The Owl Creek Unit

Bighorn Basin Division

Pick-Sloan Missouri Basin Program

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The Owl Creek Unit

Since its inception in 1902, the Reclamation program has been one of learning. Each project yielded lessons that could be applied to later projects with the goal of constant improvement. Some of those lessons have resulted in some of the most important engineering advancements of the twentieth century and have influenced dam construction and design worldwide. Reclamation as contributed significantly to the science of dam construction in many areas including concrete composition, structural analysis, and geologic investigations. But sometimes even the best science can not spot all potential problems or predict all that could go wrong, and the most promising projects can be rendered almost worthless. This is nowhere more evident that in the Owl Creek Unit of the Pick-Sloan Missouri Basin Program.

Project Location

The Owl Creek Unit is located in the central Wyoming county of Hot Springs. Project lands are located along the banks of Owl Creek and the Big Horn River north and west of Themopolis. The Unit's primary feature, Anchor Dam, is located on Owl Creek about thirty miles west of Themopolis and is designed tostore water to supplement irrigation supplies for lands along Owl Creek. Two pumping plants provide supplemental water to project lands west of the Big Horn River north of Themopolis.[1]

Historic Setting

One of the things that Wyoming has been known for for much of its history is a sparsity of population. This sparsity extends back into pre-historic times when Paleo-Indian hunter/gatherers tracked and killed now extinct mammoth and ancient buffalo. It is estimated

1. United States Department of the Interior, Water and Power Resources Service, *Project Data*, (Denver: US Government Printing Office, 1981), 965-6.

that when the first Anglos entered the region, that there were no more than 10,000 aboriginal inhabitants in the region. These were mostly Shoshone, Crow, Arapaho and Cheyenne Indians, with some Oglala and Brulé Sioux.

Since the time the first Anglos entered what is now Wyoming, the territory has been claimed by several nations, including France, Spain, Great Britain, Mexico, and Texas. The area which now makes up Wyoming was carved out of parts of the Louisiana Purchase, Oregon Territory, Texas, and the Utah Territory. Wyoming entered the Union as the 44th state in July 1890.[2]

The first Anglo settlers came to the Owl Creek Valley in the early 1870s. In 1879, rancher J. D. Woodruff drove a herd of cattle into the valley to begin the area's first livestock operation. A second cattle operation was established in 1880. By 1889, Woodruff's operation had grown to over 60,000 head. These successful operations encouraged additional settlement in the area, including the development of irrigated agriculture. The first water rights were recorded in 1880, and the irrigated acreage grew rapidly, and by the early 1900s, the area of irrigated land had exceeded the available water supply. In 1909, a small group of interested land owners hired an engineer to look into the possibility of moving water into the Owl Creek drainage from the Wind River. In the early 1930s, several groups were organized to look at the development of storage and pumping facilities in the area. In the late 1930s, after almost a decade of water shortages and drought, area water users sought the assistance of the Bureau of Reclamation.

Reclamation began investigations in the Owl Creek area in 1941. Discussions with local water users about the development of storage facilities began in 1946. These discussions led to

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2. Rand McNally & Company, *The New Rand McNally World Atlas*, (Chicago: Rand McNally & Company, 1985) 196-7, 312; T. A. Larson, *Wyoming, A Bicentennial History*, The States and The Nation Series, (New York: W. W. Norton & Company, 1977), 3-5.

the formation of the Owl Creek Irrigation District in 1946 to serve as the contracting entity for water stored in Anchor Reservoir and supplied by the Lucerne Pumping Plants.[3]

Project Authorization

The Owl Creek Unit was authorized in December 1944 by the 1944 Flood Control Act as a unit of the Missouri River Basin Project, a joint project of the Bureau of Reclamation and the U.S. Army Corps of Engineers to develop the water resources of the Missouri River Basin.[4]

