The Farwell Unit

Middle Loup Division

Pick-Sloan Missouri Basin Program

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Pick-Sloan Missouri Basin Program: The Farwell Unit

Nebraska's most abundant natural resource is fertile land, and early settlers recognized that agriculture would become the region's major industry. But Nebraska is also a land frequently ravaged by reoccurring floods and severe drought. Crop failures brought about by these conditions threatened the livestock industry and created depressed economic conditions, focusing attention on the need to create a more stable agricultural base in the region. To accomplish this goal, control of the region's water resources was key: control that came with initiation of the Pick-Sloan Missouri Basin Program and development of the Farwell Unit.

Project Location

The Farwell Unit is one unit of the Middle Loup Division of the Pick-Sloan Missouri Basin Program, the other unit being the Sargent Unit. The Farwell Unit covers portions of Custer, Sherman, Valley, and Howard Counties in central Nebraska. Located in Howard County, the bulk of project lands lay between the North and Middle Loup rivers, both tributaries of the Platte River. A small portion of the project lands are in Sherman County. The closest major city is Grand Island, Nebraska, about 25 miles south-east of the project area.[1]

One of the principle features of the Farwell Unit is Sherman Dam located on Oak Creek, about 4½ miles northeast of Loup City. Oak Creek is generally dry, having flows only following heavy rains. Water for Sherman Reservoir comes from diversions made on the Middle Loup River at the Arcadia Diversion Dam, another unit feature, and transported almost twenty miles to the reservoir site by the Sherman Feeder Canal. An extensive system of canals and laterals then transport water from Sherman Reservoir to project lands.[2]

Historic Setting

Through a series of treaties during the mid-1800s, several Indian tribes ceded much of the land in the Missouri River basin to the United States. This action helped open the way for settlerment and

establishment of the Territory of Nebraska and its eventual admission into the Union in 1867. By 1870, settlers in the region extended far up the Platte River into the valleys of the North, Middle, and South Loup rivers, north of the Platte. They established Howard County in 1871 and by 1890, most of the irrigable lands had been homesteaded. The population of Howard County continued to grow until 1920, when the population reached just over 10,700. Then drought, economic depression and advances in agricultural technology created an outward migration. By 1950, the population of Howard County had fallen to just over 7,200 people.[3]

Project Authorization

The Farwell Unit was originally authorized in the Flood Control Act of 1944 as part of the Pick-Sloan Missouri Basin Program, a comprehensive program of the Bureau of Reclamation and the Army Corps of Engineers to control and develop the waters of the Missouri River and its tributaries. Extensive investigations of the unit, conducted by the Bureau of Reclamation and completed in 1955, led to several changes and adjustments in the original plan which required re-authorization of the unit plan. The unit was re-authorized by Public Law 952 (84th Congress) on August 3, 1956.[4]

Construction History

The design of the proposed system called for diversion of water from the Middle Loup River at the Arcadia Diversion Dam, transport water via the Sherman Feeder Canal for storage in Sherman Reservoir, and distribute water to project lands through a series of canals and laterals. The plan also included one large and several small pumping plants to lift water to lands above the canal lines. Because the Middle Loup River carries a high concentration of silt, Reclamation designed the Sherman Feeder Canal headworks with a silt diverter to remove as much silt from the water as possible, along with a large settling basin to remove additional sediment before storing water in Sherman Reservoir.[5]

