

Canadian River Project

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The Canadian River Project

The Texas panhandle lies in the southern portion of the "Great American Desert" as the Great Plains were known in the mid-nineteenth century. The consistent shortage of rainwater and runoff forced area residents to rely on groundwater pumping for many years. As area urbanization and industries grew, the water table dropped. The shortage eventually alarmed city officials in the region enough that they began to look for alternatives to groundwater supplies. Their search eventually took them to the Bureau of Reclamation, and a project unusual for that entity, because the Canadian River Project does not provide any irrigation water for farms.

Project Location

The Canadian River Project is located in the Texas panhandle, in the northwestern part of the state. Sanford Dam and Lake Merideth, the Project's main storage facilities, lie on the Canadian River, thirty-seven miles northeast of Amarillo and eight miles west of Borger. The Canadian River Project supplies water to the cities of Borger, Pampa, Amarillo, Plainview, Lubbock, Slaton, Tahoka, O'Donnell, Lamesa, Levelland, and Brownfield. An unusual aspect of the Canadian River Project is that Lake Merideth rests at a lower elevation than the cities it supplies, requiring ten pumping plants to help transport the water to its destinations. Amarillo is the highest city, 864 feet above Lake Merideth. Lamesa is the lowest city at only 163 feet above the reservoir.¹

The Canadian River flows east out of the Sangre de Cristo Mountains in northeast New Mexico, crossing the Texas panhandle and most of Oklahoma before entering the Arkansas River. The principle surface features of the panhandle area are depressions or "sinks." The sinks vary in diameter between 100 feet to several miles, and in depth from a few feet to forty feet. In Texas, the Canadian River lies 500 to 700 feet below the general land surface of the panhandle. The river is flanked by the Canadian River Breaks, a fifteen to thirty mile wide strip of land

1. Water and Power Resources Service, *Project Data* (Denver: Government Printing Office, 1981), 105; R. W. Bock and C. O. Crane, *Design and Construction of Sanford Dam: A paper to be presented at the Water Resources Engineering Conference of the American Society of Civil Engineers, Milwaukee, Wisconsin, May 13-17, 1963*, Bureau of Reclamation, 1963, 2.

divided by tributaries of the Canadian River. The resulting topography varies from a rolling terrain to a rough, broken landscape.²

Historic Setting

First occupation of the Texas panhandle began approximately 12,000 years ago, and the region has been continually occupied since that time. Paleo-Indian nomads were the first inhabitants. Their habitation of the area extended from around 10,000 B.C. to 5,000 B.C. Populations of the Plains Archaic Tradition arose about 6,000 B.C. and eventually superseded the nomads. The Plains Archaic people remained in the area roughly 6,000 years. The Woodland Tradition populations lived in the area from about 0-900 A.D. The Plains Village Indians arrived about 900 A.D., and stayed until 1450, starting the first farming in the area during their occupancy. The Historic Indian nomads entered the area around 1450, until conflicts with white Americans drove them out in the late nineteenth century.³

Almost a decade after winning independence from Mexico, Texas became a state in 1845, just prior to the Mexican-American War. The U.S. Army established camps and forts from the Red River to the Rio Grande. This military protection disappeared from the area during the Civil War. The following era of Reconstruction and continued presence of Native Americans slowed westward expansion in Texas. Military removal of Native Americans soon opened the panhandle for settlement by whites. In 1876, the counties of the Project area were created, and ranching started in the panhandle.⁴

The earliest record of the High Plains white population compiled in 1880, showed the Project counties had a total population of 192. In 1890, Amarillo had a population of 482. From 1910 to 1920, much of the area converted from ranching to farming. Oil and natural gas production and processing, starting in 1921, stimulated urban population growth in the region.

2. Bureau of Reclamation, *Annual Project History, The Canadian River Project, 1961*, Record Group 115, 6-7. Record Group 115 hereafter cited as RG 115.

3. National Park Service, *Alibates Flint Quarries and Texas Panhandle Pueblo Culture National Monument: General Management Plan*, National Park Service, March 1978, 3; Bureau of Reclamation, *Annual Project History, The Canadian River Project, 1965*, RG 115, 17.

4. Reclamation, *Project History, Canadian River Project, 1961*, 1.

From the mid-1920s on, the panhandle prospered from oil development northeast of Amarillo.⁵

Pampa exploded from a railroad town and trade center, with a population of 1,000, to a city of 10,000. Borger was created and quickly jumped to a population of 6,000. Between 1920 and 1930, Amarillo's population tripled, and Lubbock and the other Project towns quadrupled. The Great Depression and the dust bowl of the 1930s did not greatly effect the area. Only two of the Project cities recorded a loss of population during the period. Between 1940 and 1960 the population of the Project cities more than doubled.⁶

Panhandle farmers began irrigating from wells in 1934. City officials realized the limited amount of the groundwater supply, and how severely the heavy pumping depleted it. Officials feared the water table would drop to or near formations containing little or poor quality water. This would result in periodic deepening of the wells and the eventual abandonment of the pumping system due to the lost water supply. The inevitability of the situation forced the cities to look toward development of surface water for a municipal and industrial water supply. The cities' officials found that the Canadian River provided the only adequate source of development at a reasonable cost. The Canadian River usually flows at a rate of about seventy cubic feet per second. During high runoff periods, flash floods of 88,000 cubic feet per second can occur. Capturing the high runoff proved to be the secret to using the Canadian River as a water source.⁷

Project Authorization

The U.S. Geological Survey periodically investigated area groundwater starting in 1900. In 1947, Reclamation began studies of the Canadian River, below Conchas Dam in New Mexico, as part of an overall study of the Arkansas River Basin. About the same time, the Army Corps of Engineers (COE) gave a prospective project on the Canadian River, near Amarillo, an unfavorable report for conservation and flood control purposes. Local interests complained the report failed to consider the municipal and industrial water needs of the panhandle. Residents of the area used the argument to block submittal of the COE report to Congress. Area businessmen

5. *Ibid.*

6. *Ibid.*, 1-2.

