

Almena Unit:

Pick-Sloan Missouri Basin Program:

**Kevin E. Rucker
Historic Reclamation Projects
Bureau of Reclamation
Reformatted, Reedited, and Reprinted by Brit Storey:
December 2009**

Table of Contents

Table of Contents	1
Pick-Sloan Missouri Basin Program	
Almena Unit, Kanaska Division	2
Project Location	2
Historic Setting	3
Geologic Setting	3
Prehistoric Setting	4
Historic Setting	5
Project Authorization	14
Construction History	14
Norton Dam and Reservoir	15
Almena Diversion Dam	18
Canal and Lateral System	19
Post Construction History	21
Settlement of Project Lands	21
Project Benefits & Use of Project Water	22
Irrigation	22
Municipal Water	22
Flood Control	23
Recreational Opportunities	23
Conclusion	25
About the Author	25
Bibliography	26
Archival Collections	26
Government Documents	26
Books	26
Articles	27
Index	28

Pick-Sloan Missouri Basin Program Almena Unit, Kanaska Division

Occupying the central position of the continental United States, Kansas the “Sunflower State” is one of the nation’s leading agricultural states. *Kansas* is a Sioux word meaning “people of the south wind.” The High Plains of western Kansas cover approximately one-third of the area of the state. The Prairie Dog Creek valley of northwest Kansas is a tributary to the Republican River Valley basin lying immediately west of the 100th Meridian and has an annual average precipitation of less than the sixteen inches. Inadequate to raise crops without irrigation, the area’s bluestem-grama mixed grass prairie is classified climatically as “Dry Subhumid.” Since the 1880s the region’s farmers have been plagued with historically severe droughts every twenty-one years and with periodic severe thunderstorms flash flooding valley farms.¹

In the aftermath of the region’s deadly 1935 flash flood of the Republican River and its tributaries, Prairie Dog Creek was included in the United States Bureau of Reclamation’s project planning. The Almena Unit became one of the participating projects of the Pick-Sloan Missouri Basin Program (PSMBP) authorized in 1944. Reclamation designed the unit to assist in the Upper Republican River Valley’s flood control and to provide irrigation water to Prairie Dog Creek valley.

Project Location

The Almena Unit is located along Prairie Dog Creek in central Kansas’ northern tier of counties, Norton and Phillips, bordering Nebraska. Prairie Dog Creek is part of the Upper Republican River drainage basin which also includes the South Fork of the Republican River,

1. United States Department of the Interior, National Park Service. *Kansas Prehistoric Archaeological Preservation Plan*. (Lawrence, Kansas: Office of Archaeological Research, Museum of Anthropology, 1987), III-15; Ibid., III-18.

Beaver Creek, and Sappa Creek. It consists of the Norton Dam and Reservoir, Almena Diversion Dam, and an irrigation distribution system of canals and laterals. The Almena Unit project lands extend from two miles southwest of Almena, Kansas, to three miles east of Long Island, Kansas, in the Prairie Dog Creek valley. Irrigation water is diverted into the main canal at the Almena Diversion Dam, seventeen miles downstream from the unit's flood control project, Norton Dam and Reservoir.²

Historic Setting

Geologic Setting

The High Plains of western Kansas rise westward at a rate of 1.5 meters per kilometer. The geologic history of the High Plains can be traced to the evolution of the Rocky Mountains. As this great mountain system slowly uplifted during the Tertiary Period, large volumes of rock were eroded from its slopes and transported eastward by rivers. The High Plains of western Kansas represent the uneroded remains of this extensive plain, and the deposits of sand and gravel lying beneath the surface are part of the Ogallala formation, the exposed rock formations of the Almena Unit's Prairie Dog Creek Valley. This formation's sedimentary material deposition was mainly of channel and flood plain type. The valley floor of the Norton Dam and the Almena Diversion Dam consists of thick deposits of silt, clay, and sand with a few sand lenses. The bedrock floor consists of the Ogallala Formation overlying the shale of the Niobrara Formation.

Deposits of aeolian, wind deposited, sands occur locally on top of early Pleistocene

2. Denver, Colorado, National Archives and Records Administration: Rocky Mountain Region, Records of Bureau of Reclamation, Record Group 115, "Annual Project History, Almena Unit, Pick-Sloan Missouri Basin Project, 1961," 1; David E. Kromm and Stephen E. White, Editors, *Groundwater Exploitation in the High Plains* (Lawrence, Kansas: University of Kansas Press, 1992), 188.

deposits or on the Ogallala Formation. Late Pleistocene loess, wind deposited soil, covered much of the High Plains region at the time of the last ice age, including the Prairie Dog Creek valley of north-central Kansas. These soil deposits average one meter in depth and provide an excellent, stone-free medium for agriculture. Cottonwoods, junipers (*Juniperous virginiana*), and bur oaks are found widely spaced along the perennial and intermittent streams dissecting the region.³

Prehistoric Setting

Archaeological research suggests that North America could have been occupied by human groups anytime during the last 60,000 years, although evidence for possible occupations prior to 13,000 B.C. are not universally accepted. Archaeologists have divided prehistoric cultural periods into three major categories: Paleo-Indian, Archaic Indian, and Historical periods.⁴

The Paleo-Indian period is placed chronologically from 10,000 to 6,000 B.C. These people were big game hunters using spears to hunt the great game herds of the last ice age. Only one of this era's sites has been excavated in the Almena Unit area, indicating this region was sparsely settled at most. At the 12-Mile Creek Site, southwest of Prairie Dog Creek, a butchering site yielded a Clovis projectile point and bison bones' radiocarbon dated at 8,485 B.C.⁵

With the end of the last ice age the vast game herds began to disappear. Some species, such as the mammoths, camels, and horses, became extinct, while others, such as the pronghorn

3. *Kansas Prehistoric Archaeological Preservation Plan*, III-14; James R. Shortridge, "Kansas," *Lexicon Universal Encyclopedia* (New York: Lexicon Publications, Inc., 1985), Vol. 12, 17.

