Brantley Lake State Park

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New Mexico Geology, v. 23, n. 4 pp. 123-128, Print ISSN: 0196-948X, Online ISSN: 2837-6420.
https://doi.org/10.58799/NMG-v23n4.123

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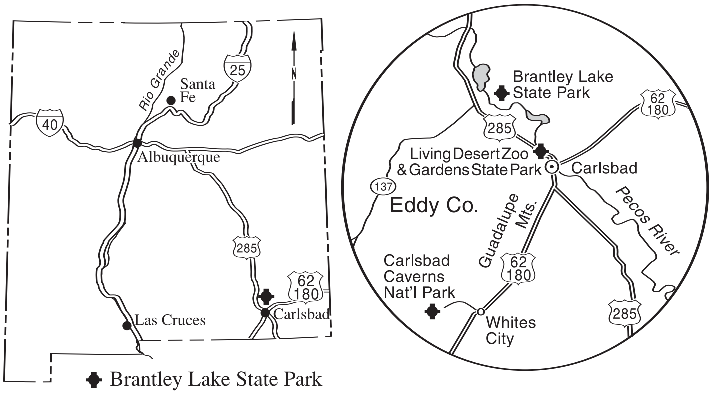

FIGURE 1— Location of Brantley Lake State Park.

Introduction and facilities

Brantley Lake State Park was officially opened in November 1989. The park lies 12 mi north of Carlsbad via US–285 (Fig. 1). Brantley Lake is designed to hold 348,540 acre-ft of water. Although the primary functions of the lake are flood control and water storage for irrigation and water commitments to Texas and Mexico, the lake is best known for its water recreation and fishing. The most common fish stocked by the New Mexico Department of Game and Fish include largemouth bass, walleye, channel catfish, trout, sunfish, white bass, bluegill, and crappie. Brantley Wildlife Management Area lies south of the dam as well as north of Brantley Lake in the area once occupied by Lake McMillan.

The state park offers camping, picnicking, boating, fishing, water skiing, swimming, and hiking. Thirty-two developed picnicking sites and 49 camping sites, including RV electric hookups, are available (Fig. 2). Primitive camping also is allowed along the shores of the lake. The park has two boat ramps, restrooms, a playground, a visitor center, and a nature trail. Hiking trails connect the campgrounds with the lake shoreline. The Pecos River valley is a major waterfowl migration route, and many species of birds are present on and near the lake throughout the year.

History

This area is rich in prehistoric archaeology. Paleo-Indians first inhabited the area about 10,000 yrs ago (Bureau of Reclamation, 1982). Sites from Archaic hunter and gatherer cultures can be found. The more agriculturally oriented Jornada Mogollon people also used this area, until the collapse of their culture by about the beginning of the 15th century (Sharp, 2001). The Mescalero Apache and Comanche Indians lived throughout the Pecos River valley as early as the 1400s. Buffalo once roamed the vast desert plains and were hunted by the Indians; the last buffalo probably left the area by about the late 1870s (Howard, 1993).

Few EuroAmericans settled in the Carlsbad area until the late 1800s. Cattlemen began settling along the Pecos River in southern New Mexico, and by 1887 Charles B. and John Eddy had developed irrigation systems throughout the valley, encouraging both ranching and farming. The Eddy brothers founded the town of Carlsbad, originally known as Eddy, in 1888 (Julyan, 1996). The name was changed from Eddy to Carlsbad in 1899, in hopes of changing a devastating economic depression and attracting newcomers.

The filling of Brantley Lake flooded the town of Seven Rivers, a stop along the Goodnight–Loving cattle trail. Seven Rivers, named for the area where seven arroyos entered the Pecos River, was settled in 1867. It was first called Dogtown because of the large number of prairie dogs. A trading post was established by Dick Reed, and in 1878 the town was renamed Seven Rivers. In 1877 a U.S. Post Office was established, which remained open until 1895. At its peak in the 1880s, 300 people lived in Seven Rivers, which consisted of two stores, a post office, schoolhouse, hotel, saloons, and