Construction History

Construction of the Owl Creek Unit was scheduled to begin in 1950, and $800,000 was approved to begin the project. But legal actions over the repayment contract between Reclamation and the Owl Creek Irrigation District delayed the start of construction until 1955. The first portion of the Unit to be constructed was the Lucerne Relift Canal and Pumping Plants. The original plan called for the rehabilitation of existing pump facilities, but it was determined that the condition of the facilities was too poor and that construction of new facilities was the best route. Bids for construction of the Lucerne Relift Canal and Pumping Plants were opened in mid-December 1955. The contract covered construction of two pumping plants, a relift canal, and the rehabilitation of the Lucerne Pumping Ditch which brings water from the Big Horn River to Pumping Plant No. 1. The contract was awarded January 16, 1956, to Charles M. Smith, who bid $277,748 for the contract. The contract completion date was set for September 8, 1956. The supply contract for four pumping units was awarded to Fairbanks, Morse and Company at a cost of $51,000.[5]

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3. United States Department of the Interior, Bureau of Reclamation, *Technical Record of Design and Construction, Anchor Dam*, (Denver: US Government Printing Office, 1962), 5-7: *Project Data*, 967.
4. *Technical Record of Design and Construction*, 7.
5. National Archives and Records Administration, Rocky Mountain Region. Records Group 115, Entry 10, Records of the Bureau of Reclamation, "Annual Project Histories: Owl Creek Unit, Big Horn Basin Division, Missouri River Basin Project," Volume I, 1956, 5-6, 8, 10-2.

Work under the main contract began in early 1956. Work progressed slowly during the winter months, but by late-May, the contractor was on schedule and ready to begin installation of the pump units. Installation of the pump units was delayed several weeks because delivery of the units and other government supplied materials was behind schedule. The units for Lucerne Pumping Plant No. 1, which lifts water 67-feet from the Lucerne Pumping Canal to the existing Lucerne Ditch and 136-feet to the Lucerne Relift Canal, were installed in late-June. The units for Lucerne Pumping Plant No. 2, which raises water 24-feet from the Lucerne Relift Canal to the existing Dempsey Ditch, arrived at the site in late-July. Work on Plant No. 1 was completed on August 16, 1956, and Plant No. 2 was completed on August 24. Because of delays beyond control of the primary contractor, the Government extended to contract period to eliminate any penalties to the contractor. Work under the contract was accepted as complete on August 24, 1956.[6]

The Lucerne Pumping Plant No. 1 has four units with a total capacity of 84 cubic feet per second (cfs). Two units lift 40 cfs 67-feet to the Lucerne Canal. The other two units lift 44 cfs to the Lucerne Relift Canal, 136-feet above Plant No. 1. The Lucerne Relift Canal runs for three miles to Lucerne Pumping Plant No. 2. Pumping Plant No. 2 has two units with a total capacity of 33 cfs. Pumping Plant No.2 raises the water 24-feet to the Dempsey Canal. The Dempsey and Lucerne Canals were constructed by private interests prior to initiation of the Owl Creek Unit.[7]

When the Bureau of Reclamation advertised for bids for construction of Anchor Dam, two specifications were issued; one for construction of a concrete dam, and one for construction

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6. *Ibid*.
7. United States Department of the Interior, Bureau of Reclamation, *Reclamation Project Data*, (Washington: US Government Printing Office, 1961), 487, 489.

of an earthfill dam. The most economic alternative would be the one picked. Bids were opened on February 24, 1957. Six bids were received; four for the concrete dam and two for the earthfill alternative. The low bid for the concrete dam, $2,289,052, proved to be over $500,000 less than the engineers estimate and almost $300,000 less than the lowest bid for the earthfill alternative. Reclamation awarded the contract for construction of a concrete dam to Foley Brothers, Inc., of St. Paul, Minnesota.[8]

