompahgre Valley was completed in 1909, twenty years after the shorter Montezuma Tunnel began operating. The delay occurred because the use of the initial canal proved inadequate. The canal had a capacity of 700 cubic feet per second, about the size of the Dolores Number Two Canal. The addition of the tunnel to the system improved the situation, but the settlers downstream at Delta had priority and often the tunnel had to be closed during the dry season. Therefore, they added a dam to the system in 1937 with a storage capacity of 106,000 acre feet.⁹² During the tenure of the tunnel, the acres under irrigation in the Uncompahgre system remained fairly constant, but rose again after the dam was constructed. The Montezuma Valley, on the other hand, irrigated an increasing number of acres after the tunnel opened and reached a plateau about 1920.⁹³

The historical significance of irrigation in the arid West is well illustrated by the Montezuma Valley irrigation system. The complex series of tunnels, headgates, canals and flumes stimulated agricultural

and urban settlement of the valley. Irrigation enabled Montezuma Valley farmers to diversity crops and increase productivity. This relieved some of the financial uncertainty and helped to stabilize farm incomes.

Perhaps equally important, the history of the Montezuma Valley irrigation system involved many themes commonly present on the American frontier, including technological innovation, cooperation, and self reliance. Technological innovations often occurred in the West in response to practical necessities. Although the engineering involved in diverting the Dolores River was not unique, it was creatively applied to the demand for water and the unusual situation of diverting water into an adjoining valley. Furthermore, the drills, patented only a decade earlier, represented modern equipment. The engineering feats in the Dolores and Montezuma Valleys were incredible when considering the remoteness of the area.

Cooperation so necessary in the West is also apparent in nearly every aspect of a working irrigation system. Mrs. LaVerne Swanner, daughter of a tunnel construction worker, believes "there wouldn't have been anyone settled in this valley if the pioneers hadn't built the Montezuma Valley Tunnel back in the 1880's."⁹⁴ Self reliance can be examined in a broader sense in the unwillingness of the company to accept federal aid throughout much of its history, unlike Uncompahgre Valley Irrigation System. Technology, cooperation and self-reliance were essential prerequisites for the Montezuma Valley Irrigation System. These frontier characteristics highlight the great importance water was and is given in the West and specifically in the Montezuma Valley.

FOOTNOTES

¹ Densil Cummins, "Social and Economic History of Southwest Colorado 1860-1948" (Ph.D dissertation, University of Texas, Austin, 1941), p.628.

² Alvin T. Steinel, History of Agriculture in Colorado, (Fort Collins: The State Agricultural College, 1925), pp. 177-78.

³ Paul O'Rourke, Frontier in Transition , A History of Southwest Colorado, (Colorado State Office: Bureau of Land Management, 1980), p. 143.

⁴ Interview with Les Nunn, Montezuma Valley Irrigation Company, Cortez, Colorado, 15 July 1981.

⁵ Lillian Hartman, Lillian Hartman's Colorado, Vol. 1. (Denver, 29 December 1909), p. 8.

⁶ The topography of the Dolores Valley makes it unsuitable for growing fruit trees, because of its higher elevation and the cold pockets of air that settle there. Interview with Robert L. Seaton, Montezuma County Extension Agent, 30 July 1981.

⁷ Rocky Mountain News, 24 January 1878.

⁸ Interview with John Reed, Montezuma Valley Irrigation Company, Dolores, Colorado, 30 July 1981.

⁹ Steve Baker and Duane Smith, "Looking Forward to Happier Times" (Bureau of Reclamation Dolores Archeological Program files, Cortez, Colorado. 1978) p. 35.

¹⁰ Rocky Mountain News, 17 September 1880.

¹¹ Montezuma Journal, 8 January 1904, p. 3.

¹² Carl Ubbelohde, A Colorado History, (Boulder: Pruett Press, Inc., 1965) p. 190.

¹³ Interview with Agnes Blake, daughter of Montezuma Valley irrigation system employee, Cortez, Colorado, 6 August 1981.

¹⁴ Baker and Smith, "Looking Forward to Happier Times," p. 19.

¹⁵ Baker and Smith, "Looking Forward to Happier Times," p. 19.