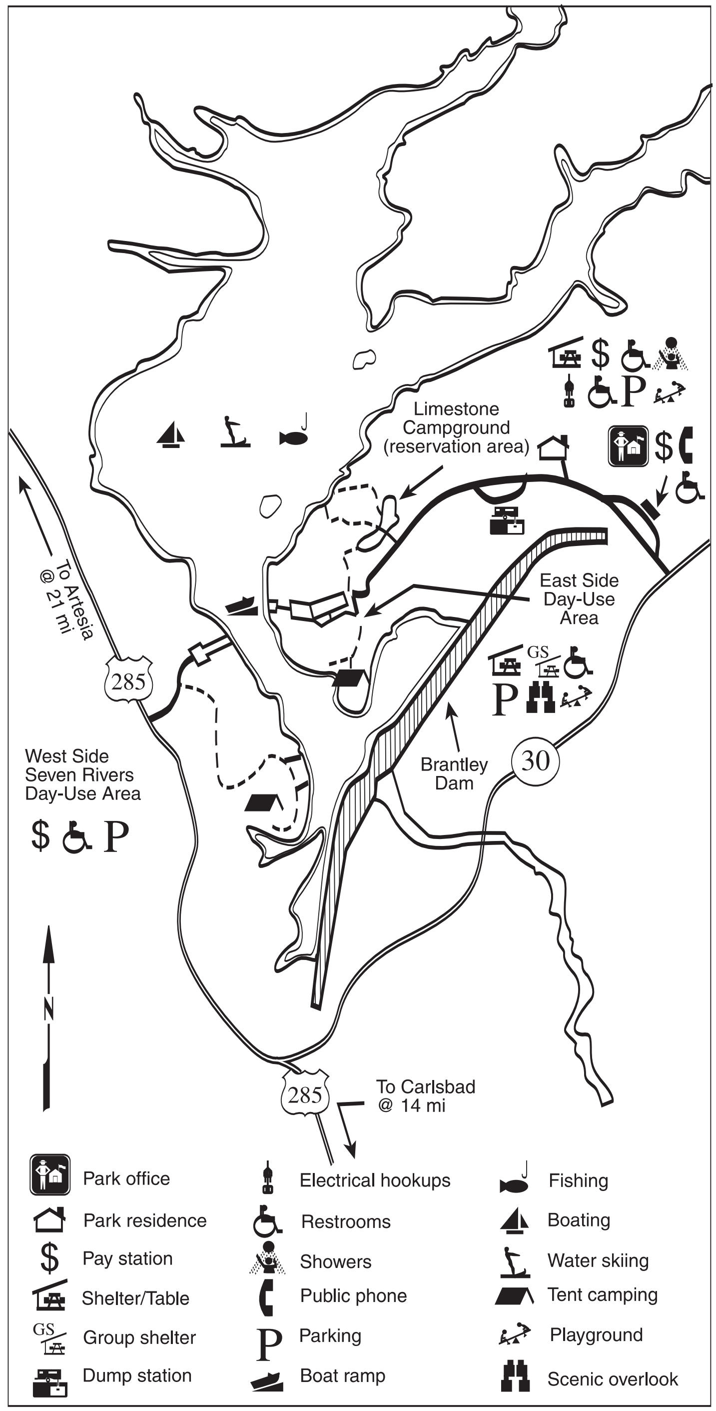

FIGURE 2—Facilities of Brantley Lake State Park.