Foley Brothers began work on the access road to the construction site on April 22, 1957, completing the work in September. Work at the damsite began in late May with preparations for river diversion and excavation of overburden. Excavations began on the right abutment and continued until all overburden was removed. Excavations on the right abutment were competed in July, and work began on the left abutment. In mid-August, it became evident that the rock on the left abutment was not suitable for the dam's foundation, forcing designers to relocate the dam upstream 145 feet on the left abutment and 50 feet on the right. Removal of overburden at the new location began immediately and was essentially complete by early October.[9]

Following removal of overburden, foundation excavations began. This work began in September 1957 with excavations in the central portion of the dam. Excavations on the right side of the foundation began in late 1958, with excavations for the left side beginning in late 1959. In October 1957, during excavations in the central section of the foundation, two solution cavities were discovered. The cavities were formed when layers of dolomite within the bedrock were dissolved either by ground water or by stream action when they were exposed. Over time, the cavities filled in with rock and debris and were covered over by sediments. These cavities posed a hazard to the dam because they would be subject to potential collapse under the weight

8. *Ibid*., 73.
9. *Ibid*., 81-2, 85-8.

of the dam and reservoir. To counter this problem, the cavities were cleared of all loose material and backfilled with concrete. Over 2,000 cubic yards (cy) of concrete were used to fill the cavities. The contract adjustment necessary to cover the extra work resulted on a cost increase of over $116,000 and delays of almost one year.[10]

Anchor Dam is a concrete arch dam that was constructed of 14 interlocking blocks on a 300 -foot constant radius. Concrete placement in the dam began in early November 1957, with placements in block 5, at the foot of the left abutment. Only four placements were made in 1957 before cold weather shut down concrete operations for the season. Concrete placements resumed in February 1958 with backfilling of the solution cavities in the foundation. Concrete was hoisted to the placement area by two stiff-legged derricks, one on each side of the canyon. The derricks could hoist four cubic yard buckets of concrete out to a radius of 140 feet, and two cubic yard buckets out to 180 feet. Concrete was placed in the dam in five foot lifts. In the lower sections of the dam, it was necessary to cool the concrete artificially. This was accomplished by placing thin-walled steel tubing on top of previous lifts prior to pouring the next lift. River water was then pumped through the pipe to speed cooling. The upper portions of the dam were thin enough to allow natural cooling. More than 40,000 feet of cooling pipe was installed in the dam. Once the dam was cool, the pipes were filled with grout, a fluid mixture of cement, water and sand that was used to seal cracks and contraction joints between the blocks of the dam. In addition, grout was pumped into holes drilled in the foundation and abutments to create a water-tight seal around the dam to prevent seepage.[11]

During construction it was necessary to divert Owl Creek to allow work at the site. During the initial stages of construction, the stream was allowed to maintain its normal course

10. *Ibid*., 73-4, 91-4, 128-31.
11. *Ibid*., 8 (drawing), 21, 29, 32, 94-101.

along the left side of the canyon while work progressed in other areas of the site. Later the stream was forced into a temporary channel along the right side of the canyon so the foundation area in the stream bed could be excavated. In January 1958, the stream was turned into a temporary wooden flume which was constructed across the partially completed block 5. In late 1958, a second flume was constructed next to block 5 and the stream re-routed through the new flume. With the stream diverted through the new flume, concrete placement in block 5 resumed. A ten foot diameter conduit was placed through block 5 during construction, and in late 1958, the stream was diverted through the conduit. When the dam was completed sufficiently to allow storage of water, the conduit was sealed and filled with concrete.[12]

Concrete placement in Anchor Dam was completed on October 1, 1960, and the primary contract was accepted as complete by the Government on October 26, 1960. Construction of the dam had been delayed over a year due to delays and extra work associated with the solution cavities and relocation of the dam. Because of the delays and additional work, Foley Brothers had been granted an addition 404 days to complete the contract.[13]

Because Foley Brothers competed concrete placement in late 1960, the concrete in the upper portions of the dam was allowed to cool through the winter before the contraction joints were filled with grout. A completion contract for grouting of the contraction joints in the upper sections of the dam was awarded in March 1961. The contract was awarded to the Prepakt Concrete Company of Cleveland. Work under the contract began in late April and was completed by the end of May.[14]

Anchor Dam is a concrete thin-arch dam 208 feet high with a crest length of 660 feet.

