

Canyon Ferry Project

Pick-Sloan Missouri Basin Program

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Canyon Ferry Unit Pick-Sloan Missouri Basin Program

As the Bureau of Reclamation approached its fiftieth birthday, its leaders envisioned projects on an increasingly grand scale. Reclamation's counterpart from the War Department, the Army Corps of Engineers, also exhibited an increasing amount of self-confidence in their abilities. In the mid-1940s, as the end of World War II approached, both Reclamation and the Corps of Engineers began generating plans to develop a program encompassing the Missouri River Basin.

Project Location

The Canyon Ferry Unit of the Pick-Sloan Missouri Basin Program is located in western Montana, about seventeen miles east of the state capital of Helena. Canyon Ferry Dam lies on the Missouri River, about fifty miles north of its origin at the confluence of the Gallatin, Madison, and Jefferson Rivers. The dam and 6,400 acres of Canyon Ferry Lake are in Lewis and Clark County. The other 28,800 acres of the lake lie in Broadwater County. The present Canyon Ferry Dam lies one and one-half miles downstream from the original Canyon Ferry Dam built by the Montana Power Company. Temperatures in the area can drop to -30 degrees and climb to over 90 degrees.¹

Historic Setting

Meriwether Lewis and William Clark led their famous expedition up the Missouri River and past the Canyon Ferry Dam site in 1805. The expedition paved the way for eventual later settlement in Montana. The American Fur Trading Company established a post at Fort Benton in 1846, during the booming years of the fur trade. The discovery of placer and lode gold, near Bannock, in 1862, fostered a mining rush in Montana. Miners involved in the rush soon

1. Bureau of Reclamation, *Annual Project History, Missouri River Basin Project--Canyon Ferry Unit, 1948*, Record Group 115, 2; Department of Interior, *Final Environmental Statement: Proposed Dust Abatement at Canyon Ferry Lake; Canyon Ferry Unit, Helena-Great Falls Division, Pick-Sloan Missouri Basin Program, Montana*, Bureau of Reclamation, February 14, 1972; Bureau of Reclamation, *Annual Project History, Canyon Ferry Unit--Helena-Great Falls Division--Missouri River Basin Project, 1950*, Record Group 115, 81, 84. Hereafter Record Group 115 cited as RG 115.

encountered even more gold, as well as silver and lead.²

John Oakes began operating a ferry across the Missouri River in 1865. Oakes established the ferry to directly connect the city of Helena, ten miles west, with mining operations on the east side of the Missouri. J. V. Stafford bought Oakes's ferry in 1866, and built a general store and a post office on the east side of the river. The two future dams at the site took their name from the ferry, in the canyon, operated by Oakes and Stafford.³

In the 1870s, the United States established forts in Montana to protect settlers against the perceived threat of Indian attacks. The forts included; Fort Benton, Camp Baker (later moved and renamed Fort Logan), Fort Maginnis, Fort Ellis, and Fort Shaw. Military roads connected most of the forts, but Missouri River steamboats, traveling to Fort Benton, provided the primary access to the area in the 1870s. Transportation to the region changed when the railroad made its way into the area during the 1880s. The Oregon Shortline Railroad built a line from Ogden, Utah, to Silver Bow, Montana, in 1882. Extensions of the line advanced the route to Helena in 1883, and Bozeman in 1885, respectively. Branch lines of the railroad also sprang up along the Oregon Shortline route.⁴

The earliest agriculture, in the Helena area, consisted of gardens and small dairy operations near the forts. In 1866, stockmen brought the first cattle herd from Texas to Montana over the Bozeman Trail. Successive ventures continued bringing cattle from Texas and Kansas. Cattlemen established most stock ranches in the area between 1865 and 1880. Ranchers loosed their herds on the open range until 1906-08, when the acreage of open ranges decreased. The Homestead Act of 1862, encouraged settlement of the area, but crop farming advanced slowly. Farming began picking up in the early twentieth century. Bad weather and drought started in 1918, and continued in the early 1920s, causing many farmers to pack and move on. Depression

2. Bureau of Reclamation, "Report on Canyon Ferry Unit—Montana, Helena-Great Falls Division, Missouri River Basin Project," Upper Missouri Projects Office, Great Falls, Montana, June 1954, *Project Reports*, RG 115, box 131, 14.