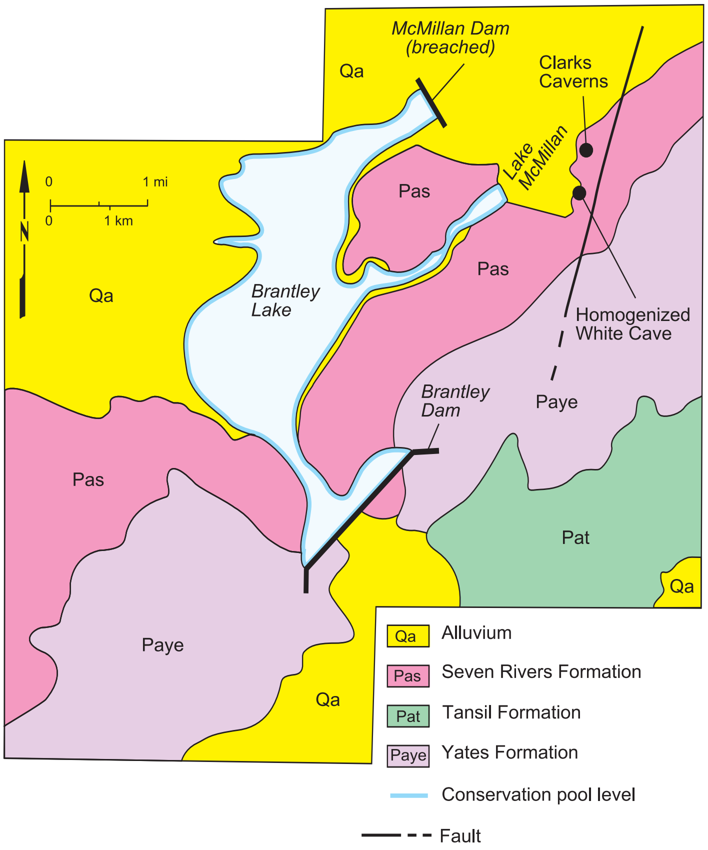

FIGURE 3—Geologic map of Brantley Lake State Park (modified from Kelley, 1971).

homes. Such infamous travelers as Billy the Kid, cattle rustler Bob Edwards, and cattleman John Chisum passed through the town. The violence in town was typical of the day; the first four people buried in the cemetery died of gunshot wounds. As the cattle industry declined in the 1890s, the residents left Seven Rivers. Many moved to Carlsbad, which was a thriving settlement by the 1890s (Howard, 1993). By 1896 Seven Rivers was deserted. The graves from the cemetery were relocated to the Twin Oaks Cemetery in Artesia before the filling of the lake.

About 1905–1906 the Oriental Cement and Plaster Company began mining gypsum from nearby quarries and manufacturing plaster at Oriental, a community south of the present location of the state park (McLemore, 1993). Poor-quality gypsum was mined from the Yates Formation. A high-viscosity oil was required to cook the plaster, so one of New Mexico's first oil wells was drilled at nearby Dayton. Oriental had a U.S. Post Office from 1910 to 1916. In 1912 the plant reorganized and became the Globe Plaster Mining Company. The plant caught fire in 1921, burned down, and was rebuilt. The plant finally closed in 1923.

McMillan Dam was constructed for irrigation in 1893 north of what is now Brantley Lake (Fig. 3), and the dam was rehabilitated in 1906 and 1909. It was an earthfill dam 57 ft high and 2,114 ft long (Crouch and Welder, 1988). The resulting lake began filling up with silt and sediment, and by the 1980s, the water storage was less than one-third of the original capacity of the lake (Crouch and Welder, 1988). In 1991 McMillan Dam was breached, and Lake McMillan was allowed to drain into Brantley Lake.

The U.S. Bureau of Reclamation began construction on Brantley Dam in 1984 and it was completed in 1988. The purpose of the project was to replace McMillan Dam (Fig. 3), and to relieve the pressure on Avalon Dam located approximately 10 mi downstream. Brantley Dam consists of a concrete section that is 730 ft long and an earthen embayment that is 3.9 mi long (Fig. 4). The maximum

FIGURE 4—Brantley Dam, looking south across the lake. Photo courtesy of New Mexico State Parks.

height is 143.5 ft. Over 442,700 tons of riprap was used in building the earthen embayment, and over 8,000 cubic yards of concrete was used in building the concrete dam! Total cost was $44.3 million (New Mexico Department of Game and Fish, press release, Oct. 25, 1988).

The area once covered by Lake McMillan is being reclaimed and revegetated for use as a wildlife refuge called the Brantley Wildlife Management Area. This is the first large lakebed in the western United States to be rehabilitated. The U.S. Bureau of Reclamation continues to own the land and manage it jointly with the New Mexico Department of Game and Fish (New Mexico Department of Game and Fish, press release, June 16, 1987).

Geology

Brantley Lake State Park is similar in geologic setting to Living Desert Zoo and Gardens State Park, approximately 12 mi to the southeast. Readers are referred to the article on Living Desert Zoo and Gardens State Park printed in *New Mexico Geology* in May 2001 (McLemore, 2001) for another discussion on the geology and geomorphology of the area.

Quaternary, Tertiary, and Permian sedimentary rocks are exposed at Brantley Lake State Park (Fig. 3). Brantley Lake lies on the Northwest shelf of the Permian Basin, a structural platform that extends along the basin's northern margin into Texas and slopes into the Delaware Basin (Hayes, 1964; Foster, 1983; Ward et al., 1986). The Delaware Basin (Fig. 5) formed during the Wolfcampian Epoch of the Permian as part of the larger Permian Basin and was filled by 1,600–2,200 ft of limestones, sandstones, evaporites, and interbedded dark shale (http://geoinfo.nmt.edu/staff/scholle/guadalupe.html, accessed on November 15, 2001). The Delaware Basin was mostly enclosed, but marine water did enter the basin. The basin consists of three parts or facies: shelf, basin margin, and basin (Fig. 5; Hayes, 1964), which changed geographic position with time as the basin subsided, filled, and dried out. The rocks change toward the center of the Delaware Basin from a shelf evaporite facies in the northwest to a shelf carbonate facies and reef facies to basin-fill sediments. Where Brantley Lake lies along the Pecos River, the Permian Seven Rivers Formation (Artesia Group) crops out (Kelley, 1971). The eastern shore of the lake consists of local outcrops of limestone, dolostone, mudstone, and gypsum of the Seven Rivers Formation (Fig. 6).