7. Reclamation, *Project History, Canadian River Project, 1961*, 2; Bock and Crane, *Design and Construction of Sanford Dam*, 3.

contacted some of Texas' Senators and Representatives in Congress, who requested Reclamation investigate the Canadian River Basin as a supply of surface water. The Congressman involved included two of Texas' heaviest hitters; Senator, later Vice President and President, Lyndon B. Johnson and Speaker of the House of Representatives Sam Rayburn. The others included Senator Tom T. Connally, and Representatives Eugene Worley and George H. Mahon. Worley introduced the Canadian River Project in H.R. 2733. Reclamation completed the report, under the auspices of the Reclamation Act of 1902, in June 1949. Reclamation Commissioner Michael W. Straus sent the report to Secretary of the Interior Julius A. Krug. The House of Representatives passed a bill authorizing the Canadian River Project on August 4, 1949, and President Harry S. Truman signed it on December 29, 1950.⁸

The Canadian River Compact Commission formed June 30, 1950. Congress consented to an agreement between the three states (Texas, Oklahoma, and New Mexico) of the Canadian River Basin to divide the river's water. The commission drafted a document, agreed to terms, and signed the compact on December 6, 1950. The three states ratified the Canadian River Compact before May 10, 1951, and the Federal government followed on May 17, 1952.⁹

The Canadian River Compact gave New Mexico free use of all water from the Canadian River above Conchas Dam, and 200,000 acre-feet below the dam. The agreement gave Texas storage rights to water from the tributaries of the North Canadian River for municipal uses, household and domestic uses, livestock, and irrigation of lands cultivated for use by the home owners and domestic livestock kept on the property. The compact limited Texas from storing more than 500,000 acre-feet outside of storage on the North Canadian River, a tributary of the Canadian, and east of the 97th meridian, until storage of more than 300,000 acre-feet in Oklahoma. Oklahoma received unrestricted use of all Canadian River water in the state.¹⁰

On June 17, 1949, the Project cities formed the Canadian River Project Organization

8. Reclamation, *Project History, Canadian River Project, 1961*, 2-3; "Canadian River Project OK'D by President," *The Reclamation Era*, February 1951, 41; Garford L. Wilkinson, "The Canadian River Project," *The Reclamation Era*, March 1951, 48; Michael W. Straus, Bureau of Reclamation Commissioner, and Howard E. Robbins, Region 5 Director, "Plan For Development," June 1949, 1.

9. Reclamation, *Project History, Canadian River Project, 1961*, 3.

10. Department of the Interior, Bureau of Reclamation, *Federal Reclamation and Related Laws Annotated, Vol. 2: Through 1958* (Washington: Government Printing Office, 1972), 1076-7.

Committee, later renamed the Canadian River Water Users' Association. The Texas Board of Water Engineers approved formation of the new district March 11, 1953. Five temporary directors were appointed until the cities ratified the district and elected five permanent directors. The Texas Board of Engineers granted the Canadian River Municipal Water Authority (CRMWA) permission to appropriate, divert, and use not more than 100,000 acre-feet, for municipal uses, and 51,200 acre-feet, for industrial uses, per year from the unappropriated water of the Canadian River. The town of Littlefield withdrew from the CRMWA in 1955. In September 1957, the CRMWA requested Reclamation develop a plan for construction of the Canadian River Project. The Authority contributed \$12,500 toward the investigation. Reclamation completed the final Definite Plan Report findings and submitted the report to the CRMWA in 1960. The CRMWA approved the plan January 18, 1961.¹¹

The member cities of the CRMWA held special elections on November 22, 1960, to contract with the Federal government. The contract only received a little opposition, passing 29,499 to 1,025. Nine cities voted in favor of community contracts with the CRMWA. Residents of Slaton voted for its community contract December 13, 1960, and Lamesa, the last city, approved a contract September 5, 1961. Reclamation and the CRMWA signed the repayment contract November 28, 1960. The estimated cost of the Canadian River Project in 1950, totaled \$84,656,000. Of the total, \$3,030,000 was allocated to flood control, while preservation and propagation of fish received \$1,612,000. Irrigation would get \$1,516,000, and the industrial and municipal supplies to be repaid totaled \$78,498,000. In 1960, Reclamation estimated the Project's cost at \$96,090,000, with a CRMWA reimbursement of \$92,960,000.¹²

Construction History

Reclamation considered three sites for the storage dam on the Canadian River. It rejected the site near Amarillo because of inadequate capacity for flood control, conservation, and

11. *Ibid.*, 3-4.