4. *Kansas Prehistoric Archaeological Preservation Plan*, IX-2.

5. *Ibid.*, IX-12.

antelope, bison, and mule deer, expanded their range with the stabilization of the climate and seasons. Prehistoric peoples of the High Plains entered into their Archaic Indian Period, 6,000 B.C. to A.D. 1, supplementing their big game diet with small game, such as rabbits, squirrels, and water fowl, and gathering edible roots, berries, seeds and nuts. Grinding stones became common and the Archaic hunting weapon of choice was the throwing stick atl-atl, the precursor of the bow and arrow.⁶

The transition from the Archaic Indian Period to the Historical Indian Period, A.D. 1 to A.D. 1800, is marked by the development of the bow and arrow, pottery, and agriculture. During the Proto-Historical Period, A.D. 1 to A.D. 1000, shelters in western Kansas were small, oval-shaped structures measuring five to six meters in diameter made of mats of twigs or grass over a light pole frame plastered with mud.⁷

The Plains Village Period of the Proto-Historical Period,, was from A.D. 1000 to 1500. Shelters became sturdier with light thatch and daub houses with irregular post patterns and hearths usually on the exterior. Game hunting continued with small scale agriculture expanding to include maize, beans, and squash - the “three sisters of agriculture.” Native Americans planting and harvesting the “three sisters” guaranteed themselves the basic balanced diet of nutrients to maintain good health.⁸

Historic Setting

The semi-horticultural societies retreated to eastern Kansas after 1500 when the nomadic, and possibly more warlike, Athapascan speaking Plains Apache move into western Kansas from

6. *Ibid.*, VIII-1.
7. *Ibid.*, XII-23.
8. *Ibid.*, XIII-38.

the north. The Plains Apache had small, semi-permanent lodges covered with grass or brush. These circular dwellings had a five-post hole pattern, similar to the Navajo fork-sticked hogans. These people focused on hunting bison and smaller game such as deer and beaver. Secondary in importance was maize agriculture and the gathering of turtles, mollusks, berries, and nuts in the river valleys.⁹

By the early 1700s, the Plains Apache found themselves forced into the Southwest with the arrival of the Comanche from Wyoming. At this time few Apache possessed horses. The Comanche were mounted and skilled horsemen and were able to sweep the Apache into New Mexico and Arizona. During the 18th century the Comanche were in command of the Great Plains from western Kansas to the Rocky Mountains and the Platte River south beyond the Arkansas River.¹⁰

The Comanche soon found themselves threatened from the east. By 1750 the Caddoan speaking Pawnee had moved westward from their traditional home on the Missouri River and settled at the future Almena Unit project site in north central Kansas. The name Pawnee was derived from the Caddoan word “pani” meaning “horn.” This was in reference to the Pawnee custom of men shaving their heads except for a scalp lock that they stiffened with grease and shaped into what resembled a horn. Archaeologists have speculated the historic Pawnee were descended from the semi horticultural peoples forced eastward by the Plains Apache.¹¹

The Pawnee dwelt in large agricultural villages fortified by ditches and/or walls. Village sites were situated on high terraces or bluff tops for protection. Dwellings consisted of large,

9. Waldo R. Wedel, *Prehistoric Man on the Great Plains*. (Norman, Oklahoma: University of Oklahoma Press, 1978), 100; *Kansas Prehistoric Archaeological Preservation Plan*, XIX-7.

10. Wedel, 115-7.

11. *Kansas Prehistoric Archaeological Preservation Plan*, XVIII-32.

semi-subterranean, circular lodges with eight central support posts approximately three to four meters apart or with six central posts and a row of external posts at the outer edge of the walls. These structures contained bell-shaped storage pits and a bison skull altar. The Pawnee had semiannual bison hunts with local year round small game hunting.¹²

During the 17th century Europeans made inroads into the trans-Mississippi west. The French explorer René Robert Cavelier, Sieur de La Salle, traveled from the Great Lakes down the Mississippi River to its mouth in 1682 and claimed all of the lands, including Kansas, whose waters drained into it as French territory. La Salle named this new land Louisiana in recognition of his monarch, Louis XIV. French fur traders began making inroads up the tributaries of the Missouri River, including the Republican River basin. The Pawnee began trading furs for muskets with the French, and later the Americans, enabling them to be more effective hunters and defend themselves from their aggressive neighbors to the west. The first recorded European to explore Kansas' Prairie Dog Creek area was French officer Etienne Veniard de Bourgmont in 1724. His report noted seeing several Pawnee villages in the area.¹³

In the aftermath of France's defeat by Great Britain in the Seven Years War, or French and Indian War, in 1761, the French signed over their lands west of the Mississippi River to their allies the Spanish the following year rather than lose the lands to the British in the Treaty of Paris in 1763. In 1799, Napoleonic France through coercion regained title to the Louisiana territory from Spain. Napoleon had grandiose ideas about resurrecting a North American French colony to supply agricultural goods to feed his burgeoning armies. But the British Navy ruled the seas and it became apparent to Napoleon that Louisiana's contribution to France's war effort

12. *Ibid.*, XVIII-31

13. Kenneth S. Davis, *Kansas: A Bicentennial History* (New York: W. W. Norton & Company, 1976), 36.

would be minimal.

It was time to dispose of the Louisiana territory at fire sale prices. In 1803, an American delegation sent by United States President Thomas Jefferson approached the French about purchasing New Orleans. Napoleon offered the incredulous delegation the land west of the Mississippi River to the Rocky Mountains for a paltry \$15 million, three cents an acre, to double the geographical size of the young American republic. The delegation quickly consummated the deal and the future territory and state of Kansas became officially American territory.