The carbonate and evaporite facies of the Seven Rivers Formation contain many caves and sinkholes, which are not suitable in a site for the construction of a dam. The evaporite facies consists of thin, red to reddish-brown gypsum, silt, clay, dolostone, and minor sandstone beds; the red to reddish-brown color is a result of the oxidation of iron oxides. The gypsum was originally deposited as anhydrite, but was altered by circulating

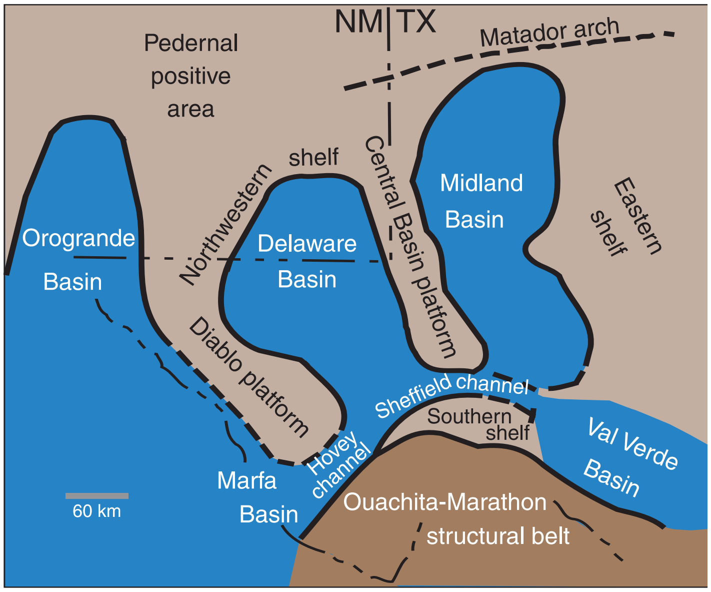

FIGURE 5—Major physiographic features of the Permian Basin during mid-Permian time (from Ward et al., 1986; http://geoinfo.nmt.edu/staff/scholle/graphics/permdiagr/LoGuadOil.html; accessed on September 21, 2000).

FIGURE 6—Campsites on a small bluff consisting of Seven Rivers limestone.

ground water (Cox, 1967). Dissolution of the highly soluble gypsum, anhydrite, and other evaporites created natural holes or caves or even larger caverns in the rock. Three caves are located in gypsum units along the bluff east of former Lake McMillan, Coffee Cave, Clarks Caverns, and Homogenized White Cave (Fig. 3). These underground cavities can cause an unstable surface and create sinkholes, similar to those found at Santa Rosa and Bottomless Lakes State Parks (McLemore, 1989, 1999). This results in karst topography. Water leaking from Lake McMillan into local sinkholes threatened to decrease the stored water capacity. Dikes were built along the eastern edge of Lake McMillan in 1908–1909 and 1953–1954 in an attempt to prevent water from leaking into the sinkholes (Cox, 1967).

Two periods of major dissolution and subsidence occurred in the Carlsbad area since the Late Permian, the first in Triassic–Jurassic time and the second in Tertiary–Quaternary time (Bachman, 1984). Two mechanisms may be responsible for this dissolution and subsidence. Rainwater percolating through crevices in the surface (joints, bedding planes, fractures) begins to dissolve limestone, gypsum, and other evaporites. Rivers and streams can widen these crevices. Rainwater coming in contact with carbon dioxide (CO_2) found in limestones can form a weak carbonic acid, which further dissolves the rocks. A second mechanism is dissolution by sulfuric acid. Sulfuric acid may have been formed by the oxidation of hydrogen sulfide that migrated from deep in the basin along faults to the surface (Hill, 1987; Crawford, 1993).