12. Reclamation, *Project History, Canadian River Project, 1961*, 5; Mary Elizabeth Kisner, "The People's Choice," *The Reclamation Era*, May 1961, 37; "Lewis A. Pick, Chief of Engineers, to Michael W. Straus, Bureau of Reclamation Commissioner," 11 April 1950, in *Canadian River Project in Texas—Letter From The Secretary of the Interior Transmitting A Report on the Canadian River Project in Texas, Prepared under the Authority of the Federal Reclamation Laws* (Washington: Government Printing Office, 1950), XVIII.

sedimentation. The site would also force the costly relocation of highways and railroads. Reclamation considered both the Tascosa and Sanford sites approximately equal. Comparative cost estimates for construction of an aqueduct revealed a system from Sanford would cost about \$17.5 million less than one from Tascosa. Reclamation engineers also contended the Sanford site had more favorable geologic and foundation conditions, and a higher degree of flood control protection.¹³

Construction of Sanford Dam began under Project Construction Engineer C. O. Crane. The H. B. Zachary Company received the contract for construction of Sanford Dam on March 1, 1962, for a bid of \$17,868,160. Zachary received the notice to proceed on March 1, 1962. The contract allowed 1,200 days for construction, from March 3, 1962 to June 15, 1965. Zachary commenced construction operations on March 5, 1962, before groundbreaking ceremonies, setting up the service yard and delivering equipment to the site. The company began stripping the foundation site on March 13. Zachary started clearing in three borrow areas, and open cut excavation at the structure sites on both sides of the river. In addition to embankment excavation, the contractor commenced tunnel excavation for the river outlet works.¹⁴

On June 30, 1962, groundbreaking ceremonies at Vista Point, on the Sanford Dam site, launched construction. The celebration included Federal, state, county, and officials of CRMWA cities. Texas Governor John B. Connally, Jr., introduced Secretary of the Interior Stewart Udall. To close the activities, Udall pushed a plunger, detonating a dynamite charge on the dam, officially starting construction.¹⁵

Reclamation engineers discovered the foundation of the Sanford Dam site consisted of "Permian Redbeds," a combination of bedded clay-shales, siltstone. and sandstone.¹⁶ Reclamation engineers found the river bed consisted of fine to medium sand with less than 5 percent gravel. Reclamation faced some difficulties in determining whether it was stable enough

13. Reclamation, *Project History, Canadian River Project, 1961*, 7-8.

14. Reclamation, *Project History, Canadian River Project, 1961*, 1; Bureau of Reclamation, *Annual Project History, The Canadian River Project, 1962*, RG 115, 1, 3.

15. Reclamation, *Project History, Canadian River Project, 1962*, 1-2.

16. Bock and Crane, *Design and Construction of Sanford Dam*, 3.

for a dam. The engineers used several methods to test the foundation's density, but none proved adequate to determine the susceptibility of the foundation to slide failure. Blast testing determined the foundation material was not as loose as first suspected. The data revealed the upper thirty feet of material was looser than below that level.¹⁷

The foundation composition forced a change in the design of Sanford Dam. Reclamation engineers added two 100 foot wide foundation trenches which removed the upper thirty feet of river bed material at the approximate location of maximum shear stress. The depth of the uncemented foundation sands threatened possible development of high uplift pressures under the downstream portion of the dam. To minimize excessive uplift and piping, Reclamation added a series of pressure relief wells across the downstream toe of the dam.¹⁸

Zachary began placement of concrete in the tunnel invert and completed the river outlet works stilling basin in 1962. The company started construction of the cofferdams and began diverting the river. During the year, the contractor placed approximately 2.3 million cubic yards of material in the embankment, and nearly finished the embankment drainage system. Zachary built several haul roads, an office building, warehouse, and shop buildings in the work area. The contractor completed one-quarter of the contract by the end of December 1962.¹⁹

Filled chimneys, extending from the surface down hundreds of feet, comprise some unusual geologic features of the Sanford Dam site. The chimneys are circular or elliptical with vertical walls. The features are believed to result from underground water dissolving and carrying away large amounts of gypsum. The action created caverns and weakened the support of the overlying beds which in time collapsed and filled the chimneys. The Chimneys' diameters range from forty to 1,000 feet. As the chimneys filled, the overlying beds slumped toward the center of the spaces.²⁰

Reclamation found twenty-seven chimneys in the dam foundation. Zachary discovered four in the river outlet works chamber. The contractor found another chimney in the gate

17. *Ibid.*, 3, 5.

18. *Ibid.*, 5-6.

19. Reclamation, *Project History, Canadian River Project, 1962*, 3.

20. Bock and Crane, *Design and Construction of Sanford Dam*, 7.

chamber site of the river outlet works. The chimney at the gate chamber site consisted mostly of un-cemented, low density material with loose sand. The material's composition made tunnel excavation extremely hazardous work. Excavation of the outlet tunnel required the use of full circle, liner-plate steel supports. Reclamation changed the dam design and moved the gate chamber upstream from the eighty foot diameter chimney, and added additional reinforcement steel to the concrete lining extending through the chimney site. The contractor found the downstream pumping plant site lay on parts of two chimneys. Zachary excavated the site an extra ten feet and backfilled with compacted sand and gravel.²¹