Also, at this time there was an ethnographic shift southward on the Great Plains. The linguistically related Cheyenne and Arapaho left their traditional homeland west of the Great Lakes and migrated south into the Great Plains pushing the Comanche south of the Arkansas River. The Pawnee retained possession of north-central Kansas, including the future site of the Almena Unit, but now they were perpetually at war with their new aggressive neighbors to the west.¹⁴

The Americans began exploring their new frontier real estate. During the early 19th century many of the famous expeditions to the West passed through Kansas, including those of Zebulon Montgomery Pike in 1806, and Stephen H. Long in 1819-1820. Reports from the Long party led to the erroneous use of the term “Great American Desert” to describe the plains region.¹⁵ Primarily because of this image, Kansas was considered an unlikely place for Euro-American settlement. With the establishment of the Santa Fe Trail to the south along the Arkansas River in 1821 and the Oregon Trail to the north along the Platte in the 1840s, bypassing north-central Kansas including the future Almena Unit site.

14. Wedel, 123.

15. Shortridge, 21.

The first recorded American to come through the future area of Norton and Phillips counties was John C. Frémont on one of his westward expeditions in the 1840s. As his party was following the Republican River westward they came across a fork in the river. Frémont and his party followed the fork south where they saw many prairie dog colonies and bestowed the name “Prairie Dog Creek” on the stream.¹⁶

During the early 1850s, the eastern third of the state was opened for settlement with the removal of the eastern tribes to Oklahoma. An 1857 treaty with the United States government moved the Pawnee north to a reservation along the Loup River in Nebraska.

Beginning in 1858, gold seekers traversed central Kansas via the Smoky Hill Trail on their way to Colorado. As tens of thousands of prospectors rushed for riches in Colorado, Native Americans on the Great Plains saw the bison herds scatter and the river valleys’ grass consumed by the mules, horses, and oxen of the wagon teams. The swarms of gold seekers en route to Colorado inevitably led to conflict with the Cheyenne and the Arapahoe, and their allies, the Sioux, to the north.

On November 29, 1864, Major John Chivington led the 3rd Colorado Volunteers into the massacre of peaceful Cheyenne and Arapahoe on their reservation on Sand Creek in southeastern Colorado, igniting a major Indian war on the Great Plains for the next five years. Cheyenne, Arapahoe, and Sioux war parties attacked settlers and harassed emigrant trail traffic from the Platte River to the Arkansas River in eastern Colorado and western Kansas. The Indian wars on the Great Plains throughout the 1860s prevented any white settlement on Prairie Dog Creek.

The Pawnee readily agreed to the U. S. government’s offer to help in the war against

16. *Norton, Kansas History*. [Http://us36.net/nortonkansas/history1.htm](http://us36.net/nortonkansas/history1.htm)

their traditional enemies. In northeastern Colorado companies of Pawnee scouts under the command of William F. “Buffalo Bill” Cody slaughtered fleeing Cheyenne and Sioux men, women, and children in the aftermath of the decisive 1869 Battle of Summit Springs.¹⁷

An era was coming to a close. The West was changing. In 1870, the Kansas Pacific Railroad reached across to Denver. The first settlers homesteaded in the Prairie Dog Creek valley in 1872. The Pawnee peacefully visited the wary Prairie Dog Creek valley settlers that first summer en route to their annual buffalo hunt. To supplement their food larders the early settlers turned their attention to hunting buffalo as they waited for their first crops ripened. To the south that same year over 2,000 professional buffalo hunters based out of Dodge City slaughtered thousands of bison for their hides and tongues, leaving their corpses to rot on the plains. By 1874, only a handful of bison remained in the state.¹⁸

During the summer of 1873, the Pawnee, numbering over five hundred men, women, and children, ventured out on their annual communal buffalo hunt north of Prairie Dog Creek on the Upper Republican River. On August 5, the Pawnee were attacked by a combined Brule and Ogallala Sioux war party of over 1,000 warriors. The Pawnee were overwhelmed and suffered a severe defeat at what became called the Battle of Massacre Canyon. At least seventy Pawnee were killed and scores wounded. Forced out of Nebraska by the Sioux, the Pawnee in 1875 agreed to accept a reservation to the south in Indian Territory (presently Oklahoma) along the Arkansas River.¹⁹

During the 1870s settlement accelerated in western Kansas. Norton and Phillips counties

17. Robert M. Utley, *The Indian Frontier of the American West: 1846-1890* (Albuquerque, New Mexico: University of New Mexico Press, 1984), 131.

18. William G. Cutler, *The History of the State of Kansas* (Chicago: A. T. Andreas Co., 1883), 10.

19. Utley, 137.

were organized in 1872, the site of the future Almena Unit project. This land boom was fueled by easy credit, the development of barbed wire, good soil, post-Civil War mobility, and a “wet” cycle across the Plains providing more than adequate precipitation for crops. In the 1880s, the rapidly expanding railroads brought thousands to the state, including many immigrants from Germany, Sweden, Russia, and elsewhere.²⁰

Previous strains of domestic wheat on the Great Plains fared poorly due to the lack of precipitation and the searing summer heat. German-Russian Mennonites immigrants introduced the hard winter wheat from the Russian steppe that transformed Kansas agriculture. Planted in the fall, the wheat seeds lie dormant throughout the winter. The spring snows and rains nourish the hardy sprouts, which mature for harvest in June before the onset of the scorching summer heat.²¹

The blizzards of 1885-1886 devastated the cattle industry on the Great Plains, including in Kansas. The ensuing onset of a severe drought caught the settlers unprepared. Eight out of the next ten years of the drought saw crop failures. Half of Kansas’ High Plains population gave up and moved away.²²

Times did get better for a while. After the turn of the century the rains came back and farmers’ optimism soared. High agricultural commodity prices and readily available credit during World War I encouraged farmers to put more land into cultivation. By 1930, the combined population of Norton and Phillips counties was 23,860. Farmers became aware during the post-World War I era the bubble of the agriculture boom was going to burst. First, in