Sherman Dam

Investigations and Design

Reclamation conducted the first surveys for the location of a dam and reservoir on Oak Creek in 1947. Those investigations located a suitable site based on the topographical features of the area. However, later searches revealed a more favorable location about one-half mile downstream from the first site. Studies to determine the suitability of the new site included drilling 24 holes for foundation and water table studies, excavation of four test pits, and investigation of potential borrow areas. These efforts revealed that the valley was covered by a thick blanket of loess, a wind-blown deposit of fine, sandy material that is common in the Missouri River basin. Laboratory tests on the foundation material showed the material to be unconsolidated but with a high load bearing capability when dry, but when saturated, it consolidated easily under fairly light loads. Sherman Dam's original design called for the excavation of a cut-off trench to reach stable ground, but due to the depth of the loess, 45 to 80 feet, Reclamation designers feared that the costs of excavation might doom the whole project. Additional studies later showed that when consolidated the loess material would provide a suitable foundation. Reclamation engineers redesigned the dam, providing for pre-consolidation of the foundation by irrigation and loading. Sherman Dam is the first dam designed and constructed by Reclamation completely on a loessial foundation.[6]

Construction

Reclamation issued an invitation to bid on construction of Sherman Dam in July 1959. It received nineteen bids,with the lowest bid, $2,149,379, submitted by the J. A. Tobin Construction Company of Kansas City, Kansas. Reclamation awarded the contract to Tobin Construction, who received notice to proceed on August 20, 1959. The contract allowed 900 days for completion of the work.[7]

Construction operations initially focused on completely saturating and consolidating the foundation area per Reclamation specifications. Industrial Pipe Line, Inc., a Tobin subcontractor, performed the foundation watering. The contractor drilled two 1,000-foot deep wells to supply water, and watering of the foundation area began on September 3, 1959. The contractor divided the

foundation area into sections ranging from 1 to 7 acres and applied water at a rate of 70- to 100-gallons-per-minute per acre. After two weeks, Industrial Pipe Line drilled test holes in the first section wetted to check the depth of penetration. These test revealed saturation to about 20 feet. Wetting resumed, with another set of tests conducted after 30 days that showed saturation to a depth of about 40-feet. Thereafter, watering continued for another 30-days, with tests conducted to determine if sections required additional watering. Industrial Pipe Line used 88,334,210 gallons of water, completing the final section of the foundation area on June 16, 1961.[8]

Dam foundation stripping began on October 7, 1959. This operation followed closely behind wetting in order to prevent excess moisture loss, removing only the top layer of material, about ½ to 1 foot. Specifications required the contractor to place the first layer of embankment within 8 hours of stripping to prevent loss of moisture through evaporation. The first embankment materials were placed on October 10. The embankment contains two zones, or types of material. The major portion of the embankment, Zone 1, is loess material taken from near the dam site. The remaining portion, Zone 2, consists of sand and gravel and is confined to a 5-foot layer in the downstream portion of the embankment. Sheepfoot rollers spread moistened and compacted Zone I material into 6-inch layers over previously layers, while a crawler tractor placed Zone 2 material in 12-inch compacted layers. Reclamation and the contractor closely monitored the moisture content of the embankment during construction. The final placement of embankment material took place on September 1, 1961.[9]

Excavations for the spillway and outlet works began on October 6, 1959. To provide a solid foundation for the outlet and spillway structures, it was necessary to excavate a trench to solid formation to a depth of about 50-feet. The contractor stored suitable materials excavated from the trench for use in the embankment, while unsuitable materials were wasted. In late November 1959 excavation halted for the season, resuming on April 9, 1960. On May 9, heavy rains caused high runoff on Oak Creek, and flooded the excavations, delaying construction. Despite the delay, the contractor completed excavations in late July.[10]