3. Bureau of Reclamation, *Annual Project History, Missouri River Basin Project—Canyon Ferry Unit, 1947*, RG 115, 5.

4. Reclamation, "Report on Canyon Ferry Unit," 14-5.

and drought in the 1930s, forced more farmers to abandon their holdings.⁵

Farmers started irrigating lands in the Missouri Basin above Great Falls, Montana, in the late 1800s. Residents in the area built several reservoirs through private, state, and Montana Power Company support. Local, state, and power interests built Lima Reservoir (90,000 acre-feet), Willow Creek Reservoir (17,000 acre-feet), and Middle Creek Reservoir (8,000 acre-feet) on the Madison River. Montana Power owned the first Canyon Ferry Dam on the Missouri River, at the time of Reclamation's construction.⁶

A group of entrepreneurs first started developing hydroelectric power generation at Canyon Ferry in the 1890s, building the first powerplant there in 1898. The plant had four 750 kilowatt units with six more generating units added in 1902. The group completed the original Canyon Ferry Dam in 1901, later selling it to the Montana Power Company, formed in 1912. The first dam was a rockfilled, timber crib, with a masonry core. It stood 47 feet high and stretched 300 feet long. The next year the company raised the dam 10 feet, creating a reservoir capacity of 40,000 acre-feet. Montana Power investigated the possibility of raising the existing dam in 1921, but a saddle in the right abutment required a 4,000 foot long dike to close. Apparently that requirement did not appeal to the company.⁷

Project Authorization

Reclamation and the Corps of Engineers each forwarded a proposal through Congress for developing irrigation, power generation, flood control, navigation, and other related interests, in the Missouri River Basin. Reclamation regional engineer W. G. Sloan authored Reclamation's proposal, published as Senate Document 191 of the 78th Congress, 2nd session. General Lewis A. Pick, Divisional Engineer, wrote the Corps of Engineers' proposal in House of Representatives Document 475, 78th Congress, 2nd session. Senate Document 247 merged the two plans into one program, commonly called Pick-Sloan after the original authors. Congress

5. *Ibid.*, 15-6.

6. Reclamation, *Project History, Canyon Ferry Unit, 1947*, 6.

7. Reclamation, *Project History, Canyon Ferry Unit, 1947*, 7a, 10, 30; *Encyclopedia Americana*, 1991 ed., s.v. "Montana," by Merrill G. Burlingame.

authorized the plan as the Flood Control Act of 1944.⁸

The Army Corps of Engineers first studied Canyon Ferry in 1929, but took no action toward development. The existing reservoirs irrigated 623,000 acres of land. A further 196,300 acres needed a supplemental supply of water. Reclamation estimated the area had another 311,900 acres of irrigable land. Reclamation determined in 1939, such development necessitated seasonal and long term carryover storage. However, Reclamation did not have enough finances budgeted for a large scale investigation. Engineers from Reclamation met with representatives of Montana Power and the Montana State Water Conservation Board. Montana Power pledged \$50,000 in cash, and the state of Montana offered \$25,000 worth of personnel time to match equal funds contributed by Reclamation for the necessary studies.⁹

Canyon Ferry received approval as part of the Missouri River Basin Project in the 1944 Flood Control Act. Reclamation engineers visited the original Canyon Ferry site and a newly proposed site in August 1944, and July 1945, choosing the new site. In preparation, Reclamation made an informal agreement with the Helena office of the General Land Office (GLO) to re-survey Canyon Ferry Lake and re-establish the original GLO markers. Reclamation hoped the re-establishment would simplify land acquisition procedures, and re-set corners lying near the flow line. Reclamation studied the possibilities of both earthfill and concrete dams for the site. The earthfill dam design required 3.4 million cubic yards of fill, and would stand 173 feet high. Reclamation chose to build a concrete dam because of unspecified, simplified spillway requirements. President Harry S. Truman signed the appropriation bill for the Department of the Interior's fiscal 1948 budget in July 1947, allocating \$915,000 to the Canyon Ferry Unit. Regional Director Kenneth F. Vernon announced the appointment of William P. Price, Jr., as Construction Engineer for the Canyon Ferry Unit on August 20, 1947. Price arrived at the project on September 9, 1947.¹⁰

Construction History

8. Reclamation, *Project History, Canyon Ferry Unit, 1947*, 2.

9. *Ibid.*, 6-7.

10. *Ibid.*, 29-31, 33-4.

Many of the first year contracts related to construction of Reclamation's camp near the dam site. Reclamation chose a camp site eight-tenths of a mile upstream from the dam site axis because it could accommodate personnel required for construction. Reclamation issued contracts to construct a permanent camp adjacent to the construction camp for operation and maintenance of the dam and powerplant. Green Lumber Company of Laurel, Mississippi, contracted to build twenty two-bedroom prefabricated residences in October 1947. Kiely Construction Company of Butte, Montana, received a contract for streets, sidewalks, and utilities in the Reclamation camp that November. Dudley Construction Company of Great Falls, Montana received a contract for most of the permanent buildings in the construction camp. Dudley built the permanent buildings between April and May 1948. These buildings included residences, a dormitory, an office, and a garage and shop building. Further permanent structures, for operation and maintenance, were built between 1947-51. Reclamation relocated a schoolhouse and "teacherage" to the camp from the reservoir pool area.¹¹

Because the new Canyon Ferry Lake required moving some county roads, Reclamation geared other initial contracts toward road relocation. Union Construction Company of Great Falls, Montana, contracted to relocate ten miles of road on September 16, 1947. The company wasted no time starting. Clearing operations began October 6, and first excavation commenced on October 8. Union Construction actually received formal notice to proceed on October 22, 1947, and October 16, 1948, was the deadline for completion. The firm stopped work for the winter on December 6, 1947.¹²