20. Davis, 123.

21. Shortridge, 22.

22. Davis, 127.

the 1920s agriculture prices plummeted and many farmers could not make their loan payments, and bank foreclosures on farms soared. Another severe drought began, and widespread winds blowing across thousands of acres of nearly unprotected soil produced the infamous Dust Bowl. The economic downturn of the 1930s, the Depression, coupled with a plague of grasshoppers, compounded the misery and nearly a quarter of the population moved out of Phillips and Norton counties as the population dropped to 18,000 by 1940.²³

Elected as president in 1932, Franklin Delano Roosevelt believed the government had an obligation to ease the economic duress the nation's citizenry experienced in the Depression. Previous administrations believed market forces should not be tampered with and relief efforts were best left to private charitable organizations. The severity of the economic depression overwhelmed the relief efforts of the private sector and Roosevelt implemented "New Deal" programs of relief, recovery, and reform. Within the U. S. Department of Agriculture, New Deal programs taught farmers dry land farming techniques, crop rotation, and erosion prevention with the planting of trees as wind breaks. What the Republican River basin, including Prairie Dog Creek, really needed was more water for irrigation. In 1939, the Bureau of Reclamation initiated reconnaissance investigations of the feasibility of building a dam and reservoir for irrigation and flood control on Prairie Dog Creek.²⁴

On March 19, 1941, representatives of Colorado, Nebraska, and Kansas agreed upon and signed a Republican River compact hailed as the first step toward a peaceful settlement of long drawn out and expensive water controversies between the three states. The compact divided the

23. United States Department of the Interior, Water and Power Resource Service, *Project Data*, (Denver: U.S. Government Printing Office, 1981), 786.

24. "Annual Project History, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1962,"3.

waters of the Republican River among the three states. Its objective was to permit development in the three states within the limitations of the allocated water supplies without danger of future litigation. There had been no litigation among the three states over the Republican River and its tributaries, but there had been considerable discussion in disputes which has risen over allocation of the waters of the stream.²⁵

After the compact was ratified by the respective state governors and legislatures it was sent to Congress for approval. On November 18, 1941, the U. S. Senate Irrigation Committee approved a bill (S. 1361) to approve the Colorado, Nebraska and Kansas compact for use of water from the Republican River, after rejecting amendments by the U. S. Department of the Interior and the Federal Power Commission. These rejected amendments, embodied in a U. S. House of Representatives bill (H. R. 5945) approved by the House Irrigation Committee, declared nothing in the compact could be construed to mean that the river was not navigable. They also provided that the rights of the Federal Government to use the waters would not be impaired. The Senate Irrigation Committee Acting Chairman Alva B. Adams, D-Colorado, Senator Joseph C. O'Mahoney, D-Wyoming, and Senator Edwin C. Johnson, D-Colorado, asserted the amendments endangered Colorado's constitutional provision placing domestic and agricultural water uses above manufacturing purposes. By rejecting the House's amendments and declaring the river not navigable, the Senate removed the Republican River from any claim of jurisdiction by the Federal Power Commission and the Department of the Interior.

The compact was approved by Congress but President Roosevelt vetoed it on April 2, 1942. It was vetoed because Roosevelt believed the compact was flawed because of the failure

25. "Colorado, Nebraska and Kansas Sign Republican River Compact," *The Denver Post*, March 19, 1941, 1.

of Congress to include Bureau of Reclamation amendments relating to the navigability of the stream. The Republican River is a tributary of a navigable river, the Missouri River, and navigation gives rise to interstate commerce and control by the Federal Power Commission and the Department of Interior. This was a landmark decision regarding the primacy of Federal rights over states rights over Western streams.²⁶

Project Authorization

The Almena Unit was approved under the Flood Control Act of 1944 (Public Law 534, 78th Congress, 2d Session) as a unit of the Pick-Sloan Missouri Basin Program development plan published as Senate Document No. 191 in April 1944. The Army Corps of Engineers had prepared a plan for the region emphasizing flood control and navigation, designated the “Pick Plan” after Colonel Lewis A. Pick. The Bureau of Reclamation’s William G. Sloan headed a study that stressed irrigation and hydroelectric power. The two proposals were reconciled, hence the name “Pick-Sloan.” The Almena Unit was authorized for construction by the Flood Control Act of 1946 (Public Law 526, 79th Congress, 2d Session).²⁷

Construction History

The Almena Unit project called for construction of Norton Dam and Reservoir, Almena Diversion Dam, and Almena canal and lateral system for distribution of irrigation water. Water storage for the Almena Unit is provided by Norton Dam and Reservoir on Prairie Dog Creek.

26. “Republican River Compact is Approved by Senate Group: Interior Department and Power Board Plans Are Rejected.” *The Denver Post*, November 18, 1941, 10; “Carr Pleased by Republican River Decision: House-Senate Action Upholds Pact, Bars Federal Control,” *The Rocky Mountain News*, March 4, 1942, 4; “Senate Approves River Compact,” *The Rocky Mountain News*, March 14, 1942; “Republican River compact Vetoed by Roosevelt,” *The Denver Post*, April 3, 1942, 1.

27. Michael C. Robinson, *Water for the West: The Bureau of Reclamation: 1902-1977* (Chicago, Illinois: Public Works Historical Society, 1979), 83; “Annual Project History, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1962,” 3-4.