Brantley Dam was specifically built where there is a facies change at the surface from permeable evaporite (gypsum, anhydrite, and dolostone) to less permeable dolostone and minor sandstone, siltstone, and shale of the Azotea Tongue of the Seven Rivers Formation (Crouch and Welder, 1988). The carbonate facies, consisting of predominantly gray to grayish-brown dolostone and some local thin pink beds, offers a better site for a dam because the rocks are not as easily dissolved as the evaporites.

Brantley Lake impounds water from the Pecos River, which has its headwaters in the southern Sangre de Cristo Mountains. The Pecos River passes through Villanueva, Santa Rosa Lake, and Sumner Lake State Parks, and it continues southward into west Texas and eventually enters the Rio Grande at Amistad National Recreation Area (Fig. 7). Following the Laramide uplift of the Rocky Mountains, large quantities of eroded material from the mountains were transported by wind and water southeastward and were deposited as large piedmonts or broad, flat to gently sloping surfaces that extended from the mountain front (Hawley, 1993). These piedmonts formed part of what is now known as the Great Plains, and they border the current Pecos River valley on the east. These deposits, known as the Ogallala Formation, were

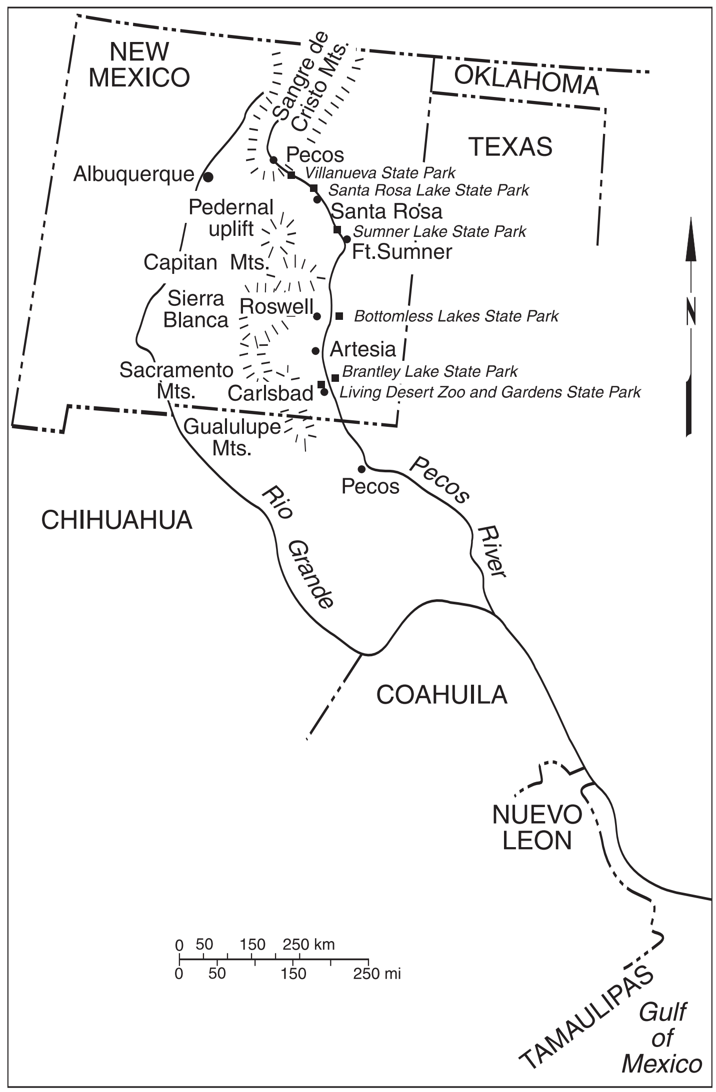

FIGURE 7—Pecos River drainage basin.

