

Oklahoma

Water
News

MONTHLY NEWSLETTER OF THE OKLAHOMA WATER RESOURCES BOARD

Oklahoma's Oxbow Lakes Trace
a History of Meandering Rivers

The phone began to ring at the OWRB only hours after an OU professor assigned his students the homework task of naming three natural lakes in Oklahoma. And, if the answer is not in the textbook, where better to seek answers to "water" questions than the Water Resources Board.

In Oklahoma, "natural" may bring to mind only the shallow playa lakes that spangle the Oklahoma and Texas Panhandles or the deep, glacier-gouged lakes of the Colorado Rockies, but Oklahoma has its share of natural lakes of still a different type. The state's natural lakes were carved by its meandering rivers. In centuries of winding their serpentine courses, the changeable rivers have left behind hundreds of oxbow orphans.

An oxbow forms when deposits of sediment fill in the open end of a U-shaped bend in a river, landlocking a skinny new lake from the river channel. Many of the state's rivers and streams cut circuitous routes and all demonstrate that a river meanders downstream toward its mouth.

The work "meander" used to describe such a convoluted course sprang from the Menderes or Meander River of Asia Minor, a river of serpentine bends. While all rivers curve and bend, "meander" generally describes curves from an indistinct S to a widely exaggerated horseshoe. Growth of meander curves can increase the length of a river by three times. Although big rivers flow faster than small ones and incise wider curves (and that alone decreases their momentum), they still can set their currents against concave curves with enough force to cause erosion.

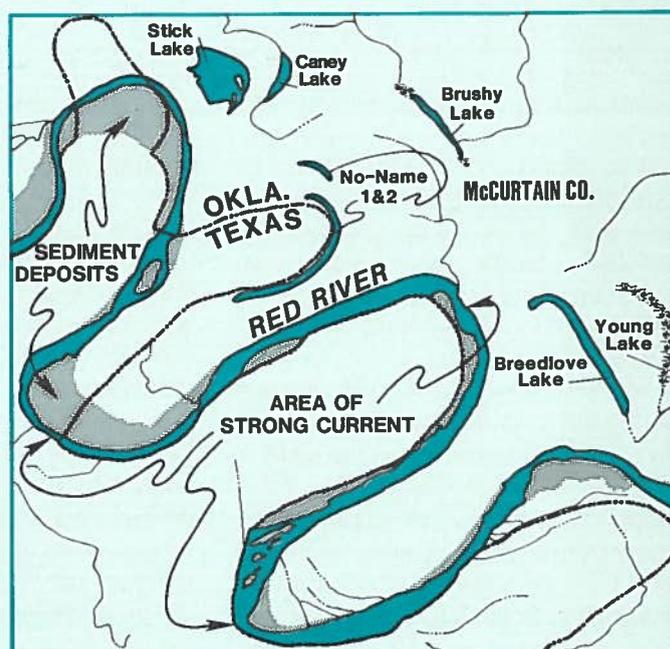
The Red River in McCurtain County is a classic example of an aging river meandering and cutting off some 26 oxbow lakes. McCurtain County's oxbows range in size from tiny "No-Name 2" which covers eight acres to the 300-acre "1941 Cut-Off." Some may be named for landowners past and present—Gunn, Breedlove, Victor, Charles, Mimitubbe, Bryarly and Colbert Lake. One can only guess how colorful names like Lick-Skillet, Dead Man, Long Log, Snag and Horseshoe Lake came into being.

The largest of Oklahoma's ox-

bows—Roebuck Lake—occupies 350 acres of Choctaw County. Love County boasts only one oxbow—the 26-acre Burk Lake near Thackerville—and few, if any, lie upstream from Love County on the Red.

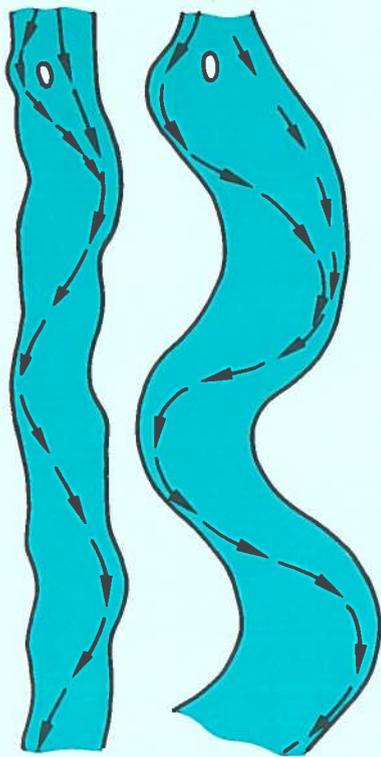
The Red River is typical of Oklahoma's meandering rivers. The shallow, sluggish Red traces a course of gentle curves from its headwaters in New Mexico through western Oklahoma. But as the gradient (drop per running mile) decreases and the river gathers strength from eastern tributary waters, it writhes and folds into countless bends. The river's meandering course is encouraged by the nearly flat terrain, in some areas declining to the south only five feet in ten miles or more. Its

Continued on page 2



The meandering Red River in McCurtain County has isolated more than two dozen oxbow lakes. Dash line shows Oklahoma-Texas border.