Concrete operations began in August 1960. The first concrete placed in the piezometer terminal well structure came on August 4, with work on the well completed August 19. Concrete placement in the canal outlet works started on September 2, with installation of the lower section of the gate chamber. Hardie Tynes Manufacturing Company supplied the two 4-by 5-foot regulating gates and the 6-by 7½-foot high pressure emergency gate that the John W. Brown Construction Company installed. Thompson Pipe and Steel Company, of Denver, fabricated the steel pipe for the outlet works. The outlet pipe consists of two sections: the first section, from the intake structure to the emergency gate chamber, is 96-inch diameter pipe completely embedded in concrete; the second section, made up of 90-inch diameter pipe, travels from the gate chamber to the downstream end of the outlet works. The downstream portion rests upon concrete supports inside a 12-foot diameter, horse-shoe shaped tunnel which provides access to the gate chamber. At the downstream end of the outlet conduit, a wye branch reduces the conduit into two 64-inch pipes which lead to the control house. To prevent leakage into the horseshoe tunnel, an asphaltic lining was placed over the completed structure prior to backfilling. A similar lining was used on the spillway conduit. Concrete placement in the spillway structure began in April 1961, and was completed in mid-September. Just over 3,850 cubic yards (c/y) of concrete and 688,400 pounds of reinforcement steel was used in the outlet works and spillway.[11]

Sherman Dam is a homogeneous earthfill structure with a maximum height of 134 feet and a crest length of 4,450 feet. The embankment contains 1,892,000 c/y of material and has a maximum base width of 610 feet from upstream toe to downstream toe. The outlet works consist of a drop style intake structure leading to a steel lined concrete conduit, a gate chamber with one emergency gate, a 12-foot diameter concrete tunnel containing a 90-inch diameter steel pipe leading to a control structure housing two canal regulating gates. Outlet works have a maximum capacity of 960 cubic feet-per-second (cfs). The spillway has an uncontrolled morning glory intake leading to a 8-foot diameter concrete conduit which discharges into a jump-type stilling basin. The maximum capacity of the

spillway is 1,095 cfs. At maximum surface elevation, Sherman Reservoir holds 68,211 acre feet (af) and has a surface area of 2,845 acres.[12]

Arcadia Diversion Dam and Sherman Feeder Canal

The contract for construction of the Arcadia Diversion Dam, on the Middle Loup River about 8 miles northwest of Arcadia, Nebraska, was opened on July 8, 1960. Reclamation awarded the contract to the Bushman Construction Company on September 7, and gave the contractor the notice to proceed on September 12. The contract covered construction of the dam, the dam section of the Sherman Feeder Canal, about 1 mile, and the sediment settling basin. The contractor conducted site investigations during the last months of 1960, but no work was undertaken on the dam itself. Bushman Construction sub-contracted excavations for the canal section and settling basin to the Wentz Construction Company, who began work on October 10, 1960. The primary contractor began work on the dam in early 1961. A small diversion confined the river to the east side of the river channel on April 17, and excavations and driving of the sheet metal piling for the western portion of the dam began on April 25. Concrete operations commenced with placements in the downstream cut-off wall in early May. On October 20, 1961, following completion of the west abutment and western portions of the dam, the river was diverted from the east side of the channel through spillways of the completed portion of the dam. Concrete placement in the eastern portion of the dam began in mid-November. Installation of the first of twelve control gates, gate number 4, was completed on April 14, 1962, with installation of the remaining gate following soon after. All work on the dam and canal section was accepted as complete on November 6, 1962.[13]

Arcadia Diversion Dam is a concrete ogee-weir with earthen embankments wings. The spillway section is 388.5 feet long and controlled by twelve, 30- by 10-foot radial gates. The spillway has a capacity of 20,000 cfs. In addition to the twelve radial gates, there is one sluiceway to remove trapped sediment from behind the dam controlled by a single 14- by 10-foot radial gate. The headworks for the Sherman Feeder Canal consist of two 20- by 7-foot radial gates. The diversion capacity of the dam is 850 cfs. The initial reach of the Sherman Feeder Canal is just over one mile long

and has a sediment settling basin to trap sediment that enters the canal. Sediment is removed from the settling basin by dredging.[14]

Reclamation planners divided construction of the Sherman Feeder Canal into two sections and awarded the Section 1 contract on August 25, 1960 to the Bushman Construction Company, who submitted the low bid of $1,818,342. Bushman sub-contracted the earthwork to the Franke Construction Company and the Mosbarger & EMS Construction Company. The sub-contractors began canal excavations on October 20, 1960. The first concrete in Section 1 was placed January 4, 1961, and after almost two years of work, Bushman completed all work under the contract on November 30, 1962.[15]