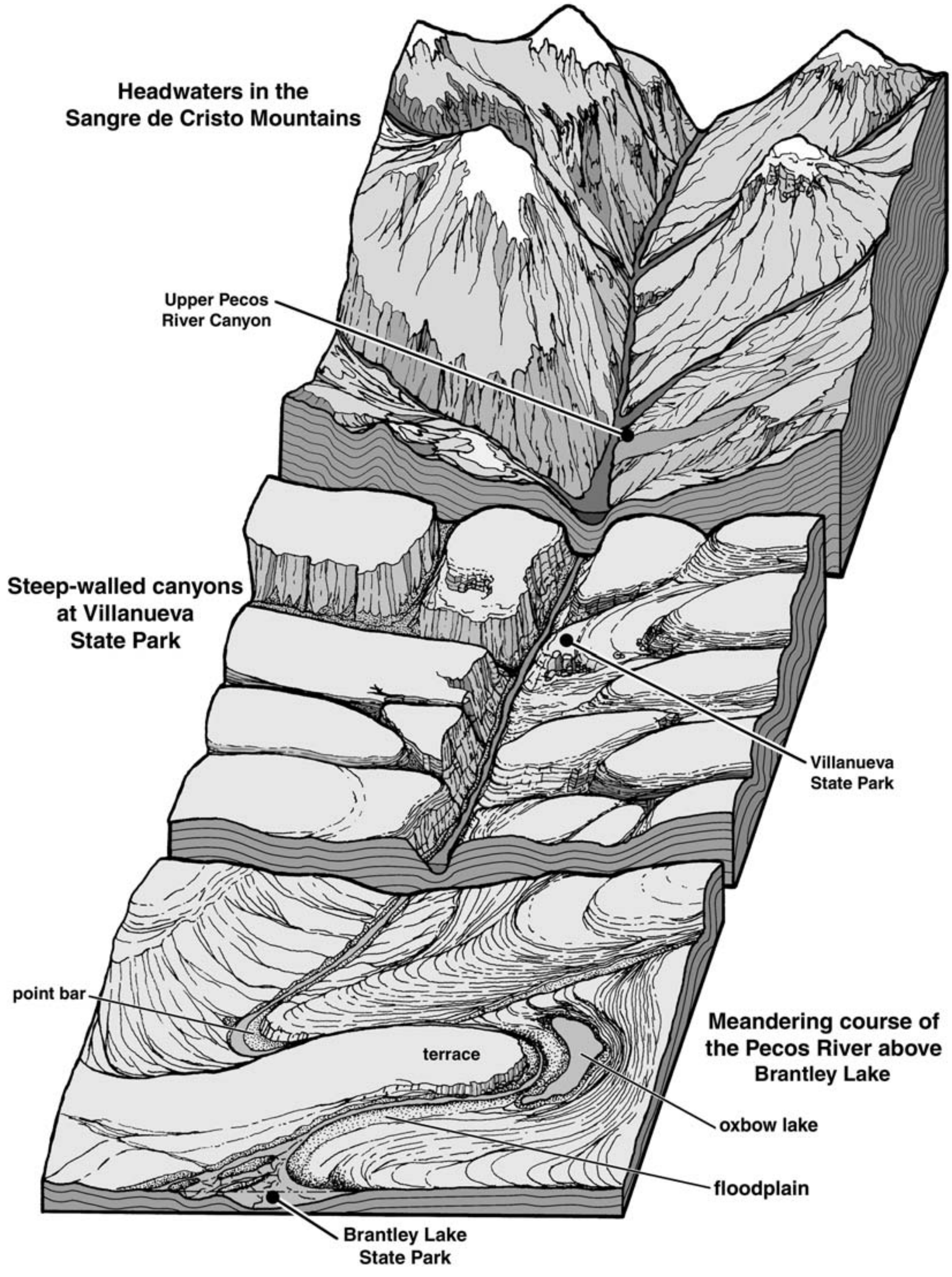

FIGURE 8—Sketch of the Pecos River showing mountains and valleys of the headwaters, steep canyons at Villanueva, and meanders above Brantley Lake (modified from Lambert and the Diagram Group, 1988).

deposited during the Miocene and into the Pliocene. Ogallala deposition ceased during the Pliocene, when the climate became wetter and the source-area drainage was diverted into a series of evolving river valleys. The Pecos River was one of these river systems, and it began cutting into the Ogallala sediments, forming the Pecos River valley, which now separates the Great Plains from the mountains. Only small patches of the Ogallala Formation remain west of the Pecos River.

A combination of three geologic processes formed the Pecos River valley: (1) dissolution of underlying rocks, (2) downcutting and lateral erosion due to regional uplift, and (3) changes in climate. The channel of the Pecos River south of Santa Rosa and Roswell (Bottomless Lakes State Park) may have been influenced in part by the dissolution of underlying rocks in a process similar to that which formed Bottomless Lakes and the lakes at Santa Rosa (Harrington, 1957; McLemore, 1989, 1999).