Some local residents expressed resentment toward construction of the new Canyon Ferry Dam early in the unit's history. James Sullivan, secretary to Congressman Mike Mansfield, took William Price to a town meeting at Townsend. Many of the community's residents opposed Canyon Ferry Lake because it would inundate Canton Valley lands. The lands provided farm area for Townsend. Montana Power voiced opposition to the dam for unspecified reasons, but

11. Reclamation, *Project History, Canyon Ferry Unit, 1947*, 33, 37, 43; Bureau of Reclamation, *Canyon Ferry Dam and Powerplant: Technical Record of Design and Construction; Canyon Ferry Unit, Missouri River Basin Project, Constructed 1949-54*, Bureau of Reclamation, Denver, December 1957, 163-4.

12. Reclamation, *Project History, Canyon Ferry Unit, 1947*, 38, 47.

objections most likely dealt with their commercial interests in the region. In spite of some voiced opposition, most area residents reacted favorably to the dam's construction.¹³

Union Construction resumed road relocation operations in April 1948, putting all earthmoving equipment on rough excavation. They completed construction, along with bridges and culverts, in June. The company developed a pit to supply surfacing material for the lower end of the road, near Townsend. They established another pit closer to the dam site to furnish surfacing material for the upper end of the road. Wet weather in June 1948, slowed the road work considerably. Nevertheless, Union Construction completed the relocation in July. The contractor completed four guard rails, guard rail posts and cable, and cattle guards September 23, 1948.¹⁴

Reclamation opened the four bids for construction of Canyon Ferry Dam on December 1, 1948. Reclamation rejected all of them as too high. Canyon Constructors, Inc., of Los Angeles, had the low bid of \$12,940,845, but it was 27 percent higher than the Reclamation engineers' original estimate and 14 percent higher than their revised estimate. Re-advertisement of the contract set the timetable back about a year. Reclamation ultimately awarded Canyon Constructors the dam contract on April 20, 1949, for \$11,896,425. Canyon Constructors was a conglomeration of Brown and Root, Inc., of Texas; Wunderlick Contracting Co., of Nebraska; Griffith Co., of California; and J. C. Maguire, of Los Angeles. The contractor received the notice to proceed on May 20, 1949 and started work right away. Reclamation invited bids for the power equipment later.¹⁵

Located in a steep, rocky canyon on the Missouri River, Canyon Ferry Dam required a large amount of work prior to beginning actual construction. Dam construction needed cofferdams upstream and downstream of the site in order to dewater the site. The cofferdams would divert water into a flume along the right abutment and around the dam site, allowing construction

13. *Ibid.*, 49-50.

14. Reclamation, *Project History, Canyon Ferry Unit, 1948*, 17.

15. Reclamation, *Project History, Canyon Ferry Unit, 1948*, 1; Bureau of Reclamation, *Annual Project History, Canyon Ferry Unit--Helena-Great Falls Division--Missouri River Basin Project, 1949*, RG 115, M, N, 15, 31; Reclamation, *Canyon Ferry Dam and Powerplant: Technical Record of Design and Construction*, 162.

of the dam. The first Canyon Ferry Dam played an important role in construction, halting the flow of the Missouri at crucial times.

Canyon Constructors began moving their equipment and materials to their construction camp site, and started grading for camp buildings on May 28, 1949. They built a temporary road and bridge across the Missouri River to the Reclamation camp site. The road opened for public use in the last week of July. In the first week of the month, Canyon commenced excavation of overburden, excess rock, on both abutments. Workers removed this overburden with bulldozers, shovels, sluicing, and scaling. The rock required some blasting and drilling. On July 26, 1949, the company put a floating gold dredge into operation on the river to excavate excess material from the Missouri River bottom. The dredge piled the material onto the river bank, and trucks hauled the material upstream. Workers used it to backfill the upstream and downstream cofferdams.¹⁶

Canyon began excavation in the right abutment, for the diversion flume, in early July 1949. Work on the abutment continued in September, after the rest of the excavation halted. Work on the actual flume commenced on September 21, and finished November 25, 1949. The diversion flume stretched 1,000 feet long, and 65 feet wide. Its walls stood twenty-five feet high at the upstream end and eighteen feet at the downstream end. The flume structure consisted of steel framing members lined with planking, tarpaper, and shiplap. Canyon halted most excavation, for the year, in September 1949.¹⁷

Canyon started building the upstream and downstream cofferdams in August and September 1949, respectively. Both cofferdams were earthfill with a core of sheet steel piling. The upstream coffer lay 300 feet from the dam site, and the downstream coffer 590 feet from the site. The contractor closed the upstream cofferdam on November 27, 1949. They closed the downstream cofferdam, but left a section open to discharge water leaking through the upstream coffer.¹⁸

16. Reclamation, *Project History, Canyon Ferry Unit, 1949*, 31-5.

17. *Ibid.*

18. *Ibid.*, 35, 40.