Bushman Construction also won the contract for Section 2, submitting the low bid of $1,682,721, on October 10, 1960. As with Section 1, Bushman subcontracted earthwork tasks, this time to the Wentz Construction Company, which began excavations on November 11, 1960. To transport water through the Middle Loup-Oak Creek Divide, it was necessary to construct a tunnel just over 2,000 feet long. Excavations for the tunnel portals began December 2, 1960, and were completed on February 13, 1961. Tunneling operations began on May 15, and continued until the tunnel was holed through on March 17, 1962. Concrete lining of the tunnel began on April 25, 1962. Reclamation accepted all work on Section 2 as complete on November 23, 1962. The first delivery of water to Sherman Reservoir through the Sherman Feeder Canal occurred on November 9, 1962.[16]

The Sherman Feeder Canal is 19.1 miles long and has a capacity of 850 cfs. The Sherman Feeder Tunnel is 2,053 feet long with a diameter of 11.6 feet and a capacity of 850 cfs.[17]

Distribution Canals and Laterals

The Farwell Unit distribution system consists of three primary and two secondary canals totaling over 114 miles, and more than 265 miles of laterals. The primary canals are the Farwell Main, Central, and South canals. The secondary canals are the Lower Main Canal which is a branch of the Main Canal, and the Upper South Canal which branches from the South Canal. The lateral system is divided into five sections: the Main and Lower Main laterals, served by the Main and Lower Main

canals; the Central laterals, served by the Central Canal; and the South and Upper South laterals, served by the South and Upper South canals In addition to the canal and lateral system, there are 38 pumping plants. The largest plant, the Deer Station Pumping Plant, has four units with a total capacity of 27 cfs. The plant lifts water 106 feet to a distribution lateral. The smaller units lift water from 7 to 54 feet.[18]

Reclamation divided construction of the distribution systme into several sections and let contracts for each. With the exception of the contract for Section 2 of the Farwell Main Canal and the Lower Main Canal, all contracts were awarded to the Bushman Construction Company. Turner Construction Company won the contract for Section 2 that included the Farwell Main Canal and the Lower Main Canal. The first contract for construction of the distribution system on section 1 of the Main Canal and Section 1 of the Central Canal went to Bushman Construction on February 20, 1961. As with previous contracts, Bushman Construction sub-contracted excavations and earthwork to other contractors. The three sub-contractors on the contract were the H&M Equipment Company, the B.O.C. Construction Company, and the Rolfmeier Construction Company. Work under the contract began on June 1, 1961, and was accepted as complete on April 23, 1963.[19]

As mentioned above, the contract for section 2 of the main Canal and the Lower main Canal was awarded to Turner Construction in March 1961. Turner subcontracted tasks for earthwork and supply and placement of concrete pipe, while it focused on construction of siphons, drops, and other structures. Work under the contract began in late June, and the first concrete was placed in early July. By the end of 1962, Turner Construction had completed 83% of the work. The contractor completed all concrete work for section 2 in early September 1963, and Reclamation accepted as complete all work under the contract on October 30, 1963.[20]

Reclamation awarded the remaining contracts to Bushman Construction; the first beginning January 19, 1962, with the final contract for construction of the Main and Central laterals let in July 1965. In August 1966, Bushman completed all contract work on the Farwell Unit distribution canals and laterals. The contract for construction of the Deer Station Pumping Plant was awarded to

Bushman Construction in early 1964, and work under the contract began June 5 and was completed June 24, 1965.[21]