The potential high runoff threat caused a policy change in diverting the river. Normally the contractor proposed plans to divert the river, and Reclamation approved the plans. At Sanford, Reclamation gave the river diversion special attention, to prevent erosion of the fine sand by possible raging torrents. Under Reclamation specifications, Zachary built a 500 foot wide channel with two dikes flanking the channel. Zachary laid riprap across the channel floor and around the upstream ends of the dikes to protect the inlet of the channel against scouring, with a stilling basin at the downstream end. Riprap also extended from the downstream end of the diversion channel.²²

Western Telephone Service, Inc., installed communication lines to service Sanford Dam and reservoir and the construction area at a cost to Reclamation of \$948. The Amarillo Oil Company relocated a gas well from the reservoir. The operation started in October 1961, and finished in February 1962. Amarillo Oil charged Reclamation \$47,478 for the relocation, \$12,978 over the contract terms. Upon completion of the finding of facts, the General Accounting Office approved the over-run.²³

In 1963, the estimated cost of the pumping plants dropped by \$3.75 million. The savings came about in part by using electric motors instead of natural gas engines to operate the pumps, and by a reduction in the number of pumping plants required for the Project. The estimated cost

21. *Ibid.*, 8.

22. *Ibid.*, 4.

23. Reclamation, *Project History, Canadian River Project, 1962*, 4-5.

of the Canadian River Project fell to \$85 million in 1963.²⁴

During 1963, work continued at Sanford Dam. Zachary cleared part of one borrow area and all of two others. Excavation work continued for structures and the embankment foundation. The contractor started de-watering the flood control outlet works and spillway discharge channel, and completed excavating the river outlet works' tunnel and gate chamber. The contractor installed a rock crushing plant, and started a rock borrow area. Both allowed production and processing of a rockfill blanket, riprap bedding, and riprap placement to commence. Zachary also placed concrete in the river outlet works, various sections of the spillway, and several sections of the flood control outlet works.²⁵

Reclamation awarded the first Main Aqueduct contract to R. H. Fulton, Contractor, of Lubbock, Texas, on January 3, 1963. The contract covered the first fifty-six miles of the aqueduct. Cen-Vi-Ro of Texas, Inc., (CVR) from Shafter, California received the second aqueduct contract on November 12, 1963. The CVR contract covered the aqueduct from the end of the Fulton contract for a distance of ninety-one miles.²⁶

Fulton received notice to proceed on January 26, 1963, with a completion date of May 10, 1966. In late March, H.A. Nelson Construction Company, subcontracting some of the Fulton contract, started operations on the regulating reservoir near Amarillo. Nelson started excavating the reservoir and the base structure for a surge tank by May 23, 1963. Gifford-Hill-American (GHA), subcontracting the pipe manufacture operations, located a pipe plant near eastern Amarillo, next to a Chicago, Rock Island and Pacific railroad spur. GHA started casting pipe cores on June 6, 1963.²⁷

Fulton started operations on the first contract in early July 1963, with tunneling under state highway 217. Pipe installation commenced August 8, 1963, and Fulton laid 162 feet of seventy-two inch diameter pipe at the inlet to the regulating reservoir. Fulton simultaneously started operations at the south end of the contract. The contractor experienced problems in

24. Bureau of Reclamation, *Annual Project History, The Canadian River Project, 1963*, RG 115, 1.

25. *Ibid.*, 4-5.

26. *Ibid.*, 1-2.

27. *Ibid.*, 5-6.

joining the pipe sections because stresses cracked the non-reinforced, asbestos-cement lining. Lack of testing equipment prevented testing the water tightness of the joints, but Nature provided her own test for the pipe. Heavy rains accumulated in the trench and seeped through the defective joints. Reclamation decided to remove and re-lay the affected reach with improved pipe. The problems did not seriously affect production, and the contractor laid 3,200 feet of pipe by the end of August. R. H. Fulton laid 32.6 miles of pipe on the first contract during the year.²⁸

Early in the pipe laying operations, C. O. Crane, the Project Construction Engineer, suggested to R. H. Fulton officials that they develop an excavating machine to cut a semi-circular trench for the pipe. They modified a standard excavator by attaching two specially shaped cutters to the ends of an axle geared to the excavation wheel which made a smooth half circle for the pipe. Barber-Greene, a heavy equipment manufacturer, produced their own model of excavator based on the Fulton design. In operation, a backhoe dug a ten foot wide trench, then the excavator went to work. The operation became known as the "deep cradle" method of excavation.²⁹

Zachary concluded excavation of the river outlet works discharge channel, the flood control approach channel, spillway and flood control chutes, stilling basins and outlet channels in 1964. The contractor backfilled the conduit sections of the spillway and flood control structures. Work finished on the compacted backfill and backfill around the concrete structures, and in the embankment cutoff trenches. Zachary finished concrete work for the most of the spillway structure.³⁰

Reclamation awarded the contract for clearing the Sanford reservoir to M.C. Winters, Inc., of Johnson City, Texas. Work began on April 9, 1964. Winters' contract called for clearing the reservoir of all brush, trees, fences, houses, and windmills. The contractor started operations at the dam site and worked to the upstream end of the reservoir. Winters completed most of the

28. *Ibid.*, 6.

29. V. O. Grantham, "Innovations in Aqueduct Construction on the Canadian River Project," *Reclamation Era*, August 1964, 53.