Oxbows, continued from page 1



The spiral current of a stream scours sediment from the outer bank and deposits it in the quieter water of an inside curve. Deflected from one side of the channel to the other, the ricocheting action of the swifter water nibbles at the banks until the river becomes a maze of bends and curves. Long arrows show swifter current; short ones, slower water.

devious pattern is further enhanced by its soft, erodible banks of sand, gravel and clay particles laid down by the river at an earlier stage.

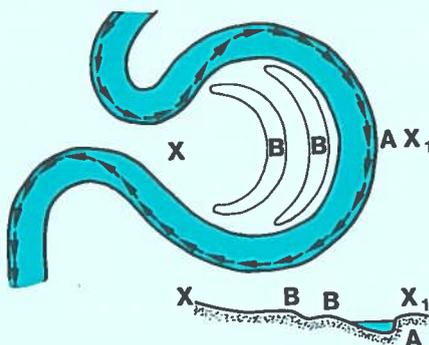
Meandering is characteristic of rivers in lowlands. So level is the terrain over which they flow that they have to cut away only a small amount of material to shift a river bend. And rivers consistently sweep in suspension a sediment load just waiting to settle in the slow waters of the opposite bank. Constant erosion on the outside curves and deposition inside shifts, more than widens, the river bed.

Water in the Red River and all other rivers and streams flows in a spiral, set in motion by the water on the surface running faster than the water on the bottom. The spiral current scours sediment from the outer bank and drags it to the placid waters of the inner bank where it settles to the bottom. The current is deflected toward the opposite

bank, the process repeats and a converse bend forms. Again and again, the high velocity thread of water crosses the river channel to the outside of subsequent bends, like a snake wriggling its way along a gutter.

Bends widen to broad meanders. The easily erodible sediment in the narrow strip between adjacent meanders may be removed to form a cutoff. Once the separation is made, the current in the river is swifter and the velocity is much greater in the cutoff than in the original meander. Sediment is deposited in the meander near the cutoff, where particles constantly escape the current into the quieter water of the

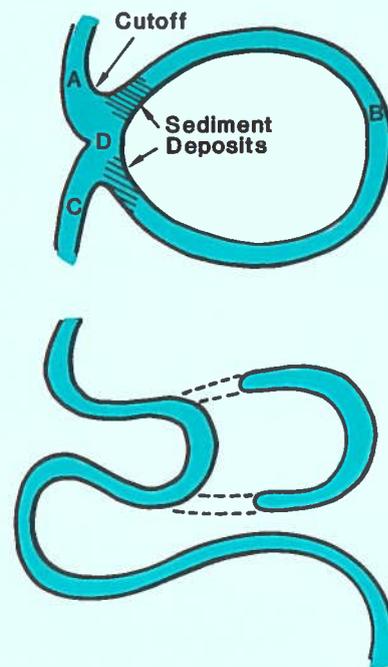
Swiftest water sweeps around outside of the meander (AX), deepening the outside of the channel by erosion and allowing the slower sediment-laden water to deposit its burden on the inside of the curve. Lower right: cross section of channel from X to X₁ with sandbars labeled B.



meander. The channel fills and eventually an oxbow lake is formed in the abandoned meander. Freed of this troublesome bend after the meander cutoff, the river gathers velocity for the next curve and a new meander.

And severed from its mother river, the shallow new lake will be nourished only by rainfall, runoff and in some cases, the underlying alluvium of the old river.

A generous sprinkling of oxbow lakes, wide crescents of sand and broad valleys attest to the rivers' wanderlust. And a "border" river that no longer coincides with Oklahoma's mapped boundary further bears out the meandering history of the wayward Red River.



Erodible sediments in the narrow strip between adjacent meanders may be removed to cause a cutoff. Shaded areas show sediment deposits near the cutoff. Deposits eventually sever the meander from the channel, and an oxbow is formed in the abandoned channel. Velocity is much greater in the steeper gradient of A-D-C than in A-B-C. Below: meandering stream and oxbow lakes.