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12. *Ibid*., 23, 85-6.
13. *Ibid*., 73, 111.
14. *Ibid*., 103.

The dam has a maximum thickness of just over 54 feet and is just over 13½ feet wide at the crest. The total volume of the dam is 69,350 cy. The spillway is a 100-foot wide, uncontrolled over flow crest located in the center of the dam crest. The capacity of the spillway is 13,500 cubic feet per second (cfs). The outlet works consist of two 30-inch diameter conduits through the dam. Flows are controlled by 30-inch hollow jet valves. The capacity of the outlet works is 500 cfs. Anchor Reservoir has a maximum capacity of 17,419 acre-feet (af) with a surface area of 440 acres at maximum capacity.[15]

Post Construction History

In addition to the solution cavities located in the foundation area during construction, several large sinkholes were located within the reservoir area. These were investigated and filled with impervious materials prior to filling the reservoir. During the initial filling of the reservoir in 1961, several other sinkholes appeared that drained the reservoir. In the years that followed, attempts were made locate, investigate, and fill additional sinkholes in the reservoir area. Attempts were also made to isolate some sinkholes by constructing dikes. For the most part, the attempts to solve the problem have been only partialy successful, and significant long-term storage is not possible. Currently, the dam is operated for flood control purposes and to extend the irrigation season with what water that can be stored. Anchor Reservoir has never filled to capacity.[16]

Settlement of Project Lands

At the time of construction, all of the lands served by the Owl Creek Unit were in private ownership or held in trust for the Shoshone and Arapahoe tribes of the Wind River Reservation.

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15. *Ibid*., frontispiece
16. Dave Hinchliff, "Anchor Dam, Comprehensive Facility Review, Report of Findings," (United States Department of the Interior, Bureau of Reclamation, April 1997), 1-2.

Because of this, no lands were withdrawn for future settlement and there was no increase in population expected as a result of development.[17]

Project Benefits and Uses of Project Water

The primary benefit of the Owl Creek Unit is supplemental irrigation water for some 12,000 acres of land along Owl Creek and the Big Horn River. Anchor Reservoir is usually able to store sufficient water each season to provide for supplemental late season irrigation for project lands along Owl Creek. Supplemental irrigation supplies for project lands along the Big Horn River is provided by pumping from the river. As livestock production is the primary agricultural activity in the area, the crops grown on project lands are those which support the livestock industry: irrigated pasture, alfalfa hay and other hays. About 3,000 acres are cropped with corn, oats and barley. In 1992, the most recent reporting year, just under 12,000 acres of project lands on 131 farm units received project water. The value of crops grown was just over $125.00 per acre for a total value of almost $1,500,000.

Because of the problem with water storage at Anchor Reservoir, recreational opportunities are limited. The primary recreational activities are land based, consisting of camping, hunting, and hiking. Some fishing is available. Recreational activities are administered by the Bureau of Reclamation.[18]

Conclusion

In spite of Reclamation's efforts to correct the problems in the reservoir area at Anchor Dam, it is still not possible to store a significant amount of water for more than a short time. But even with these deficiencies, Anchor Dam is still able to provide some benefit with what water

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17. *Technical Record of Design and Construction*, 6.
18. *Project Data*, 968; Department of the Interior, Bureau of Reclamation, *1992 Summary Statistics, Water, Land, and Related Data*, (Denver: US Government Printing Office, [1995]), 111, 116, 309.

that is able to be retained, but it seem unlikely that the project will ever be able to provide full range of benefits that were envisioned when the project was planned.

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.

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