Reclamation awarded a contract to Kiely Construction for relocating the county road approaches to the dam. Dillsworth and Punnea, a subcontractor, started work on the right abutment road May 16, 1949. They completed the work at the end of July, except for the guardrail. Kiely began work on the left abutment road May 19. The company finished excavation in August, and completed the road, including cattle guards and guard rails for both sides, on October 22, 1949.¹⁹

Delays in land acquisition postponed initial clearing of the reservoir area. Privately owned ranch land dominated the prospective reservoir. Montana Power Company was the largest single landowner. Ranchers owned the remaining land with a few government-owned parcels scattered in between. Reclamation acquired about 39,000 acres for the reservoir and the government camp. Originally scheduled for contract work, Reclamation cleared part of the reservoir between the dam site and the old Canyon Ferry Dam by force account. Other force account work consisted of remodeling the "teacherage" and school, and landscaping and fencing the Reclamation camp in May, June, and July.²⁰

A ground breaking ceremony, to start actual construction of the dam, drew several celebrities and politicians. The ceremony coincided with a local celebration in Helena, in May 1949. Reclamation Commissioner Michael Strauss attended the ceremony, along with Washington, regional, district, and project officials, to represent Reclamation. Gary Cooper, Dinah Shore, and George Montgomery added Hollywood glitz to the Montana celebration. In addition, the governors of North Dakota, South Dakota, Nebraska, and Missouri attended the ground breaking.²¹

Reclamation executed a contract with Montana Power in December 1949, to acquire the company's Canyon Ferry Dam, Powerplant, and other holdings. The contract allowed Reclamation to inundate the old Canyon Ferry Dam and Powerplant for a payment of \$950,000. Montana Power would operate its Canyon Ferry Powerplant until March 15, 1950. Afterward,

19. *Ibid.*, 50.

20. Reclamation, *Project History, Canyon Ferry Unit, 1949*, 72-4; Reclamation, *Canyon Ferry Dam and Powerplant: Technical Record of Design and Construction*, 163.

21. Reclamation, *Project History, Canyon Ferry Unit, 1949*, 131.

Reclamation would provide 47,500 acre-feet of water for Montana Power under the company's Montana storage right of 1898. As Montana Power released its water storage, the company could replace it with storage from Hebgen or Madison Reservoirs on the Madison River. Montana Power could use its share of water to generate power at Hauser, Holter, Black Eagle, Rainbow, Ryan, and Morony Dams downstream, as well as any future power developments.²²

Canyon Constructors began removing water from the dam site in February 1950. The company put a fine silt on the outside faces of the cofferdams as a lining to prevent water from percolating through. Canyon installed pumps in the dam site to remove water continually seeping into the foundation through the upper cofferdam. On March 22, 1950, a forty-two foot section of the diversion flume's right wall collapsed. The company repaired the section with a six foot high steel plate with concrete placed behind.²³

More problems struck on April 18. While workers backfilled the flume, a sheet piling transition on the river side of the flume collapsed. Workers installed additional anchors and pulled the piling back into position to repair the section. Workers excavated overburden along the left canyon wall to carry part of the river around the cofferdams, in case the flow exceeded the flume's capacity. The Missouri's current damaged the flume inlet and undermined the flume, resulting in a break on June 10, 1950. Canyon responded by dropping a large amount of rock upstream from the flume. The rock prevented further erosion around the inlet, and sealed the leak into the foundation.²⁴

The contractor resumed water removal in early July, when the river's flow decreased. Leaks in the flume continued, and the accumulated water delayed complete water removal from the dam site, until August. The old Canyon Ferry Dam held back the Missouri on September 5 and 6, while Canyon Constructors laid a concrete blanket in the bottom of the inlet transition. The company took the opportunity to repair some of the flume's floor planking. Workers excavated the foundation, between two blocks, for the spillway curtain, to prevent erosion when

22. Ibid., 77-8.

23. Reclamation, *Project History, Canyon Ferry Unit, 1950*, RG 115, 39.

24. Ibid., 39, 43, 45.

the dam spilled and grouted low pressure holes in the dam foundation between August and November of 1950.²⁵

Workers laid the first concrete in block 13, near the center of the dam on August 25. They placed the first official bucket of concrete on September 13. Canyon transported the concrete from the mixing plant to the dam and powerplant in buckets loaded on a flatcar pushed by a small, diesel locomotive. The track ran from the mixing plant to the downstream face of the dam. A cableway across the canyon carried the buckets to the placement areas. Canyon raised the odd numbered blocks in five foot lifts, designating them "high" blocks. When the high blocks stood fifteen feet above the foundation, work crews started on the even numbered "low" blocks. After removing the forms, workers cleared faulty or "dummy" concrete off and replaced it. The contractor put grout pipe and seals in each contraction joints to allow future grouting of the joints. Canyon cured the concrete by flooding the work or using a system of pipes and spray nozzles. The company laid two blocks to 25 feet, one block to 20 feet, and three to 10 feet by the end of the construction season, completing 8 percent of the concrete work.²⁶