30. Bureau of Reclamation, *Annual Project History, The Canadian River Project, 1964*, RG 115, 7-8.

work during 1964, with only some fences and windmills remaining at the end of the year.³¹

Nelson completed the earthwork portion of the Amarillo regulating reservoir in early April 1964. The Blue Lawn Sod Company of Denver, laid grass seed in the regulating reservoir during the year. The Pittsburgh-Des Moines Steel Company completed the steel surge tanks in June 1964, and finished painting them the following August.³²

Reclamation awarded the third contract for the last stretch of the Main Aqueduct and Pumping Plants Eight through Eleven to R. H. Fulton on August 8, 1964. On receiving the contract, Fulton drew another 140 miles of the Main Aqueduct, from Lubbock to Lamesa, and the Southwest Aqueduct from Lubbock to Levelland and Brownfield. The contractor received the notice to proceed on August 19. The contract specified completion in 1,030 days, with June 15, 1967, as the completion date. Fulton designated Cen-Vi-Ro as the manufacturer and supplier of the pre-stressed concrete pipe.³³

Cen-Vi-Ro started construction of a pipe manufacturing plant about two miles north of Plainview in January 1964. The company brought part of the main plant buildings, and batching and mixing equipment from their plant in Lockeford, California. The contractor purchased the remaining necessary equipment. R. H. Fulton subcontracted CVR's construction on the second contract. Brown-McKee, Inc., became a second tier subcontractor for construction of concrete structures.³⁴

Fulton began tunneling operations under U.S. highway 87 and the Panhandle and Santa Fe railroad crossings to start the second contract. Fulton first set sixty-six inch pipe along the right of way, then began laying the pipe on September 2, 1964. Through the year, CVR suffered problems with substandard pipe coming from their plant. Fulton laid all of the acceptable pipe by September 21, 1964. With no more sixty-six inch pipe in stock, Fulton moved the laying equipment to the south end of the contract area, near Lubbock. Fulton laid another diameter of pipe in the area from October 6 to October 16, 1964, when, again, operations shut down because

31. *Ibid.*, 9.
32. *Ibid.*, 12, 31.
33. *Ibid.*, 4, 14.
34. *Ibid.*, 12-3.

of a lack of pipe.³⁵

In 1964, Coastal Bend Construction Company and Electric Construction Company, Inc., of Corpus Christi, Texas, received a contract to build and furnish equipment for Pumping Plants One through Four. Coastal Bend Construction and Electric Construction received the notice to proceed on their contract March 12, 1964. The contract specified 760 days, establishing April 11, 1966, as the completion date. Fuller Construction Company, a subcontractor, started work on Pumping Plants Three and Four during the first week of April 1964. Wes-Tex Construction Company started concrete work on two of the pumping plants in June, one plant in July, and one in August 1964.³⁶

On March 17, 1965, Allison and Haney, Inc., of Albuquerque received the fourth contract for construction of thirty-five miles of the East Aqueduct from Pumping Plant Two to Pampa, and Pumping Plants Five and Six. Reclamation awarded a contract to Brown-McKee on September 27, 1965. Brown-McKee's contract was for construction of chlorination stations on the Main Aqueduct at Pumping Plant One, near Amarillo, and north of Plainview.³⁷

Reclamation accepted Sanford Dam as complete on August 31, 1965. At the end of 1965, Lake Merideth, as the Sanford reservoir came to be called, stored 214,761 acre-feet of water. During the work season, Zachary finished excavating flood control outlet works outfall channel, the drainage outlet channel, and keyway trenches. The contractor concluded placement of the embankment material and backfill. Zachary placed the last of the riprap, riprap bedding, and the rockfill blanket material. M. C. Winters finished clearing the reservoir during 1965.³⁸

R. H. Fulton finished work on the majority of the first aqueduct contract in August 1965, with a final cost of \$11,895,527. Production problems continued plaguing Cen-Vi-Ro at their pipe manufacturing plant. The quantity of pipe increased, but the pipe quality remained marginal, with a high percentage of the units requiring expensive repairs before acceptance by

35. *Ibid.*, 13.

36. *Ibid.*, 4, 15-6.

37. Reclamation, *Project History, Canadian River Project, 1965*, 7; Bureau of Reclamation, *Annual Project History, The Canadian River Project, 1966*, RG 115, 13.

38. Reclamation, *Project History, Canadian River Project, 1965*, 18-9.

Reclamation. Afterwards, C. O. Crane demanded certain criteria before repairing the pipe. S. R. Hubbard, Vice President of Cen-Vi-Ro, moved to Plainview and took over active control of the plant from the resident manager on May 20, 1965. Mike Herrera arrived from CVR's California office and became full time quality control engineer at the Plainview plant, later becoming production manager. Fulton resumed laying the pipe for the second contract on May 7, 1965. Fulton exhausted the supply of sixty inch diameter pipe in August. The contractor shut down work for the year on December 22, 1965, after laying 192,462 feet of pipe during the year.³⁹

Work on the third aqueduct contract did not progress as well in the first six months of 1965, as on the other contracts. In the first half of the year, Fulton only completed a small percentage of the contract work. Fulton's pace sped up through the latter half of 1965. Fulton began laying pipe in the Brownfield area which was clogged with streets, curbs, and pipe line crossings. The continual lack of pipe forced moves in the pipe laying operations in order to use the available diameters of pipe. The chronic pipe shortage compelled CVR to enter an agreement with Gifford-Hill-American for the latter to produce about 300,000 feet of pipe. The first pipe came from GHA's Dallas plant because the Lubbock plant could not produce the initial order.⁴⁰

Major items worked by R. H. Fulton in 1965, included forty-two miles of concrete pressure pipe, pre-tension concrete pipe, and asbestos-cement pipe ranging from fourteen to twenty-seven inches in diameter. Fulton completed most of the bases and superstructures for all pumping plants and all but one of the surge tanks.⁴¹

Allison and Haney received notice to proceed on the fourth aqueduct contract March 18, 1965. Opening their construction office on April 19, the company started pipe laying operations east of the Pampa water treatment plant site. Allison and Haney worked on the downstream section of the contract. When the contractor completed the section, the workers started

39. *Ibid.*, 24-5.