¹⁶ Montezuma Journal, 28 April 1888, p. 1.

¹⁷ To claim a specific amount of water an entity petitions the water court to adjudicate this amount and the court assigns him a priority number, like a place in line at the bakery. The person or company may only use his specified amount of water after those priority numbers lower than his have received their allotment. The Montezuma Valley irrigation system has 64.6 second feet of water with a priority number of 21 and a conditional decree for 1235.4 second feet with a priority number of 50 adjudicated to them.

- ¹⁸ Ubbelohde, A Colorado History, p. 190.
- ¹⁹ Ibid, p. 191.
- ²⁰ Michael Robinson, Water for the West: The Bureau of Reclamation 1902-1977, (Chicago: Public Works Historical Society, 1979).
- ²¹ Cummins, "Social and Economic History....", p. 632.
- ²² Ibid, p. 637.
- ²³ Ibid., p. 638.
- ²⁴ Interview with Agnes Blake.
- ²⁵ Interview with John Reed, Montezuma Valley Irrigation Company Gatekeeper, Dolores, Colorado, 30 July 1911.
- ²⁶ Interview with Wilford Speer.
- ²⁸ Montezuma Journal, 28 April 1888.
- ²⁹ Henry S. Drinker, Tunneling, Explosive Compounds and Rock Drills, 2nd ed. (New York: Wiley, 1882).
- ³⁰ Walter H. Graves, Irrigation and Agricultural Engineering, (Denver: Republican Publishing Company Printers, 1886), p. 6.
- ³¹ Steinel, History of Agriculture in Colorado, p. 233.
- ³² Interview with John Reed.
- ³³ Lindsay T. Baker, Water for the Southwest, Historical Survey and Guide to Historic Sites, (New York: ASCE Historical Publication No. 3, 1973), p. 68.
- ³⁴ The steel arches were installed over 4" x 6" x 4' wide lagging and placed every four feet for a distance of 1200 feet at the tunnel outlet. Interview with Lester Failey, former superintendent for the Montezuma Valley Irrigation Company, Cortez, Colorado, 29 July 1981.
- ³⁵ Interview with Agnes Blake.
- ³⁶ Ira S. Freeman, A History of Montezuma County Colorado: Land of Promise and Fulfillment, (Boulder: Johnson Publishing Company, 1958), p. 96.
- ³⁷ Baker, Water for the Southwest, p. 68. Interview with Les Nunn.
- ³⁸ M. J. Mack, "Irrigation Engineering in the Former Home of the Aztecs," Engineering News, December 1887, p. 468; See also Drinker, Tunneling Explosive Compounds and Rock Drills, p. 270 and Mack, Engineering News, p. 468
- ³⁹ Lindsay T. Baker, "Montezuma Valley Irrigation", Colorado Municipalities, issue unknown, pp. 128-129.

- ⁴⁰ Freeman, A History of Montezuma County Colorado.
- ⁴¹ Interview with John Reed.
- ⁴² Montezuma Journal, 15 August 1980.
- ⁴³ Freeman, A History of Montezuma County Colorado, p. 96.
- ⁴⁴ The sheep wagon was stored at the William Blake home in the winter and used as a playhouse by his children. Interview with Agnes Blake.
- ⁴⁵ Frank Hall, History of the State of Colorado, (Chicago: The Blakely Printing Company, 1895), Vol. 4, p. 228.
- ⁴⁶ Interview with Charlie Porter, former employee of the Montezuma Valley Irrigation Company, Cortez Colorado Public Library.
- ⁴⁷ Hall. History of the State of Colorado, p. 228.
- ⁴⁸ Montezuma Journal, 15 August 1980, p. 5B.
- ⁴⁹ Harold Keown, "Montezuma Valley Irrigation Company Report," 1972.
- ⁵⁰ The Morton Flume, first constructed of wood in the shape of a box, leaked badly and was replaced with a metal flume. After the metal deteriorated from sand abrasion, the flume was reconstructed of Oregon fir in a half-barrel shape. Pieces of this flume still exist in alternate uses such as watering troughs. The final Morton Flume was metal and sections can still be seen flattened over several Montezuma Valley Irrigation Company buildings in Cortez. See for example, Interview with Lester Frailey.
- ⁵¹ Hall, History of the State of Colorado, p. 228.
- ⁵² Montezuma Journal, 8 January 1904, p. 2.
- ⁵³ Harry V. Pyle, Dolores the Gateway, Harry V. Pyle, the Guide to the Montezuma Valley, (pamphlet 1906).
- ⁵⁴ Freeman, A History of Montezuma County, Colorado, p. 98.
- ⁵⁵ Ibid.
- ⁵⁶ Montezuma Journal, 26 February 1904.
- ⁵⁷ Freeman, A History of Montezuma County, Colorado, p. 100.
- ⁵⁸ Montezuma Journal, 8 January 1904, p. 3.
- ⁵⁹ See Montezuma County, Colorado -- Land of Fine Climate, Climate, Beautiful Scenery, Rich Soil, Abundant Water, Large and Varied Production, and Great Opportunities, (pamphlet 1915). Bureau of Reclamation, Dolores Archeological Program Files, Cortez, Colorado; and Hartman, Lillian Hartman's Colorado, p. 12.