Weather Researchers Return for Studies

As a follow-up to last year's cloud data-gathering effort, scientists and technicians from the University of North Dakota's Department of Atmospheric Studies returned to Oklahoma skies in September. The researchers, assisted by OWRB and National Weather Service meteorologists, were once again successful in collecting pertinent cloud data for use in a weather modification program funded by the Bureau of Reclamation and the State of Oklahoma.

In May and June 1986, the UND specialists used a heavily instrumented Cessna Citation jet to study Oklahoma spring storm patterns. Recent studies focused on similar data collected from late summer clouds. Information from both years and seasons will be compared for utilization in a more progressive program to be implemented in 1989, according to Mike Mathis, OWRB meteorologist and

weather modification program coordinator.

The OWRB regulates weather modification activities in Oklahoma through licensing, permitting and reporting. Mathis has coordinated the past two data gathering efforts with the UND team.

"In 1989, we hope to do some actual cloud seeding," he said. "Also, we've planned some experiments that will yield specific information on how cloud seeding materials move to upper cloud levels—areas critical to our success."

Using the UND aircraft and sophisticated radar, researchers will release an inert tracer gas, sulfur hexafluoride, to track the movement of seeding materials from ground-based generators. Interest in this study, the Southwest Cooperative Program, is running high. Mathis and members of a lay group, the Weather Modification Advisory Committee, hope a proposed Bureau of Reclamation/State of Oklahoma cost-sharing program of \$400,000 becomes a reality.



Governor Appoints Meibergen

Gov. Henry Bellmon recently named Lew Meibergen of Enid to serve as a member of the Kansas-Oklahoma Arkansas River Commission. Meibergen, chief executive officer and chairman of the board of Johnston Enterprises of Enid, will serve in the position recently vacated by the retirement of Jacques Cunningham of Tulsa. Meibergen served the previous Bellmon administration in 1964 as president of the State Board of Agriculture. Meibergen presently oversees companies dealing in wheat and feed and seed grains founded by his grandfather in 1893.

He will serve on the Kansas-Oklahoma Arkansas River Commission with Federal Commissioner Paul Thornbrugh of Tulsa, Dr. Tracy Norwood of Tahlequah and James R. Barnett, ex officio member and executive director of the Oklahoma Water Resources Board. Other Oklahomans

serving the commission are J.A. Wood, OWRB Stream Water Division Chief, who serves on the Engineering and Budget and Finance Committees and Dean Couch, OWRB general counsel, who serves on the Legal Committee.

Problems Plague Arcadia Lake

Problems continued to muddle the gala opening at Arcadia Lake northeast of Oklahoma City late last month. First of the problems concerned disagreements between the Corps of Engineers who constructed the lake and the Edmond City Council which contracted with the Corps to develop five lakeside parks. Edmond claims that the City Council was not apprised in advance of huge cost overruns which increased its share from \$4.2 million to \$10.5 million.

Officials of the Corps, Edmond Mayor Carl Reheman, City Council members and Oklahoma's Congressional delegation failed to reach a compromise in a meeting in Washington September 23.

Just prior to the lake opening, the discovery of chlordane contamination in Arcadia Lake's large channel catfish further darkened the celebration. Fishermen were warned not to consume channel catfish 14 inches or longer.

Also on the eve of the opening, drinking water in Spring Creek Park was declared unsafe due to contamination with coliform, a bacteria found in fecal matter. The problem was easily solved by flushing the water lines with chlorine, but the procedure could not be completed in time for the scheduled park opening.

Farmers Balk at Contract

According to an editorial in the September issue of U.S. Water News, farmers in southwest Colorado, near the new McPhee Reservoir, are seeking a way out of contracts signed 10 years ago.

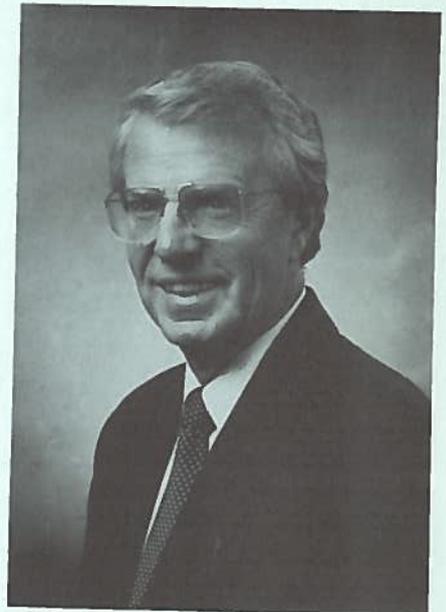
When the Bureau of Reclamation began construction on the project to supply irrigation water to the semi-arid region, farmers were eager for the opportunity to convert from dryland farming to growing (then) high-priced irrigated corn and alfalfa. A glut of

grain, plummeting commodity prices and huge cost overruns in construction of the project drove the cost of irrigation water from \$8 an acre-foot originally projected to \$16. Farmers say the cost would force them into bankruptcy. The Bureau insists the farmers take the water anyhow.