40. *Ibid.*, 25-6.

41. *Ibid.*, 26.

upstream. Allison and Haney installed 22.1 miles of pipe by the end of 1965.⁴²

Coastal Bend Construction and Electric Construction finished most of the work on Pumping Plants One through Four by the end of 1965. Most of the work during the year consisted of raising the steel superstructures and insulated metal wall panels. The companies also built the pumping plant buildings. The contractors installed the pumps before the end of the year.⁴³

In 1966, construction continued. The Texas State Highway Department completed and opened R. M. 687 over the crest of Sanford Dam. Reclamation filled the first contracted section of the Main Aqueduct. CVR and R. H. Fulton completed most of the second contract well within the contract's allotted time by the end of the year.⁴⁴

CVR's pipe quality continued improving, and production increased throughout 1966. Fulton resumed laying the large pipe, according to Reclamation officials, at a record pace. The contractor finished pipe laying operations on the contract July 12, 1966. One of CVR's second tier subcontractors, Brown-McKee, finished most of the structure work. The other second tier subcontractor, Hudson and Sparks, started construction of the embankments and compacted earth lining for the Lubbock regulating reservoir on March 8, 1966. Hudson and Sparks concluded all of the earthwork on July 21, 1966. Delays in delivery of the pugmill, for processing soil-cement, prevented R. H. Fulton from beginning the reservoir lining until October 20, 1966. Fulton completed lining the reservoir in February 1967, for a total of \$12,435,673.⁴⁵

In 1966, as with the latter half of the previous year, Fulton made up for the slow progress during the first half of 1965. By the end of the year, the contractor completed a substantial portion of the work with a good deal of the contract time remaining. The pipe laying pace continued to outdistance production and supply. Fulton transferred the pipe laying crews from location to location, depending on the diameter of pipe available at the time, to continue

42. *Ibid.*, 27.

43. *Ibid.*, 28.

44. Reclamation, *Project History, Canadian River Project, 1966*, 10.

45. Reclamation, *Project History, Canadian River Project, 1966*, 11-2; Bureau of Reclamation, *Annual Project History, The Canadian River Project, 1967*, RG 115, 4.

operations. During the year, the contractor laid ninety-eight miles of concrete pressure pipe, pre-tension concrete pipe, and asbestos-cement pipe, ten to seventy-two inches in diameter. On November 2, 1966, a ceremony celebrated the laying of the last joint of pipe. The contractor finished backfilling and final cleanup along the aqueduct in November 1966. Total contract earnings were \$8,683,412. Reclamation accepted R. H. Fulton's work on the third contract as substantially complete on September 13, 1967.⁴⁶

Allison and Haney finished most of the work on the fourth aqueduct contract in 1966. The contractor laid 11.7 miles of pipe, and completed the Borger regulating reservoir and its appurtenant structures. Allison and Haney concluded work on the superstructures for Pumping Plants Five and Six. Allison and Haney finished the concrete work in January 1967, and Reclamation accepted the work, which totaled \$4,408,019, the following March.⁴⁷

Reclamation accepted Coastal Bend Construction and Electric Construction's work on Pumping Plants One through Four as substantially complete on April 11, 1966. The major items accomplished during the year included placing riprap and bedding material, final grading and cleanup, concrete ditch liners, sandblasting and painting, and the final alignment of motors and pumps. The final construction cost of the contract for the first four pumping plants was \$2,744,838.⁴⁸

Sanford Dam is a 228 foot high zoned earthfill dam, with a crest length of 6,380 feet. The dam's top width is forty feet, and the maximum base width is 1,900 feet. The dam has a total volume of 15,308,000 cubic yards. The spillway is a concrete conduit, chute, and stilling basin with an uncontrolled morning glory inlet. The outlet works consist of a forty-six inch gate-controlled aqueduct supply conduit and a gate-controlled 102-inch diameter river outlet conduit. The flood control outlet is a three barrel concrete conduit with twelve by fifteen foot radial gates, a chute, and stilling basin. Lake Merideth has a total storage capacity of 1,407,572 acre-feet.

46. Reclamation, *Project History, Canadian River Project, 1966*, 12-3; Reclamation, *Project History, Canadian River Project, 1967*, 5.

47. Reclamation, *Project History, Canadian River Project, 1966*, 13; Reclamation, *Project History, Canadian River Project, 1967*, 6.

48. Reclamation, *Project History, Canadian River Project, 1966*, 14; Reclamation, *Project History, Canadian River Project, 1967*, 7.