Canyon laid the first concrete for the spillway apron on October 3, 1950. The apron would prevent earth from eroding around the base of the spillway's exit tunnel. Workers used a pumpcrete machine for the apron because the cable system did not reach the apron site. Problems occurred when the concrete set prematurely, and mechanical breakdown forced the crews to abandon the pumpcrete machine. To circumvent the difficulties, the contractor divided dump truck beds into two cubic yard containers. The dumptrucks loaded concrete into a dragline bucket which then dumped the material into the apron block. Work crews completed 20 percent of the apron by the end of the season.²⁷

The approach of winter required Canyon to warm the concrete after placement to protect against damage from freezing. Five boilers heated the newly placed concrete. The boilers bled steam into water sitting on top of the concrete to prevent freezing. Large radiant heaters warmed

25. *Ibid.*, 45.

26. Reclamation, *Project History, Canyon Ferry Unit, 1950*, 53, 61; Reclamation, *Canyon Ferry Dam and Powerplant: Technical Record of Design and Construction*, 218.

27. Reclamation, *Project History, Canyon Ferry Unit, 1950*, 53, 55.

the sections which could not be flooded. The contractor also steamed the sides of the blocks to heat and cure them. Wood frames with tarps covered the spillway apron allowing steam fed blowers to circulate warm air around the new concrete. These procedures allowed work crews to lay five blocks of the apron in sub-freezing temperatures. However, a severe cold spell in November 1950, forced winter concrete placement to halt.²⁸

Light river flow in April 1951, allowed Canyon to repair water erosion damage on the downstream end of the flume. Workers pumped 900 cubic yards of concrete into the section. Timber braces and cable slings shored up the flume walls. The company raised the upstream coffer to protect against projected May flooding. The precautions paid off as the flume effectively handled the river's extra water.²⁹

Canyon put two ten-foot diameter diversion tubes through block twelve of the dam. The company requested permission to keep block twelve low, to allow water over, in case the current became too great for the tubes. Reclamation agreed, but required Canyon to insulate contraction joints to within twenty five feet of the top, to reduce temperature stresses. During April and May of 1951, workers grouted faults in block fourteen and along the left abutment to the line of blocks five and six. Concrete placement resumed on March 30, 1951. The contractor laid the year's first apron block three days later. The threat of floods made placement of the apron first priority. Canyon increased the placement rate of the apron from three sections per week to ten per week.³⁰

Work crews laid four lifts on the dam per week during the 1951 work season. Both project officials and Canyon Constructors' supervisors considered progress too slow. Foremen blamed slow headway on the elaborate form work for trashrack structures and the powerhouse. They said the forms consumed most of the carpenters time, keeping them from other work. Early in June, crews started placing penstock number two in block fifteen. Later in the month they began putting penstock number three in block fourteen. The workers completed number

28. Ibid., 55-7.

29. Bureau of Reclamation, *Annual Project History, Canyon Ferry Unit--Helena-Great Falls Division--Missouri River Basin Project, 1951*, RG 115, 35, 38.

30. Ibid., 45, 49.

two by the end of the work season, but not number three. Crews started installing the four outlet pipes in June 1951, and finished the job in July. They completed installing the gates and hoisting mechanisms in August.³¹

In mid-June the company made preparations for concreting the powerplant structure, and workers laid the first stage of concrete. Canyon completed the spillway retaining walls in August, and started backfilling the left wall. Backfilling operations concluded in September. During the month, work crews installed and aligned the fixed wheel gate frames for the river outlets in blocks eleven and thirteen. They started on the frames in blocks seven and eight during the same month. Canyon dipped the trashracks and painted the outlet tubes with coal tar pitch. Crews laid the grounding system mat for the powerplant, and placed the concrete slab downstream of the draft tubes. They placed riprap in the downstream section below the powerplant. The advent of winter shut work down on November 14, 1951, because Canyon could not satisfactorily protect the concrete, and because the labor force then shrank considerably.³²

Canyon removed the pumps from the dam site on November 1, 1951. Water, leaking through the cofferdams, filled the excavated area in three days. Canyon dismantled the downstream coffer to release some of the water. Extensive grouting the previous year, to stop seepage, made removal of the sheet steel piling difficult. Work crews used an air driven extractor and a stiff leg derrick to remove one-half of the piling. A dragline eliminated one-half of the earthfill.³³

During December 1951, Lake Sewell, behind old Canyon Ferry Dam, again captured the entire flow of the Missouri for preparation of second stage diversion. Canyon Constructors built a 1,500 foot dike across the river while they dismantled the upstream coffer with draglines. Canyon opened a section of the dike when it began springing leaks, to relieve water pressure. When they opened the section, water eroded the dike away and surged toward the dam site.

31. *Ibid.*, 49, 53.

32. *Ibid.*, 60, 63.

33. *Ibid.*, 41.