The Farwell Main and Lower Main canals have a combined length of 37.5 miles and an initial capacity of 960 cfs. The Farwell Central Canal is 18.5 miles long with an initial capacity of 170 cfs. The Farwell South and Upper South canals are a combined 39.7 miles long and have an initial capacity of 340 cfs. The Farwell Main and Lower Main laterals total slightly more than 105 miles in length and have capacities that range from 60 cfs down to 4 cfs. The Farwell Central Lateral system totals more than 46 miles in length with capacities ranging from 30 cfs down to 4 cfs. The Farwell South and Upper South lateral system is just under 103 miles long with a capacity that ranges from 30 cfs down to 4 cfs.[22]

Post Construction History

Although the entire distribution system was not completed until 1966, the first deliveries of water took place in June 1963, when 63 farm units received water for irrigation of 3,200 acres of project land. On January 1, 1966, Reclamation transferred responsibility of all features of the Farwell Unit to the Loup Basin Reclamation District for operation and maintenance. Under a unique contractual arrangement, the Loup Basin Reclamation District supplies water to both the Farwell and Sargent units through contracts with the Farwell and Sargent irrigation districts.[23]

Since its completion in 1963, the Farwell Unit has established an impressive record of success. The Farwell Unit has posted cumulative crop values of over $273,500,000, placing it squarely among most successful units in the Pick-Sloan Program. All of the features of the unit have performed well, requiring only routine maintenance, and minor repairs and modifications.[24]

Settlement of Project Lands

Most of the lands within the Farwell Unit had been homesteaded and settled by the late 1800s, therefore, no project lands were withdrawn for future settlement. But the development of the Farwell

Unit may have played an important role in maintaining settlement in the region. One of the goals of the promoters of the Farwell Unit was to halt the outward migration of people from the region. The population of Howard County peaked around 1920, when more than 10,000 people lived there. Drought and depression forced many to abandon the land and move to other areas. By 1950, the population had dropped to just over 7,200, and by 1960, even further, to just a little more than 6,500. Following completion of the Farwell Unit in the mid-1960s, the population of Howard County rose, reaching just over 6,800. By 1980, the population had declined slightly to about 6,770 people, and even further, to about 6,050, by 1990. Although the population of the region continues to decline, the outward migration appears somewhat slower, a trend that could be partially attributed to the establishment of a stable agricultural base made possible by the development of the Farwell Unit.[25]

Project Benefits and Uses of Project Water

The largest benefit derived from project water is a stable supply for irrigation. In 1992, water was delivered for irrigation of just over 49,000 acres of project lands. The primary crop raised on project land is corn, covering more than 39,400 acres. Alfalfa and other forage crops cover another 3,800 acres, with soybeans and other field crops grown on the remaining acreage. In 1992, the value of crops grown on the Farwell Unit exceeded $13,700,000.

Recreation is another benefit of the Farwell Unit, with recreational activities available at both Sherman Reservoir and the Arcadia Diversion Dam. Popular activities include boating, camping, fishing, hunting, and sightseeing. The Nebraska Game and Parks Division administers recreational activities at both locations.[26]

The Farwell Unit provides only limited flood control benefits.

Conclusion

By all measures, the Farwell Unit is an outstanding success. By providing a stable supply of water for irrigation, the unit allows the farmers in the region to take advantage of Nebraska's most

prized natural resource: its land. The success of the Farwell Unit speaks not only to the value of the land, but also to the value of cooperation among area water users, irrigation and reclamation districts, and the Bureau of Reclamation. Cooperation that helped make the unit one of the most successful units in the Pick-Sloan Missouri Basin Program.

About the Author

William Joe Simonds was born and raised in Colorado and has a clear understanding of the importance of water in the American West and its influence on the development of that region. He attended Colorado State University where he received a BA in History in 1992 and a Masters in Public History in 1995. He lives with his wife and two children in Fort Collins, Colorado.

Notes

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2. *Technical Record of Design and Construction*, 1; *Project Data*, 841.

3. *Technical Record of Design and Construction*, 1; *Project Data*, 843.

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8. Ibid., 75-76, 79-85.

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