The Main Aqueduct travels from Lake Merideth south to Lamesa. The East Aqueduct stretches east to Pampa. The Southwest Aqueduct branches off of the Main Aqueduct near Lubbock and transports water west to Levelland. Another section of the Southwest Aqueduct branches off at Pumping Plant Eleven, just east of Levelland, and travels south to Brownfield. The Aqueduct system is reinforced concrete stretching a total of 322 miles. The Aqueduct has a diameter of fourteen to ninety-six inches. The Canadian River Project has ten pumping plants ranging in capacity from 5.4 to 189 cubic feet per second.⁴⁹

Post Construction History

Reclamation first released water through the river outlet works of Sanford Dam, into Pumping Plant One, on March 4, 1966. Allison and Haney started pumping on the morning of March 10, and started leaking around noon. After repairs, pumping resumed the next day. After Reclamation discovered a leak in the Main Aqueduct, work crews de-watered the pipe and repaired it. Pumping operations re-started on March 23, 1966, and Pumping Plant Two started operation the following day. At one time or another all of Pumping Plants One through Four experienced problems with the hydraulic-operated gate valves. The valves failed to close when switched to the "off" position. When left open for four to eight hours, the valves sustained a higher failure rate.⁵⁰

In February 1967, Reclamation found a slight leak in a surge tank. Inspection of the tank's interior revealed severe corrosion in the base and walls of the stainless steel tank. Further inspection of other tanks showed the same problem in all tanks to different degrees. In April 1967, the Chief Engineer had R. H. Fulton repair the tanks by lining them with concrete, setting the completion date in the following October. A subcontractor started work in July 1967, but progressed slowly. Fulton employed a second subcontractor in November to speed the work. Work on three of the tanks concluded by February 1968, and work on the fourth finished in March. Overtopping of two pipe checks and several vent structures led to modification of some

49. Water and Power Resources, *Project Data*, 106, 109-08; Reclamation, *Project History, Canadian River Project, 1965*, 26; Bureau of Reclamation, *Annual Project History, The Canadian River Project, 1968-69*, RG 115, 2.

50. Reclamation, *Project History, Canadian River Project, 1966*, 14-5.

Main Aqueduct structures in 1968.⁵¹

In March and April of 1973, high winds damaged riprap on Sanford Dam. The first storm hit the dam on March 13, lasting thirty-six hours with gusts up to seventy and eighty miles per hour. The second storm struck on April 19, lasting twelve to fourteen hours with gusts up to 100 miles per hour. The winds caused the most extensive damage to the north end of the dam. The wind displaced approximately 2,000 feet of riprap. The E. D. Baker Corporation received the contract for repairs in September 1973, but other commitments prevented the company from starting until the end of October. The contractor used 3,000 cubic yards of rock to cover the 2,400 foot long, thirty-five foot wide damaged area, completing the work on February 7, 1974.⁵²

Reclamation treated a growth of pondweed in the Amarillo regulating reservoir with copper sulfate. The treatment controlled some species, but not the more troublesome ones. A Shell Oil Company seismograph crew detonated a dynamite charge near the Southwest Aqueduct on November 17, 1977. The explosion fractured the aqueduct and blew an eighteen inch hole in the 27 inch pipe section, and damaged three other sections. Replacement of the four sixteen foot sections cost \$23,490, and Shell paid for the repairs.⁵³

For many years, Reclamation considered the threat of liquefaction of Sanford Dam, by seismic activity, low. In 1989, the fear of larger earthquakes than originally anticipated caused Reclamation to regard the possibility of liquefaction high in the event of an earthquake of magnitude seven to eight on the Richter scale. However, Reclamation determined Sanford Dam could safely hold a 100 year Probable Maximum Flood (PMF), and overtopping would not occur. Reclamation regarded Sanford's overall safety classification as fair.⁵⁴

Settlement

After the population explosion between 1940 and 1960, growth slowed considerably in the area, sometimes going in reverse. Amarillo dropped from 137,969 in 1960, to 127,010 in

51. Reclamation, *Project History, Canadian River Project, 1967*, 4; Reclamation, *Project History, Canadian River Project, 1968-69*, 8-9, 11.

52. Reclamation, *Annual Project History, The Canadian River Project, 1970-76*, RG 115, 28.

53. *Ibid.*, 15.

54. Bureau of Reclamation, *SEED (Safety Evaluation of Existing Dams): Analysis Summary—Sanford Dam* Bureau of Reclamation, 2 October 1989, 1, 5.

1970. The city rose again in 1980, with 149,230 and 157,615 in 1990. The other large city on the Project, Lubbock, jumped from 128,691 to 149,101 in 1970. Lubbock's population increased to 173,979 in 1980, and again to 186,281 in 1990. The population of most of the smaller Project cities fell between 1960 and 1990. Levelland provided the exception, increasing from 10,153 in 1960 to 13,986 in 1990.⁵⁵

Uses of Project Water

Unlike most Reclamation projects, which supply irrigation water to farmers, the Canadian River Project supplies municipal and industrial water to cities in the Texas panhandle. Industries served by water from the Canadian River Project include or included petroleum, natural gas, petrochemicals, carbon black, helium, sulfur and sulfuric acid, zinc, and ammonia. The Canadian River Project supplied cities and industry with 58,000 to 65,000 acre-feet each year for calendar years 1970-76. Sanford Dam and Lake Merideth also provide the region with flood control protection. The Army Corps of Engineers supervises the flood control operations.⁵⁶