Rushing water floated the diversion flume, allowing water into the powerhouse excavation, and quickly filling it. The contractor used pumps to dry the excavation out. Workers started dismantling the flume and finished removing it by March 1952.³⁴

Contractors took over reservoir clearing from government forces in 1951. C. L. Hubner Company and Thompson-Kirkwood Company each received a contract early in the year, and completed their work before 1952. Reclamation awarded Lindquist, Olson, and Company a third contract later in 1951. Lindquist, Olson and Co. finished 6 percent of the clearing before stopping for the winter. The reservoir site was cleared from the dam site to seventeen miles upstream by the end of 1951.³⁵

Early in 1952, Canyon resumed excavating overburden in the dam foundation, powerplant foundation, and retaining wall site for the powerplant parking lot. The company excavated a major fault trench in blocks sixteen and seventeen. Close observation of the site revealed a fault in the right abutment near block seventeen. To stabilize it, workers grouted the shaft and the dam's drain tunnel. The contractor installed the spillway gate seats, gate frames, and the gate guides, when the continuing concrete operations allowed.³⁶

Concrete operations resumed in 1952, when work crews raised block seven up five feet on March 25. Favorable weather helped progress by allowing Canyon to open up the construction area. The contractor ran eight hour shifts six days a week. The shifts increased to nine hours, which proved more attractive to the newer men by providing overtime pay. The available overtime apparently kept many men on the job. The day shift concentrated on form work, reinforcement placing, and pipe work. Swing and graveyard shifts laid concrete, sandblasted where needed, and did general cleanup.³⁷

Work crews started installing the draft tube forms in powerplant Units One and Two, in May 1952. They finished the substructure for the two units in June. During the same month,

34. *Ibid.*, 45.

35. *Ibid.*, 73.

36. Bureau of Reclamation, *Annual Project History, Canyon Ferry Unit–Helena–Great Falls Division–Missouri River Basin Project, 1952*, RG 115, 29, 32.

37. *Ibid.*, 32.

crews began the main structure and resumed work on the powerplant. They successfully raised the main unit walls and placed the structural concrete roof slab by the end of the year. Work crews placed concrete backfill in the fault shaft of block seventeen, grouted the right abutment, and lined the drainage tunnel with concrete. Before the end of the work season, Canyon raised blocks twenty-one through twenty-four to elevation 3808.5, and blocks ten, eleven, thirteen, and fourteen to the spillway crest. Blocks eleven and thirteen stood level with the top of the trashrack roofs.³⁸

Removal of the flume in March 1952, inaugurated the second stage of diverting the Missouri. Water now flowed both through the ten foot diversion tubes and over block twelve, deliberately kept below the surrounding blocks for that purpose. By August 6, the river's flow declined and freed block twelve of water. Canyon laid concrete on the block as quickly as possible. In one 48 hour period work crews finished one full, five foot lift and laid another partial lift. After the completion of block twelve, the outlet conduits and diversion tubes handled all the river's flow.³⁹

E. L. Pennington Construction Company received the final contract for clearing the Canyon Ferry Reservoir site in 1952. The firm started work on May 26, but wet ground caused problems for the heavy equipment, quickly forcing the company to postpone work on May 29. While operations resumed in June, ground moisture continued to slow work. One area required only the burning of driftwood to complete. The company finished approximately one-half of the contract before the end of the year. Lindquist, Olson, and Co. finished their contract October 25, 1952. E. L. Pennington finished the final clearing contract July 24, 1953.⁴⁰

Reclamation opened bids for the completion contract for the dam and powerplant on December 18, 1952. Eisenman, Seabrook, and Elliott and Reclamation entered the contract on January 7, 1953. The contract primarily consisted of installation of power equipment, three turbines and governors, and placement and testing of three generators; and the switchyard, but

38. *Ibid.*, 34, 41.

39. *Ibid.*, 25.

40. *Ibid.*, 47-8.

included placement of miscellaneous structural steel and metalwork. Eisenman, Seabrook, and Elliott completed the contract April 13, 1954.⁴¹

Canyon backfilled the diversion tubes in block twelve with a pumpcrete machine, early in spring of 1953, before spring runoff. They finished the backfill on March 28. Montana Power installed the flashboards on old Canyon Ferry Dam to temporarily stop the Missouri's current at midnight, on March 23, and the contractor drew the pool upstream of the new dam down. At 6:00 a.m. of the same day, Canyon began setting the gates over the diversion tubes. Steel framed, timber caissons, hinged to the downstream face, sealed the downstream ends of the diversion tubes. In October 1953, the company dismantled the rest of the downstream cofferdam. They used material from the coffer to backfill the diversion flume area. Work crews leveled the backfill for an access road to the dam.⁴²

Between February 6 and August 14, 1953, Canyon drilled and grouted high pressure holes in the foundation bedrock, forming a continuous grout curtain to prevent seepage through the foundation. From January 28 to March 20, 1953, Canyon limited concrete operations to the powerplant, where temperatures stayed above freezing. The company laid the first mass concrete of the year in block twenty on March 21. The contractor added 1 percent calcium chloride, by weight, to the concrete mixture to speed curing, and shorten the time necessary to protect the work against the cold. Mass concrete placement, on the dam and trashracks, accelerated in April. Crews placed the concrete as soon as the carpenters finished the forms. Workers made smaller placements in the powerplant when large forms were not available.⁴³