The dam is 2.5 miles upstream from Norton, Kansas. Releases for irrigation purposes are diverted by the Almena Diversion Dam, eleven miles downstream from Norton Dam. Water diverted from Prairie Dog Creek by the diversion structure is carried by the Main and South Canals and a system of laterals to lands of the Almena Irrigation District No. 5. These lands are in Prairie Dog Creek Valley and extend from two miles southwest of Almena, Kansas, to three miles east of Long Island, Kansas.²⁸

Norton Dam and Reservoir

The contract for the construction of the Norton Dam and Reservoir was awarded on September 4, 1962, for the low bid of \$5,579,025, from Van Buskirk Construction Company, Sioux City, Iowa, and Graves Construction Company Inc., Melvin, Iowa. The notice to proceed was received on September 21, 1962, and construction began in December of 1961. Due to inclement weather the only construction phase possible during January of 1962 was excavation of the road. In February, excavation of channel changes, bridge piers, and the driving of steel pilings was started. Stripping the dam foundation began on October 18, 1962, and rolling operations on the dam foundation on October 24, 1962. In November of 1962 excavations for the dam cutoff trench and the left abutment cutoff trench began and the material placed in the dam embankment. At this time the stream was diverted through a dug channel in preparation for the structural excavation for the outlet works. Approximately 25% of the riprap and 56% of the rock bedding was placed or stockpiled at the site and the sub-ballast's placement was substantially complete by the end of 1962.²⁹

In early March of 1963, excavation began on the underlying sand deposits to be used in

28. *Project Data*, 786.

29. "Annual Project History, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1962," 3; *Ibid.*, 7.

the dam embankment. Excavation of the dam embankment foundation, dewatering operations, and structural excavation in the spillway continued during April and May. Also, in April, structural excavation of the outlet works began, the left abutment cutoff trench was constructed, and work began on the main cutoff trench. In May the chute and stilling basin on the outlet works was readied for the first concrete placement in Norton Dam in early June. During June, work began on the belled anchor bars in the subgrade of the spillway and a considerable amount of the dam embankment were placed following the completion of the excavated sections in the cutoff trenches.³⁰

By the middle of the year, dewatering and excavation on the dam embankment cutoff trench was completed with refilling operations close behind. Approximately 1,500,000 cubic yards had been excavated, with 1,000,000 cubic yards stockpiled or wasted, and 500,000 cubic yards placed in the embankments. Drainage material was hauled and placed in the subgrade of the spillway late in the summer. Concrete placement on the outlet works accelerated during August and September with completion of the conduit section, including installation and easements of the metal piping, high-pressure gates and transitions, and completion of the gate chamber, chute and stilling basin. From August to November, concrete placement on the spillway increased rapidly, from 460 cubic yards per month to 2,600 cubic yards per month.³¹

The core trench was completed in November, except for the area adjacent to the outlet works. After the contractor was warned of the Prairie Dog Creek's flash flood potential, a protective dike was constructed between the diversion channel and the outlet works to protect the area. By November, the dam embankment had reached an elevation of 2340 feet or

30. "Annual Project History, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1963," 7-9.

31. *Ibid.*, 8-10.

approximately 50 feet in height. Throughout November hauling and placement of bedding rock was completed on the upstream face of Norton Dam. Hauling and placing of riprap followed in December.³²

On January 28, 1964, the water of Prairie Dog Creek was diverted from the diversion channel through the completed outlet works. Work continued throughout the spring and summer, and the contractor completed the earthwork and placing of the rock bedding and riprap. The drilling, placing, and grouting of the belled anchors in the spillway were completed in August. By October the concrete placement in the spillway was virtually complete. On October 5, 1964, the 48-inch slide gate in the intake structure of the outlet was closed, and the initial storage of water was started.³³

Norton Dam project was a zoned earthfill structure with rock riprap on the upstream face. Its height above streambed is 101 feet and with a crest length of 6,450 feet. The volume of the embankment is 3,740,000 cubic yards. The spillway is located at the right abutment and consists of an approach channel, concrete inlet structure, concrete gate structure, concrete chute, concrete stilling basin, and an outlet channel. There are three radial gates in the gate structure. The capacity of the spillway is 94,600 cubic feet per second.³⁴

The outlet works is located at the left abutment and consists of a concrete intake structure, concrete conduit, concrete gate chamber, concrete control house, concrete chute and stilling basin, and outlet channel. The intake structure includes a cast iron slide gate used during diversion and a gate chamber with a high-pressure gate. The outlet capacity is 330 cubic feet per

32. *Ibid.*, 11-13.

33. "Annual Project History, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1964," 4-5.

34. *Project Data*, 785.

second. Water is released to the stream and to a sixteen inch diameter steel conduit that serves the city of Norton, Kansas. The capacity of Norton Reservoir is 134,740 acre-feet. Of this amount, 2,718 acre-feet are allocated for dead storage, 2,566 acre-feet are inactive capacity, 30,651 acre-feet are allocated for irrigation and municipal supply, and 98,805 acre-feet are for flood control.³⁵

Almena Diversion Dam

On August 3, 1965, bids were opened at Norton, Kansas, for construction of the Almena Diversion Dam under Specifications No. DC-6316. For the low bid of \$549,649 Bushmen Construction Company of St. Joseph, Missouri, was awarded Contract No. 14-06-D-5728 on August 23, 1965, and received the notice to proceed.³⁶

After the first of the year, the contractor made good progress placing approximately 426 cubic yards of concrete in the crest section of the spillway and 347 cubic yards of concrete in the sluiceway floor, and walls. Simultaneously, the contractor compacted backfill operations until January 15 when cold weather forced suspension of earthwork operations until March. Concrete placement for the structure continued throughout the winter and by May the right downstream wingwall, right sluiceway wall, headworks, and right downstream wingwall were completed. Excavation of the main canal began in May. During the summer, concrete was placed in the spillway, and slide gates were installed in the headworks and the sluiceway, and placement of the riprap and bedding rock began.³⁷

On June 23, 1966, heavy rains caused Prairie Dog Creek to flood, cresting a foot over the

35. *Ibid.*

36. "Annual Project History, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1966," 7.

