



GEOLOGY OF LAKE MURRAY BASIN AND DAMSITE

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The Oklahoma Legislature in its 1933 session appropriated \$90,000.00 for the purchase of lands in and immediately adjacent to a remarkable natural basin in Love and Carter Counties, lying chiefly in Townships 5 and 6 South, Range 2 East. The basin has been eroded by Anadarche Creek and its tributaries, which drain via Hickory Creek into Red River.

Near the southeast corner of Sec. 14-T. 6S.-R. 2E., Anadarche Creek emerges from the basin in question through a remarkably deep and narrow gap in a sandstone ridge which constitutes much of the natural barrier enclosing the basin. One side of the gap is a vertical cliff approximately 150 feet in height. A dam some 1100 feet long at the top at this point will impound a lake covering 10,600 acres, with a rugged, irregular, wooded shoreline over 150 miles long, in which the water will be over 80 feet deep for five miles up the course of Anadarche Creek.

The area of the proposed lake, together with the bordering lands which have been acquired by the state around its shores, is underlain by a very thick series of sedimentary rocks of early to middle Pennsylvanian age, belonging to the Deese and Hoxbar formations. They include shales and sandstones, with a few conglomerates and thin limestone members. This series dips steeply northeastward throughout the area. The dips average 60 degrees or more along the southwest margin of the lake, and exceed 40 degrees throughout most of the lake area; although they diminish gradually toward the northeastern side of the lake, achieving angles as low as 15 degrees (still in a northeastward direction) in Sec. 26-T. 5S.-R. 2E.

Near the northeastern margin of the lake these steeply-dipping rocks are unconformably overlain by late Pennsylvanian redbeds which also dip in general northeastward, but much more gently, the angles seldom exceeding 5 degrees. These red sediments include arkoses, shales and sandstones. Along the extreme eastern side of the area in question, both the redbeds and the older rocks are again overlain by the Trinity sand of lower Cretaceous age, the basal formation of the Gulf Coastal Plain, which is nearly level, but slopes gently southeastward at an angle less than 1 degree.

There is no bedded gypsum in the lake basin area, and very little limestone. The Pennsylvania rocks all dip northeastward into a deep syncline from which they rise to outcrop again at similar levels along the Washita River some miles east of Ardmore. As there is no substantial difference in elevation between their outcrops on the two sides of the syncline, no hydrostatic head is available to enable water to escape from the lake through any porous bed to the outcrops along the Washita. As a matter of fact, most of the latter are at higher levels than the outcrops of corresponding strata beneath Lake Murray.

The Trinity sand lies almost entirely above the water level and therefore cannot serve as an important channel of leakage from the lake. Where the lake at maximum levels will touch this formation, as along the extreme northeast arm of the lake on Fourche Maline ("Push Maline") Creek north of Hoxbar, the normal ground water level will be such as to feed water into the lake from the Trinity sand rather than to permit its movement in the opposite direction.

The ridge formed by the Devil's Kitchen member of the Deese formation constitutes the southwestern shoreline of the lake for some distance, and it is through this ridge that Anadarche Creek has cut the gap which is to be closed by the dam. The hard backbone of rock which has preserved this ridge during the natural excavation of the softer rocks in the lake basin consists of about 200 feet of quartz sandstone including some 30 feet of chert conglomerate, both cemented chiefly by silica and therefore very resistant to solution. This rock has an average dip of about 60 degrees all along this ridge; and except within a few rods of the damsite gap it is flanked on both sides, to and above the water level, by thick masses of impermeable clay shales which would absolutely prevent outward leakage of water through the ridge even if it passed through the sandstone itself at right angles to the bedding. At the damsite, erosion has exposed the sandstone below the intended water level for a short distance back from Anadarche Creek on both sides of the gap; and the exposed portion of the sandstone, where undermined by the creek, has tended to break off in huge blocks 20 feet or more in diameter. Even here there is remarkably little open jointing transverse to the bedding of the sandstone, which is very massive. These broken portions, I understand, would be blasted away before construction of the dam.

It appears certain in view of these facts that if the dam itself can be tied into the bedrock in such a manner as to prevent leakage along the contact between the two, there need be no fear of substantial leakage through the bedrock itself from Lake Murray at any point. Slow seepage might take place through the exposed portion of the sandstone near the dam; but the exposed surfaces extend below the water level for only a few hundred feet along the south side of the ridge on either side of the gap. They would be partially covered by an earthen dam, and could be surfaced with concrete at relatively small expense if seepage of consequence developed.

As to structural strength of the bedrock foundation for the dam, the steep northeast dip (37 to 40 degrees) of the sandstone core of the ridge causes it to cross the bed of Anadarche Creek somewhat upstream from the face of the cliff on either side, so that a concrete dam built with the customary upstream convexity would rest its weight exclusively on this stratum, whose structural competence is certainly hundreds of times greater than would be demanded of it by this structure. Even a straight concrete dam probably would find a solid sandstone foundation throughout. The alluvium of Anadarche Creek is probably very shallow through the gap. It of course would be removed prior to the construction of the dam.

An earthen dam would rest part of its weight upon shales flanking the sandstone and dipping into the ground parallel to it. If these shales were of great thickness and occupied the entire area for a considerable distance around the damsite, there might be some doubt as to their structural competence; although less competent formations carry much greater loads in New Orleans and other cities built upon deep allivium. These shales have the further great advantage of structural reinforcement by interbedded sandstones ranging up to 200 feet in thickness, which parallel the main Devil's Kitchen sandstone at a distance of a few hundred feet on either side. Under these circumstances there is no possibility of substantial creep of the shales under the weight of the dam.