Canyon resumed work on Unit One of the powerplant on May 13, 1953. Workers transported the concrete from the trestle, at the mixing plant, by cable. The cable loaded the concrete in a truck, which drove into the powerplant to unload the mix where needed. Canyon completed the first roadway and sidewalk blocks on May 15. Work on the rest of the blocks

41. Reclamation, *Canyon Ferry Dam and Powerplant: Technical Record of Design and Construction*, 162, 259.

42. Bureau of Reclamation, *Annual Project History, Canyon Ferry Unit--Helena-Great Falls Division--Missouri River Basin Project, 1953*, RG 115, 28-9, 33, 35; Reclamation, *Canyon Ferry Dam and Powerplant: Technical Record of Design and Construction*, 181.

43. Reclamation, *Project History, Canyon Ferry Unit--Helena-Great Falls Division, 1953*, 34-5.

continued through June. Work crews started on the elevator tower in July. The contractor finished the spillway bridge on September 12, 1953. Completion of the elevator tower came on October 8. Installation of the radial gate seats and trunions, and the pier plates started in spring of 1953, and continued through the work season as laying of the spillway bridge piers permitted.⁴⁴

Canyon completed the initial work on the powerplant's three units in July 1953. They finished Unit One by December, and it started operation on December 10, 1953. Unit Two and Three generators commenced operation in 1954. Canyon completed floor finishing in the powerplant. The company concluded the requirements of the contract by removing their camp buildings and equipment from the dam site in June 1954, officially completing the dam June 23, 1954. Final construction costs for Canyon Ferry Dam and Reservoir totaled \$15,520,824, the powerplant cost \$6,013,812, and \$495,235 for the switchyard. The total of direct and indirect costs of Canyon Ferry Dam and Powerplant totaled \$28,772,465. Reclamation transferred Canyon Ferry Dam and Powerplant to Operations and Maintenance on December 31, 1954.⁴⁵

Reclamation used fly-ash in the concrete as a pozzolan mixture to combat an alkali-aggregate reaction. The fly-ash was an abundant waste material from burning coal, often used by Reclamation in the late 1940s because of its ability to harden underwater. Pozzolan described any such material. In 1952, Reclamation reduced the mixture from 25 percent fly-ash to 15 percent. Reclamation felt the new ratio would provide the concrete with maximum durability, but have enough fly-ash to prevent any alkali-aggregate reaction.⁴⁶

Canyon Ferry Dam is a concrete gravity structure standing 225 feet tall with a crest length of 1,000 feet. The top width is 20 feet with a maximum base width of 173 feet. The structure contains 414,400 cubic yards of material. The Canyon Ferry Powerplant has three generators with a combined capacity of 50,000 kilowatts. Canyon Ferry Lake has a total

44. *Ibid.*, 35, 42.

45. Reclamation, *Project History, Canyon Ferry Unit, 1953*, 45, 50; Bureau of Reclamation, *Annual Project History, Canyon Ferry Unit—Helena-Great Falls Division—Missouri River Basin Program, 1954*, RG 115, VI, 25, 34; Reclamation, *Canyon Ferry Dam and Powerplant: Technical Record of Design and Construction*, 164-5.

46. Reclamation, *Project History, Canyon Ferry Unit, 1952*, 45.

capacity of 2,051,000 acre-feet.⁴⁷

Post Construction History

Immediately following completion of Canyon Ferry Dam, the left abutment suffered a slide, and Reclamation realized debris needed clearing from the reservoir site. Reclamation deferred clearing both until 1955, when cleanup concluded. A severe earthquake at 11:40 p.m., August 17, 1959, at Hebgen Dam woke residents at the Canyon Ferry site, but caused no damage to the dam. In other upgrading actions, Reclamation replaced the log boom, keeping boats from the outlet works; with a barricade of twenty-three 55 gallon drums connected by cables, in 1961.⁴⁸

Canyon Ferry Dam's more severe problem hit around 1970. When Reclamation drew down Canyon Ferry Lake, it exposed 4,800 acres of beach to wind erosion. Wind picked up the dust and blew it over the Townsend area, depositing over 300 tons per square mile per month; well beyond the 15 to 20 tons considered acceptable. In 1968, the Governor of Montana, Lee Metcalf, Montana State Fish and Game Department, and the Montana State Health Department requested Reclamation take measures to control the blowing dust. At the same time, Montana officials urged the development of wildlife habitat in the upper region of the lake. Reclamation instituted a plan to build ten miles of retention dikes, standing up to fifteen feet high, on both banks of upper Canyon Ferry Lake. Reclamation intended for the dikes to convert the lake's mud flats to ponds for waterfowl and prevent the soil from drying. Reclamation finished construction of the dike system by 1978.⁴⁹

Settlement of Project

Because the Canyon Ferry Unit only supports agricultural irrigation indirectly, settlement has less significance than on many Reclamation projects. The closest community is Townsend,

47. Water and Power Resources Service, *Project Data* (Denver: Government Printing Office, 1981), 818.

48. Reclamation, *Project History, Canyon Ferry Unit, 1954*, 27; Bureau of Reclamation, *Annual Project History, Missouri River Basin Project, Helena Valley Unit–Canyon Ferry Unit–Great Falls Division and Transmission Division, 1959*, RG 115, 5; Bureau of Reclamation, *Annual Project History, Missouri River Basin Project, Helena Valley Unit–Canyon Ferry Unit–Great Falls Division and Transmission Division, 1961*, RG 115, 6.