37. *Ibid.*

top of the incomplete spillway crest section. The contractor experienced only minor losses and a temporary dike was constructed to divert the creek's flow through the completed sluiceway. But in August, torrential rains resulted in a flash flood that breached the protective dike and flooded the work site. A local labor shortage caused a considerable delay in the flood cleanup and the contractor experienced difficulty in making up for lost time. Nonetheless, the diversion dam was completed in February of 1967.³⁸

The Almena diversion dam consists of a 150 foot long reinforced concrete ogee overflow weir, nineteen feet high, and includes abutment wing walls, sluiceway with six to eighteen foot radial gate, and constant head orifice-type turnouts to the canals with two 72- by 60-inch orifice gates and two 60- by 48-inch turnout gates. Earth dikes 310 feet long and thirty-one feet high above the streambed were included in the construction of this diversion dam.³⁹

Canal and Lateral System

Bids were opened at Norton, Kansas, on September 9, 1965, for construction of the Almena Main Canal and Almena South Canal under Specification No. DC-6335. On October 14, 1965, Contract No. 14-06-D-5755 was awarded to the Bushmen Construction Company for the low bid of \$1,619,082.⁴⁰

Excavations began in October of 1965 on the Almena Main Canal and continued until cold weather and snow shut down all earthwork operations on January 17, 1966. In late March earthwork operations resumed with the earth lining placed in selected reaches of the main canal. During June the entire main canal was completed. Operations were then moved to the laterals

38. *Ibid.*

39. *Project Data*, 785.

40. "Annual Project History, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1966," 8.

and the Almena South Canal for the remainder of the summer. By November, all major earthwork on the Almena Main Canal, laterals, and drains and the Almena South Canal, laterals and drains were completed. In December, several completed reaches of the canals and laterals were seeded to prevent erosion.⁴¹

After a pause because of cold weather, seeding operations began again in the early spring of 1967. During seeding operations tragedy struck on March 21, 1967, when a tractor overturned and fatally injured a Bushmen Construction Company employee. This was the first project fatality since it began in 1961.⁴²

Beginning in April of 1967, and continuing throughout the summer, work was done on the inlet and outlet transitions for siphon and drop structures, inlet and baffled outlet structures for culverts, baffled apron drops on drains, check structures, canal headwork turnouts, and wasteway structures. On April 14, 1967, water was released from Norton Dam for pre-season ponding on the completed sections of the irrigation system. Ponding is a method of compacting soil using water added after the soil is in place until free water stands on the surface. From April to the end of the year approximately 23,500 linear feet of precast concrete pipe of various types, ranging from fifteen inch diameter to 66-inch diameter, were laid to line and grade the canal, lateral and drain structures. All pipe jacking under the Chicago, Burlington & Quincy Railroad line and pipe laying operations across U. S. Highway 383 were completed in August.⁴³

The Almena Main Canal originates at the headwaters of the Almena Diversion Dam on the south side of Prairie Dog Creek. The canal siphons below the town of Almena to serve lands

41. *Ibid.*, 9.

42. *Ibid.*

43. *Ibid.*, 10; United States Department of the Interior, Bureau of Reclamation. *Bureau of Reclamation's Glossary of Terms*. <http://www.usbr.gov>

on the creek's north side and terminates just west of Woodruff, Kansas. The canal has a length of twenty miles, a capacity of 100 cubic feet per second, and serves 3,380 acres of land.⁴⁴

The Almena South Canal originates at the main canal below Almena and serves the south side of the valley. The canal has a length of over eight miles, a capacity of thirty-six cubic feet per second and serves 1,520 acres of land. The lateral system serves 2,450 acres; the remaining 2,900 acres are served by turnouts from the canals. Of the irrigated lands, about 350 acres are served by privately installed canal side pumps. Over six miles of collector drains disposes of excess surface runoff and irrigation waste. There are seventeen laterals with a total length of just over fourteen miles and capacities ranging from four to fifteen cubic feet per second.⁴⁵

Post Construction History

The Norton Dam and Reservoir were transferred to operation and maintenance (O&M) status on June 1, 1965. The dam and the reservoir are operated by the Bureau of Reclamation. The reservoir operation is integrated with that of other reservoirs in the Republican River basin of the Pick-Sloan Missouri Basin Project. The Corps of Engineers furnishes the operational procedures for regulation of water stored in the flood control pond. The Almena Diversion Dam, canals, laterals, and drains were transferred to operations and management (O&M) status on July 1, 1967. These are all operated and maintained by Almena Irrigation District No. 5. The Almena Unit has operated without significant problems since entering service other than routine maintenance.⁴⁶

Settlement of Project Lands

44. Project Data, 785.

45. *Ibid.*

46. *Ibid.*, 787.

At the time of construction of the Almena Unit in the 1960s, the lands within the project's boundaries were in private ownership. No lands were available for withdrawal for future settlement. In 1992, 105 farm customers received full irrigation water on fifty-six full-time farms and 3,627 municipal customers benefitted from project water deliveries.⁴⁷

Project Benefits & Use of Project Water

Irrigation

Norton Reservoir provides storage water for full irrigation of 5,350 acres of land in the Almena Irrigation District. On April 17, 1967, water was turned into part of the canal system, after filling of the pool behind the diversion dam and on the following day was the first farm delivery of water. In 1992, a total of 5,763 irrigable acres on fifty-six full-time farms raised crops of corn, milo, corn and sorghum silage, alfalfa hay, and soybeans. The 1967-1992 cumulative crop value was \$26,904,000. The agricultural operations and management (O&M) cost per acre in 1990 was \$15.49.⁴⁸

Municipal Water

The city of Norton, Kansas, entered into a contract with the United States government on March 7, 1958, to receive annually up to 1,600 acre-feet of water. The city agreed to repay the Federal Government the principal amount of \$365,000, amortized at 2.5% interest, in forty successive annual payments of \$14,540. The first delivery of municipal water was on September 6, 1965.⁴⁹

During July of 1968, a severe algae taste and odor developed over two weeks. The city's

47. United States Department of the Interior, Bureau of Reclamation. *1992 Summary Statistics: Water, Land, and Related Data*. (U. S. Government Printing Office, 1992), 65.