Changes in the amount of regional uplift combined with changes in the climate produced the steep-walled, narrow canyons of the Pecos River canyon at Villanueva State Park and northward (Fig. 8; Hawley et al., 1976; Hawley, 1993; McLemore, 1996). Deep, narrow canyons only formed along the upper Pecos River (Fig. 8), where uplift was more pronounced, producing a steeper gradient, and resulting in the river maintaining its course and downcutting into the sedimentary rocks exposed there. In contrast, the Pecos River valley south of Villanueva, including the Brantley Lake area, is broad, because the river has meandered back and forth over time (Fig. 8). Regional uplift was minimal in this area of the river valley, so the gradient is flatter; therefore, the valley remained broad and relatively flat.

During this period of regional uplift, the climate was affected by episodic changes in precipitation and runoff that were related to cyclic periods of glacial melting (Hawley et al., 1976; Hawley, 1993). When the glaciers melted, greater amounts of water and sediment flowed swiftly downstream from the mountains cutting steep-sided canyons. When glacial melt decreased, local tributary drainage basins supplied most of the water and sediment into the Pecos River, and the river valley began to fill with sediment. Geologists call this process of rivers filling with sediment aggradation.

The present Pecos River channel occupies the lowest point in the valley and is bordered by floodplains, oxbow lakes, and swamps that formed as a result of abandonment of the older Pecos River. Meanders or looplike bends in the river are common along the current floodplain. The meanders widen and flatten the river valley by carving low cliffs called "bluffs" and dumping sediment onto the floodplain (Fig. 8). Erosion is much less along the southern Pecos River than in the north where the gradient is steeper.

Much of the northeast side of Brantley Lake consists of surficial river deposits of Quaternary and Tertiary age. These sediments are derived from the Sangre de Cristo, Sacramento, and Capitan Mountains and consist of poorly sorted, poorly consolidated deposits of sand, silt, gravel, and rare cobbles and boulders as much as 35 ft thick. The coarser fragments are well rounded by mechanical abrasion as a result of tumbling in the river over long distances. The river deposited silt, sand, and gravel in channels. Along the inner loop of each meander, the water was shallower and the water velocity was lower than along the outside of the meander; coarser sediments accumulated as point bars. During flood stages, finer-grained material, silt and clay, accumulated as overbank deposits along the floodplain of the river. As the river meandered back and forth and encountered less-erodible material along its course, it abandoned its course and continued to move toward the lowest point in the valley. Cut-off meanders formed oxbow lakes (Fig. 8). The abandoned river deposits formed terraces above the current floodplain. Dams, such as Brantley Dam, and levees were built along the Pecos River, to control floods as well as to store water.

Sand dunes are common throughout and around the state park. They were formed in modern times from wind-blown material. The constant wind moves the sand, forming new dunes almost daily. These sand dunes are reddish brown to tan to cream colored because the sand is composed of medium- to fine-grained, clear quartz and reddish to tan feldspar crystals. Some dunes are white because they consist of white gypsum, clear quartz, and minor feldspar. Locally, these dunes are as much as 60 ft thick (Cox, 1967).

Summary

Brantley Lake State Park is an example of how local geology is used in siting a modern dam. The dam was specifically built where the less permeable, carbonate facies of the Seven Rivers Formation crops out at the surface, near the facies change from evaporite to carbonate rocks. The state park is one of the southernmost reservoirs on the Pecos River in New Mexico and offers camping, picnicking, boating, fishing and hiking year round.

Acknowledgments. Special thanks to the state park personnel for discussions and information on the history of the park. Dana Ulmer-Scholle, Dave Love, Steve Cary, and Christy Comer reviewed an earlier version of this manuscript and their comments are appreciated. Kelly Donahue provided technical assistance. Peter Scholle, Director, New Mexico Bureau of Geology and Mineral Resources and State Geologist, is acknowledged for his support and encouragement of this project. The New Mexico Bureau of Geology and Mineral Resources Cartography Department drafted the figures.