49. Interior, *Final Environmental Statement*, 1-2; Clark C. Spence, *Montana: A Bicentennial History* (New York: W. W. Norton, 1978), 170; Water and Power Resources, *Project Data*, 817; Harold E. Aldrich, "Ashes to Ashes, Dust to Ducks," *Reclamation Era*, August 1972, 14-5.

near the southern tip of Canyon Ferry Lake. It had a population of 1,635 in the 1990 census. Helena, in the Helena Valley Unit, had 24,569 residents. Lewis and Clark County, where Canyon Ferry Dam is located, had a population of 47,495 in 1990. Broadwater County, which contains most of Canyon Ferry Lake, had a 1990 population of 3,318.⁵⁰

In May 1951, the National Park Service sent a historian and photographer to investigate and record historical features near Canyon Ferry Lake. Most features consisted of cabins and buildings constructed by early settlers. Some exhibited unusual features like hewn timber, arch beams and cow manure chinking between logs. Other features included camp sites of the Lewis and Clark expedition, the valley's first church, the home of Herb Gill, and a ranch where, rumors said, western artist Charles Russell lived.⁵¹

Uses of Project Water

The Canyon Ferry Unit primarily functions as a power generation and flood control unit for the Missouri River Basin. Canyon Ferry Powerplant continued power generation, first started in the area around the turn of the century. It has three generators with a capacity of 16,667 kilowatts each and a total capacity of 50,000 kilowatts. The powerplant started operation in 1953. Canyon Ferry Lake supplies some irrigation and municipal water to Helena Valley through a pumping plant and tunnel constructed under the auspices of the Helena Valley Unit, a nearby unit in the Pick-Sloan Missouri Basin Program. Since the establishment of the wildlife habitat on the upper banks of the lake, Canyon Ferry has played an important role in fish and wildlife conservation in Lewis and Clark and Broadwater Counties. Recreation activities abound on and around Canyon Ferry Lake. Some activities include; boating, swimming, fishing, waterskiing, picnicking, hiking, camping, and sightseeing. To promote one recreational activity, the Helena Shriners started their annual Fish Derby in 1955.⁵²

Reclamation built up the marsh areas of Canyon Ferry Lake as habitat for upland game

50. Department of Commerce, Bureau of the Census, *Twenty-First Census of the United States, 1990: Population and Housing*, Bureau of the Census, on CD-ROM.

51. Reclamation, *Project History, Canyon Ferry Unit, 1951*, 98.

52. Reclamation, *Project History, Canyon Ferry Unit, 1959*, 33; Water and Power Resources, *Project Data*, 818, 906-07; "Recreation at Canyon Ferry," *The Reclamation Era*, May 1959, 35; Bureau of Reclamation, *Annual Project History, Missouri River Basin Project, Canyon Ferry Unit--Helena-Great Falls Division, 1956*, RG 115, 9.

birds and waterfowl. Montana informed the U.S. Fish and Wildlife Service in 1950, the state Fish and Game Department did not want to operate the refuges. The declaration forced Reclamation to reduce the wildlife development to 400 acres. In spite of their refusal to operate the refuges, Montana asked the National Park Service to consider recreation development in the wildlife area in 1951.⁵³

The Canyon Ferry Recreation Association encouraged boating on Canyon Ferry Lake by sponsoring a Boat-a-rama on July 26, 1958. The dedication of the Lewis and Clark Picnic and Campground area, including a short speech by John W. Bonner, former governor of Montana; promoted further recreational activity in the region. On August 17, 1958, the Canyon Ferry Recreation Association sponsored a picnic on Cemetery Island. The association asked some of the older residents to help identify unmarked graves in preparation for placing new markers.⁵⁴

Conclusion

The Canyon Ferry Unit is a small endeavor when compared to many of Reclamation's projects. However, the unit occupied a niche in an ambitious, cooperative undertaking of the Bureau of Reclamation and the Army Corps of Engineers. The Pick-Sloan Missouri Basin Program strove to supply irrigation water, electricity, and flood control to much of the Great Plains through a series of interconnected units located on the Missouri River and its tributaries.

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53. Reclamation, *Project History, Canyon Ferry Unit, 1950*, 90-1; Reclamation, *Project History, Canyon Ferry Unit, 1951*, 92.

54. Bureau of Reclamation, *Annual Project History, Missouri River Basin Program, Canyon Ferry Unit—Helena-Great Falls Division and Transmission Division, 1958*, RG 115, 9.

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