Forty-one farmers are suing their local irrigation district because it won't release them from the contracts they signed 10 years ago. The farmers say the Bureau built them a Cadillac when all they needed was a Chevy.

Joe Hall Now BR Deputy

A former Oklahoma representative of the Bureau of Reclamation, Joe D. Hall, has been appointed BR deputy commissioner. Commissioner of Reclamation C. Dale Duvall announced that Hall will serve as deputy and chief operating officer of the agency's 8,000-employee regional office in Denver, Colorado.



Joe D. Hall

Hall served as reclamation representative in the Oklahoma City office from July 1971 to July 1975. He served as regional director for the Bureau until 1980, then joined the Western Area Power Administration as assistant administrator.

Hall first joined the Bureau in 1961. He is a graduate of Texas A&M University and is a registered professional

Continued on page 4

Mainstream, continued from page 3

civil engineer in the state of Texas.

OWRB chairman Gerald Borelli recalls Hall as a strong advocate of water development. "Hall is a leader and a man of vision in water resources matters," says Borelli. "His assistance to

the Board was priceless as we developed strategies for the Oklahoma Comprehensive Water Plan. The Commissioner of Reclamation couldn't have chosen a more gifted and capable deputy than Joe Hall," said Borelli. "He's been a good friend to the state."

In announcing Hall's appointment, Commissioner Duvall said, "we are extremely fortunate that Joe Hall will be returning to the Bureau of Reclamation as deputy commissioner. His experience and leadership ability will be invaluable to the Bureau."

**ACTIVE CONSERVATION STORAGE IN SELECTED OKLAHOMA LAKES AND RESERVOIRS
AS OF SEPTEMBER 22, 1987**

| PLANNING REGION LAKE/RESERVOIR | CONSERVATION STORAGE (AF) | PERCENT OF CAPACITY | PLANNING REGION LAKE/RESERVOIR | CONSERVATION STORAGE (AF) | PERCENT OF CAPACITY |
|-----------------------------------|------------------------------|------------------------|-----------------------------------|------------------------------|-------------------------|
| SOUTHEAST | | | NORTHEAST | | |
| Atoka | 109,831 | 88.5 | Eucha | 77,000 | 96.7 |
| Broken Bow | 828,568 | 90.0 | Grand | 1,306,240 | 87.0 |
| Pine Creek | 77,700 | 100.0 | Oologah | 543,090 | 99.7 |
| Hugo | 149,982 | 95.0 | Hulah | 30,525 | 99.8 |
| CENTRAL | | | Fort Gibson | 365,200 | 100.0 |
| Thunderbird | 101,365 | 95.0 | Heyburn | 6,399 | 97.0 |
| Hefner | 70,045 | 92.9 | Birch | 18,986 | 98.8 |
| Overholser | 15,322 | 96.3 | Hudson | 200,300 | 100.0 |
| Draper | 73,265 | 73.3 | Spavinaw | 25,000 | 83.0 |
| SOUTH CENTRAL | | | Copan | 42,131 | 97.0 |
| Arbuckle | 62,502 | 99.9 | Skiatook | 309,601 | 97.0 |
| Texoma | 2,540,800 | 96.3 | NORTH CENTRAL | | |
| Waurika | 199,149 | 98.0 | Kaw | 427,760 | 99.8 |
| SOUTHWEST | | | Keystone | 604,880 | 98.0 |
| Altus | 109,244 | 82.2 | NORTHWEST | | |
| Fort Cobb | 80,157 | 100.0 | Canton | 97,342 | 99.8 |
| Foss | 179,996 | 73.8 ² | Optima | 3,000 | 100.0 ¹ |
| Tom Steed | 83,123 | 93.4 | Fort Supply | 13,900 | 100.0 |
| EAST CENTRAL | | | Great Salt Plains | 31,400 | 100.0 |
| Eufaula | 2,294,410 | 98.0 | STATE TOTALS | | |
| Tenkiller | 619,116 | 98.0 | | 12,018,016.00 | 92.8³ |
| Wister | 25,070 | 92.0 | | | |
| Sardis | 298,617 | 98.0 | | | |

1. In initial filling stage
2. Temporarily lowered for maintenance
3. Conservation storage for Lake Optima not included in state total

Data courtesy of U.S. Army Corps of Engineers, Bureau of Reclamation, Oklahoma City Water Resources Department, and City of Tulsa Water Superintendent's Office.

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OKLAHOMA WATER NEWS

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