48. *Ibid.*, 62; *Ibid.*, 58; *Ibid.*, 91.

49. "Annual Project Report, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1965," 6.

water engineers from Wilson and Company of Salina, Kansas, traced the problem to Norton Reservoir's green algae (*Volvox aureus*). It is a green algae that occurs in water that is rich in nitrogenous substances and sometimes "blooms" in short duration in the summer months. The rapid algae growth is a result of high phosphate concentration from farm fertilizers. The water engineers discovered the city of Norton's prechlorine treatment was trapping the algae odor so it could not be removed. They recommended eliminating the prechlorination, and substitute potassium permanganate while using a more effective brand of activated carbon. Also, a copper sulfate treatment was used at the reservoir and this eliminated the odor producing plants and algae and the municipal water's odor cleared up within a week.⁵⁰

Flood Control

Norton Reservoir protects the valley downstream against flash floods which have in the past damaged or destroyed towns, crops, livestock, bridges, railroads, and other property. On September 5, 1972, a heavy rainstorm centered above Norton Reservoir caused the banks of Prairie Dog Creek to overflow and the reservoir elevation rose eight feet. It was estimated that the operation of the dam and reservoir prevented \$500,000 in flood damages.⁵¹

Recreational Opportunities

The Kansas Forestry, Fish and Game Commission administers 5,656 acres of reservoir water surface and wildlife lands above the dam, and the recreation areas are administered by the Kansas State Park and Resources Authority. The Commission also assumes responsibility for the administration of the water surface and wildlife lands above Almena Diversion Dam. Between 1964 and 1968 the Commission planted approximately 30,000 trees around Norton

50. "Nasty Water Taste, Odor Upsets Norton Citizens." *The Salina Journal*, August 20, 1968.

51. "Annual Project Report, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1972," 11.

Reservoir. These plantings consisted of Red Cedar, Russian Olive, Choke Cherry, American Plum, Cotoneaster, Skunk Brush, Sumac, Hansen's Hybrid Rose, Russian Mulberry, and Osage Orange.⁵²

The Kansas Forestry, Fish and Game Commission has seven crop share leases covering 1,200 acres of crop land. Their share of the crop is generally left in the field for the wildlife or part of it harvested and stored for winter feeding. A game management and public hunting area has been established. Hunting for quail, pheasant, waterfowl, small game, and deer is available. A small waterfowl refuge has been established. The reservoir provides fishing for a variety of species. On July 2, 1968, Clyde A. Vernon of Oberlin, Kansas, caught a new state record Northern Pike at Norton Reservoir, 16 lbs., 10 oz.⁵³

On October 14, 1968, the Kansas State Park and Resources Authority established Prairie Dog Creek State Park on the Prairie Dog Creek arm of the reservoir. The state of Kansas constructed recreational facilities, including paved roads, boat launching ramps, picnicking, camping, swimming fishing, day use activities, and modern water and sanitation facilities.⁵⁴

The only problem the Almena Unit has had to face was a serious prairie fire. On March 6, 1972, sparks from passing trains ignited a fire that strong winds quickly spread and consumed 3,600 acres of grass and wildlife habitat on the north and south sides of Norton Reservoir.⁵⁵

52. *Ibid.*

53. "Annual Project Report, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1968," 2.

54. *Project Data*, 787.

55. "Annual Project Report, Almena Unit Project, Pick-Sloan Missouri Basin Project, 1972, 9.

Conclusion

The Almena Unit's Norton Dam and Reservoir, Almena Diversion Dam, canals, and lateral system enabled the region's farmers to break out of the boom and bust cycle of regular droughts about every twenty-one years. The project also tamed the periodic flash floods that afflicted north-central Kansas in the summer months. Recreational activities were greatly enhanced in this region with the establishment of Prairie Dog Creek State Park. Even though the Almena Unit was one of the Bureau of Reclamation's smaller projects, it has made a significant impact in improving the quality of life of farmers along the valley of Prairie Dog Creek.

About the Author

Kevin E. Rucker was born in Clarinda, Iowa, in 1956, but has lived in Colorado since 1958. Rucker received his Bachelor of Science in Marketing from Metropolitan State College of Denver in 1993, his Bachelor of Arts in History from University of Colorado at Denver in 1995, and his Master of Arts in History from the University of Colorado at Denver in 1997. Rucker is currently in the doctorate program of the Graduate School of Public Affairs at the University of Colorado at Denver. He teaches European, American and Colorado history at Metropolitan State College of Denver and Red Rocks Community College. A published author, Rucker has served on the Jefferson County Historical Commission since 1997. Rucker is married to Darcey and has three children and lives in Arvada, Colorado.

Bibliography

Archival Collections

Denver, Colorado. National Archives and Records Administration: Rocky Mountain Region. Records of the Bureau of Reclamation. Record Group 115.

“Annual Project History. Almena Unit. Pick-Sloan Missouri Basin Program. 1961-1975.”

Government Documents

United States Department of the Interior, Bureau of Reclamation. *1992 Summary Statistics: Water, Land and Related Data*. Denver [1995].

United States Department of the Interior. Water and Power Resources Service. *Project Data*. Denver: U.S. Government Printing Office, 1981.

United States Department of the Interior, National Park Service. *Kansas Prehistoric Archaeological Preservation Plan*. Lawrence, Kansas: Office of Archaeological Research, Museum of Anthropology, 1987.

Books

Cutler, William G. *History of the State of Kansas*. Chicago: A. T. Andreas Co., 1883.

Davis, Kenneth S. *Kansas: A Bicentennial History*. New York: W. W. Norton & Company, 1976.

Kromm, David E. and White, Stephen E., Editors. *Groundwater Exploitation in the High Plains*, Lawrence, Kansas: University Press of Kansas, 1992.