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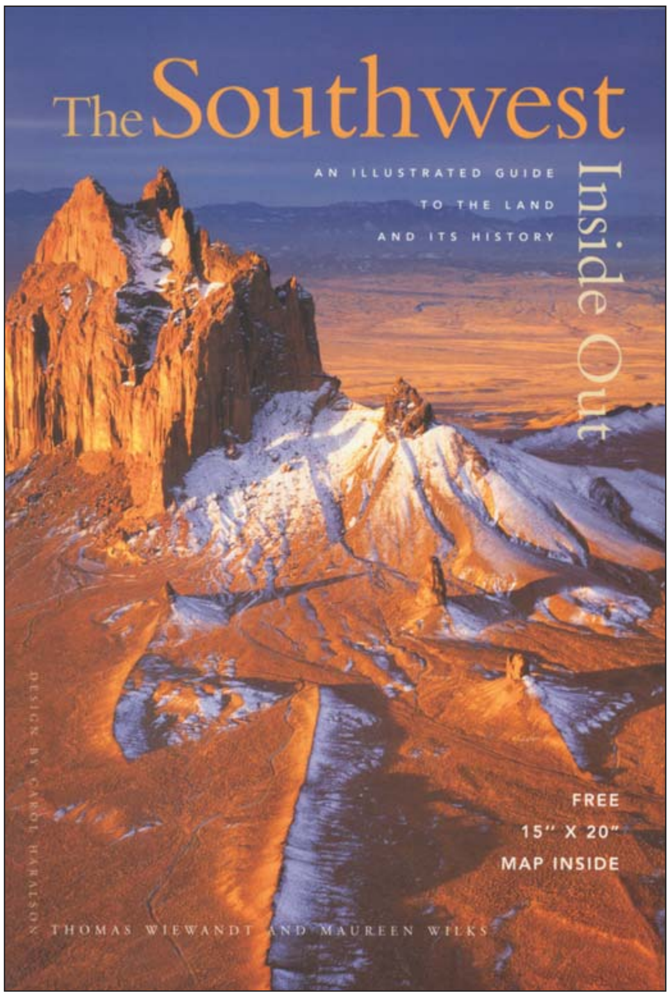
—Virginia T. McLemore

Book Review



***The Southwest Inside Out: An Illustrated Guide to the Land and Its History*, by Thomas Wiewandt and Maureen Wilks, 2001, Wild Horizons Publishing, ISBN 1-879728-03-6, $24.95 (pbk)**

In the past several years there's been a growing trend toward publishing books in the earth sciences that are increasingly appealing and accessible to a general audience. This book is one such effort. It is commendable for the quality of its photographs, the accessibility of its text, and its professional and eye-catching design. Marketed as an illustrated guide to the land and history of the Southwest, the book clearly has a geologic focus, but with an emphasis on process rather than place. The 300-plus color photographs by photographer (and co-author) Thomas Wiewandt provide a remarkable overview of the Southwest landscape. These photographs, by a world-class photographer with an eye for knock-your-socks-off images of landscape and wildlife, are clearly the focus of the book. But complementing those photographs are maps and illustrations (mostly full color) that round out the book's educational value in a visually striking manner. Co-author Maureen Wilks, a geologist with the New Mexico Bureau of Geology and Mineral Resources in Socorro, brings a level of integrity and professionalism to the text, making it far more than a book of eye-catching photos. It is clearly written for a popular audience, but the book is graphically exciting enough to appeal to almost anyone with an interest in the subject.

The book is divided into chapters that address broad topics related to the shape and origin of landscape. The chapters themselves are further subdivided into those specific features that draw our attention—dune fields, slot canyons, hoodoos, volcanic necks, and arches, to name a few. And there are sections on ghost towns and mining history, color and texture, and some discussion of ancient landscapes, including a handy list of state fossils for the seven states that comprise the greater Southwest.

The book was designed by Carol Haralson, who brings her own brand of sophistication to the project. The combination of text, sidebars, and extended captions on each spread provides a rich, layered approach to the subject, making the book accessible on many levels. There is a remarkable amount of information embedded in this rich tapestry of photos, illustrations, and text. While there are those who may find this approach overwhelming, the simple truth is that the vast majority of today's public seem to prefer it. It allows readers to approach the book like a box of candy, picking out the best pieces on impulse, returning to the remainder at their leisure. When skillfully done (as this one is), such a book is a pleasure to encounter. The flexible and durable soft-cover binding adds a sense of tactile delight to the final product. At $24.95, it's a remarkably good value.

Several lengthy appendices include resource information for over 100 parks and public lands throughout the region, a list of 37 related Web sites, and over 67 suggestions for further reading. And for those unfamiliar with the region, there's a foldout map of the greater Southwest in the back. While clearly not a guidebook per se, nor an authoritative treatment of process and landscape evolution in the Southwest, the book nonetheless provides a tantalizing glimpse of this extraordinary landscape. Readers can preview the book at www.wildhorizons.com. Those wishing to obtain a copy may order it from the bureau's publication office (505-835-5410) or directly from the publisher (1-800-925-9777).

—L. Greer Price
Chief Editor