Lake Merideth caters to a wide variety of activities, both on and off the water. The National Park Service built and operates several separate recreational areas and boat ramps around the shoreline of Lake Merideth. Reclamation advanced payment to the National Park Service for the development of public use facilities at Sanford Dam. The Park Service surveyed the area, prepared studies, and presented an overall recreation development plan in June 1962. On March 11, 1963, Reclamation and the Park Service executed a "Memorandum of Understanding and Agreement" for fish and wildlife aspects of the lake. The agreement provided advance funds to the Park Service of \$13,000 in fiscal 1963, \$20,000 in 1964, and \$15,000 in fiscal 1965, for technical services provided by the Park Service in developing recreational resources. The U.S. Bureau of Sport Fisheries and Wildlife, later the Fish and

55. Department of Commerce, Bureau of the Census, *Nineteenth Census of the United States, 1970: Characteristics of the Population, Vol. 46: Texas* (Washington: Government Printing Office, 1973); Department of Commerce, Bureau of the Census, *Twentieth Census of the United States, 1980: Vol. 46: Texas* (Washington: Government Printing Office, 1983); Department of Commerce, Bureau of the Census, *Twenty-First Census of the United States, 1990: Population and Housing*, Bureau of the Census, 1990, on CD-Rom.

56. Bureau of Reclamation, *Definite Plan Report, Vol. 1: General Plan and Sanford Dam and Reservoir, Canadian River Project, Texas*, January 1954, 29-32; Water and Power Resources, *Project Data*, 108.

Wildlife Service, concurred with the agreement.⁵⁷

The National Park Service requested to use the flood control outlet works stilling basin as a swimming pool. In response the Field Solicitor prepared a brief regarding the owner of swimming pools, lakes, and canals as affected by the doctrine of "Attractive Nuisance in Texas."⁵⁸ The Solicitor sent a letter dated June 24, 1965, contending that until the lake reached a stable water level, no area could be considered safe for swimming. Chief Engineer B.P. Bellport further cautioned that Reclamation could not be held responsible for damage to any of the recreation facilities by operations of the dam for its designed functions.⁵⁹

In 1963 and 1964, Sanford Dam received no appreciable river flows before dam closure. During the summer of 1965, the panhandle received the most intense and widespread rain in several years. The sudden accumulation of water promised to make Lake Merideth a reality much sooner than expected. Lake Merideth stored over 181,000 acre-feet before the end of September 1965. The first annual Borger Water Festival took place for three days in June 1965, to introduce the recreation area to the public. The water festival drew 15,000 people to Lake Merideth for boat races, water skiing demonstrations, beauty contests, and other ceremonies. The large stilling basin downstream was stocked for a fishing rodeo. Reportedly, 30,000 people crowded the recreation sites over the July fourth holiday. Lake Merideth officially received its name in a bill passed on August 31, 1965. The lake was named in honor of A.A. Merideth of Borger. Merideth worked for the development of the Canadian River, the CRMWA, and the tri-state water compact. Merideth died in April 1963.⁶⁰

In the first six months following the opening of Lake Merideth, visitors launched 12,000 boats from the first usable boat ramp at Sanford-Yake. Texas Parks and Wildlife Department and the U.S. Bureau of Sport Fisheries and Wildlife stocked the lake with 480,000 bass, 500,000 walleye, and over 600,000 catfish. In 1965, more than 250,000 people frequented Sanford-Yake

57. Reclamation, *Project History, Canadian River Project, 1962*, 2; Reclamation, *Project History, Canadian River Project, 1963*, 2.

58. Reclamation, *Project History, Canadian River Project, 1965*, 11.

59. *Ibid.*, 11.

60. *Ibid.*, 17-8.

Recreation Area. In September 1965, the Park Service opened Blue-West Recreation Area. Located at Blue Creek on the northern side of Lake Merideth, Blue-West was the second public access point opened on the lake.⁶¹

President Lyndon B. Johnson signed a bill on August 31, 1965, creating the first national monument in Texas, on the shore of Lake Merideth. The bill created the Alibates Flint Quarries and the Texas Panhandle Pueblo Culture Center National Monument, located on the south shore of Lake Merideth. The flint quarries cover about a 300 acre area with a horseshoe shaped series of 250-300, mostly oblong, quarry pits. The monument also has approximately 100 individual houses built by the Plains Village Indian peoples. The Works Progress Administration first started excavation of the site in the 1930s. Native Americans fashioned the alibates flint into hide scrapers, double-blade knives, hammers, awls, and weapon points, among other tools. The length and complexity of the national monument's name received complaints, as did the name's archaeological inaccuracy (the Texas Panhandle had no Pueblo culture). Nevertheless, the national monument provided the panhandle region with its first area conserving and interpreting the pre-history of the Plains Village Indian culture.⁶²

Conclusion

The Canadian River Project proved a political victory for the urban residents in the Texas panhandle. The influence of their biggest name politicians netted them a Reclamation project with no farms to be irrigated. By supplying water for municipal and industrial uses, the Canadian River Project became one symbol among many, in the mid-twentieth century, of Reclamation's changing role in water resources.

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61. *Ibid.*, 20.

62. Reclamation, *Project History, Canadian River Project, 1965*, 17; National Park Service, *Alibates Flint Quarries and Texas Panhandle Pueblo Culture National Monument: General Management Plan*, 4, 6; Ida Mae Ellis, "On the Canadian River Project, Texas,...So That History May Not Repeat," *Reclamation Era*, February 1965, 12.

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