Lexicon Universal Encyclopedia. New York: Lexicon Publications, Inc., 1985.

Robinson, Michael C. *Water for the West: The Bureau of Reclamation 1902-1977*. Chicago, Illinois: Public Works Historical Society, 1979.

Utley, Robert M. *The Indian Frontier of the American West: 1846-1890*. Albuquerque, New Mexico: University of New Mexico Press, 1984.

Wedel, Waldo R. *Prehistoric Man on the Great Plains*. Norman, Oklahoma: University of Oklahoma Press, 1978.

Articles

Kivett, Marvin F., "The Woodruff Ossuary, A Prehistoric Burial Site in Phillips County, Kansas," *Bulletin 154, River Basin Surveys Papers No. 3*, Bureau of American Ethnology, 1953.

"Nasty Water Taste, Odor upsets Norton Citizens" *The Salina Journal*. Salina, Kansas. August 20, 1968.

Paul, R. Eli. "Lester Beach Platt's Account of the Battle of Massacre Canyon." *Nebraska History*, 1986 67(4): 381-407.

Index

12-Mile Creek Site	4
3rd Colorado Volunteers	9
Adams, Senator Alva B.	13
Almena canal	14
Almena Diversion Dam	3, 14, 18-21, 23, 25
Almena Irrigation District	22
Almena Irrigation District No. 5	15, 21
Almena Main Canal	19, 20
Almena South Canal	19, 21
Almena Unit	2-4, 6, 8, 11, 14, 21, 24, 25
Almena, Kansas	3, 15
Arapaho	8, 9
Archaic Indian	4, 5
Arizona	6
Arkansas River	6, 8-10
Army Corps of Engineers	14
Athapascan	5
atl-atl	5
Battle of Massacre Canyon	10
Battle of Summit Springs	10
Beaver Creek	3
Blizzards of 1885-1886	11
Bureau of Reclamation	12, 21
Bushmen Construction Company	18-20
Caddoan	6
Cavelier, René Robert	7
Sieur de La Salle	7
Cheyenne	8-10
Chicago, Burlington & Quincy Railroad	20
Chivington, Major John	9
Clovis	4
Colorado	9, 12, 13
Comanche	6, 8
Corps of Engineers	14
de Bourgmont, Etienne V.	7
Denver	10
Department of Agriculture	12
Department of Interior	13, 14
Depression	12
Dodge City	10
Early Historical Period	5
Etienne Veniard de Bourgmont	7

Federal Power Commission	13, 14
Flood Control Act of 1944	14
Flood Control Act of 1946	14
France	7
Frémont, John C.	9
French and Indian War	7
German-Russian Mennonites	11
Germany	11
Graves Construction Company Inc.	15
Great American Desert	8
Great Britain	7
Great Lakes	7, 8
High Plains	3-5
Historical Indian	5
House Irrigation Committee	13
House of Representatives	13
Indian Territory	10
Jefferson, Thomas	8
John C. Fremont	9
Johnson, Edwin C.	13
Kansa	8
Kansas	2, 5-9, 11-13, 24
Norton	2
Norton County	2, 10, 11
Phillips County	2, 10, 11
Kansas Forestry, Fish and Game Commission	23
Kansas Pacific Railroad	10
Kansas State Park and Resources Authority	23, 24
La Salle, Sieur de	7
Long Island, Kansas	3, 15
Long, Stephen H.	8
Louisiana	
Louisiana	7
Loup River	9
Melvin, Iowa	15
Middle Historical Period	5
Mississippi River	7, 8
Missouri River	6, 14
Napoleon	7
Navajo	6
Nebraska	2, 9, 10, 12, 13
Loup River	9
New Deal	12
New Mexico	6

New Orleans	8
Niobrara Formation	3
Northern Pike	24
Norton County	2, 9-11
Norton Dam	3, 16, 20
Norton Dam and Reservoir	3, 14, 15, 21, 25
Norton Reservoir	18, 23, 24
Norton, Kansas	15, 18, 19, 22
O'Mahoney, Joseph C.	13
Oberlin, Kansas	24
Ogallala formation	3
Oklahoma	9, 10
Oregon Trail	8
Paleo-Indian	4
Pawnee	6-10
Phillips	9
Phillips County	2, 9-11
Pick, Colonel Lewis A.	14
Pick-Sloan Missouri Basin Program	2
Pick-Sloan Missouri Basin Project	21
Pick-Sloan Missouri River Basin	14
Pike, Zebulon Montgomery	8
Plains Apache	5, 6
Plains Village Period	5
Platte	8
Platte River	6, 9
Pleistocene	3
Prairie Dog Creek	2, 4, 9, 10, 12, 14, 15, 18, 20, 23-25
Prairie Dog Creek State Park	24, 25
Republican River	2, 7, 9, 12, 13
South Fork of the Republican River	2
Rocky Mountains	3, 6, 8
Roosevelt, Franklin D.	12
Russia	11
Salina, Kansas	23
Sand Creek	9
Santa Fe Trail	8
Senate Irrigation Committee	13
Senator	
Johnson, Edwin C.	13
O'Mahoney, Joseph C.	13
Senator Johnson	
Adams, Alva B.	13
Senator O'Mahoney	13

Seven Years War	7
Sieur de La Salle	7
Sioux	2, 9, 10
Sioux City, Iowa	15
Sloan, William Glenn	14
Smoky Hill Trail	9
Spain	7
St. Joseph, Missouri	18
Sweden	11
Tertiary Period	3
Third Colorado Volunteers	9
Treaty of Paris	7
U. S. Highway 383	20
Upper Republican River	10
Upper Republican River drainage basin	2
Beaver Creek	3
Sappa Creek	3
Van Buskirk Construction Company	15
Vernon, Clyde A.	24
Volvox aureus	23
William F. “Buffalo Bill” Cody	10
Wilson and Company	23
Woodruff, Kansas	21
Wyoming	6