⁶⁰ Carl Ubbelohde, Maxine Benson, and Duane Smith, A Colorado History, (Boulder: Pruett Publishers, 1976), p. 260.

⁶¹ Montezuma Journal, 15 August 1980, p. 5B.

⁶² Hartman, Lillian Hartman's Colorado, p. 2.

⁶³ Freeman, A History of Montezuma County, Colorado, p. 99.

⁶⁴ "Water District 71, Dolores River: Decrees of Adjudication February 1, 1892, December 18, 1933, March 8, 1937, March 22, 1963 Transfers and Conditionals made Absolute, Glen E. Humiston, W.C.I."

⁶⁵ Montezuma Journal, 4 March 1904, p. 1; and 13 May 1904, p. 1.

⁶⁶ Water District 71, Dolores River.

⁶⁷ Freeman, A History of Montezuma County, p. 99.

⁶⁸ Montezuma Journal, 15 August 1980, p. 5B.

⁶⁹ Ibid.

⁷⁰ Freeman, A History of Montezuma County, p. 101.

⁷¹ Ibid, p. 11.

⁷² Interview with Charlie Porter.

⁷³ Freeman, A History of Montezuma County, pp. 100-101.

⁷⁴ Interview with Les Nunn.

⁷⁵ Keown, "Montezuma Valley Irrigation Company Report."

⁷⁶ Denver Post, 7 December 1938, p. 19.

⁷⁷ Keown, "Montezuma Valley Irrigation Company Report."

⁷⁸ This area served as a sheep pasture before flooding. Interview with John Reed.

⁷⁹ Denver Post, 7 December 1938, p. 19.

⁸⁰ Keown, "Montezuma Valley Irrigation Company Report."

⁸¹ Ibid.

⁸² "... So They Built a \$1/2 Million Dam," Western Farm Life, 15 August 1948, p. 5; and Interview with Lester Frailey.

⁸³ Keown, "Montezuma Valley Irrigation Company Report."

- ⁸⁴ Keown, "Montezuma Valley Irrigation Company Report."
- ⁸⁵ Interview with Lester Frailey.
- ⁸⁶ Keown, " Montezuma Valley Irrigation Company Report."
- ⁸⁷ Cummins, "Social and Economic History of Southwest Colorado 1860-1948," p. 644.
- ⁸⁸ Bureau of Reclamation, Recommendations on Project Number 34-8-2, p. 14.
- ⁸⁹ O'Rourke, Frontier in Transition, p. 144.
- ⁹⁰ David W. Brunton and John A. Davis, Modern Tunneling with Special Reference to Mine and Water Supply Tunnels, (New York: John Wiley and Sons, 1914), p. 331.
- ⁹¹ "Report on the Irrigation Canals of Colorado," Engineering News and American Contact Journal, 25 December 1885, Vol. 16, p. 425.
- ⁹² Ibid., p. 655.
- ⁹³ Ibid., p. 670.

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ADDENDUM TO:
MONTEZUMA VALLEY IRRIGATION COMPANY SYSTEM
Dolores vicinity
Montezuma County
Colorado

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FIELD RECORDS

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