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Ground Water Investigations in Oklahoma

By

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Prior to 1937, ground-water work in Oklahoma consisted of broad scale early-day reconnaissance and a few brief investigations of local areas. The reconnaissance is distinguished by C. N. Gould's "Geology and Water Resources of Oklahoma" (Water-Supply Paper 148, 1905), which covers about half of the present State of Oklahoma. Among the shorter reports are two by Schwennesen for areas near Enid and Oklahoma City, one by Renick for Enid, and one by Thompson on irrigation possibilities near Gage. These reports are now inadequate by modern standards.

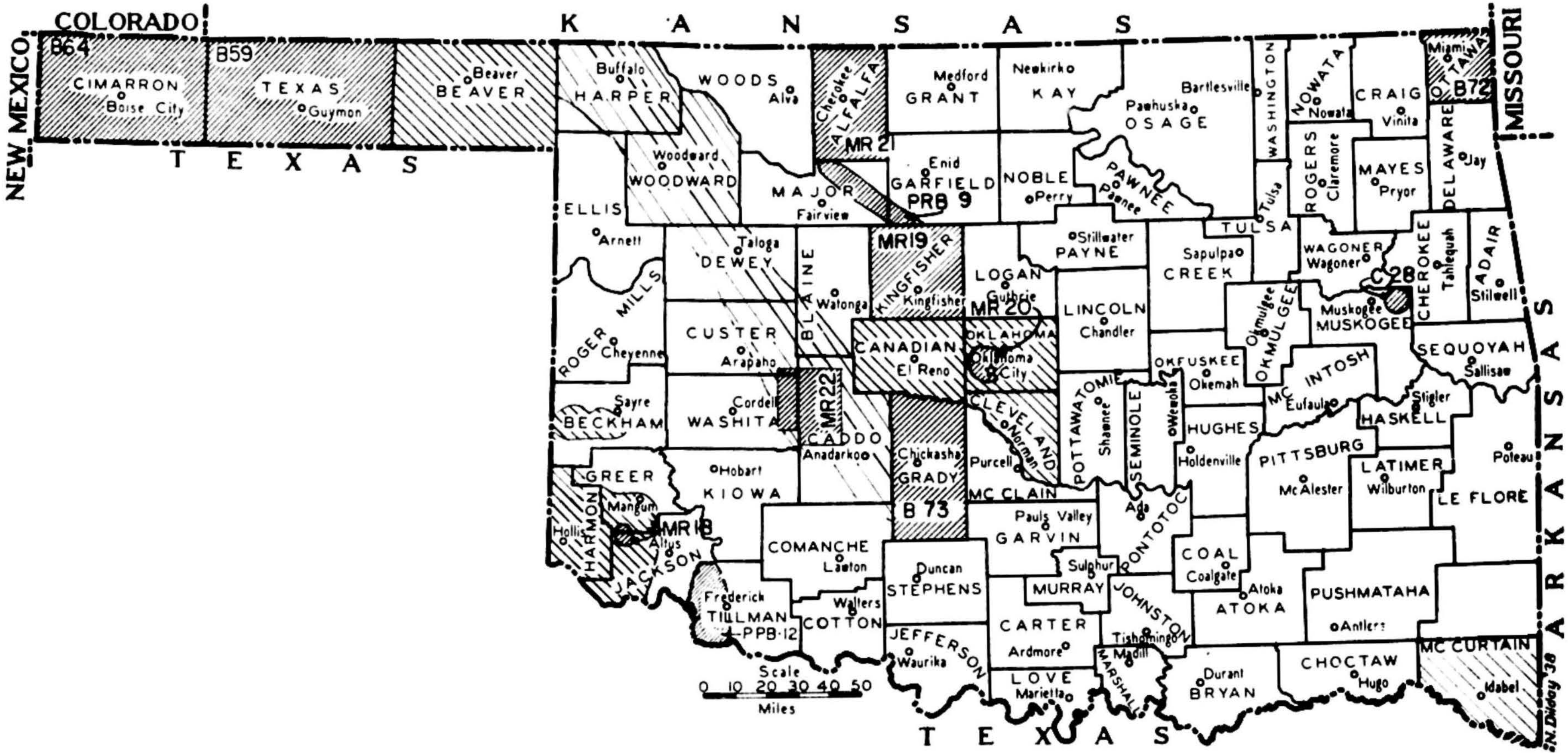
Cooperative ground-water work in Oklahoma by the United States Geological Survey began in 1937, with the Oklahoma Geological Survey as cooperating agency. With the passage of the new ground-water law by the State Legislature in 1949, the need for more information on available ground waters and the safe yield of the various aquifers became very pressing. Accordingly, the Division of Water Resources of the Oklahoma Planning and Resources Board, to which was delegated the responsibility of administering the Ground-Water Law, entered into a cooperative agreement with the U. S. Geological Survey, providing for an expansion of ground-water investigations. Both cooperators have consistently given full and enthusiastic cooperation, often beyond the requirements of the cooperative program.

The first cooperative investigation was an evaluation of ground-water supplies available for irrigation in the Panhandle. In 1937 the Panhandle was still very much in the dust bowl, and it was hoped that irrigation would alleviate the drought. A bulletin on Texas County was published in 1939, and one on Cimarron County in 1943. Ground-water investigations during the World War II were restricted to the demands of Army and Navy installations, and to defense industries. Ground-water investigations since 1945 have included both country-wide and aquifer-type investigations. In Oklahoma it has been the policy for the State cooperator to publish the results of the ground-water investigation.

Reports published by the Oklahoma Geological Survey include several mineral reports and bulletins on areas or aquifers. The bulletins are: "Geology and ground water of Grady and northern Stephens Counties," "Geology and ground water of Ottawa County," "Geology and ground water resources of Texas County," and "Geology and ground water resources of Cimarron County." Bulletins on McCurtain and Canadian Counties will be published in 1956.

The Oklahoma Planning and Resources Board has published bulletins on the ground-water resources of the Cimarron terrace and the ground-water resources of western Tillman County. A report entitled "Public water supplies in Oklahoma" contains a brief description of the various ground-water reservoirs in the State. Publication number 50, by the Oklahoma Engineering Experiment Station at Stillwater, also contains a digest of the ground-water reservoirs in Oklahoma.

Active projects in cooperation with the Oklahoma Geological Survey include the study of the ground water in Oklahoma and Cleveland Counties, and in the Rush Springs sandstone on the north side of the Anadarko basin. In cooperation with the Oklahoma Planning and Resources Board we are investigating the ground water in Woodward County, and in Harmon, Greer, and Jackson Counties. (Exhibit A)



Areas in Oklahoma covered by ground-water investigations in progress and those covered by published reports of the Oklahoma Geological Survey and the Oklahoma Planning and Resources Board are shown by ruled patterns. B, Oklahoma Geological Survey Bulletin; C, Oklahoma Geological Survey Circular; MR, Oklahoma Geological Survey Mineral Report; PRB, Oklahoma Planning and Resources Board Report.

EXHIBIT A

Ground Water Reservoirs in Oklahoma

The major ground-water reservoirs of Oklahoma may be classified into five general groups: sands and gravels underlying the High Plains, alluvium along valleys, terrace deposits, sandstones, and limestones. (Exhibit B).

(1) Deposits underlying the High Plains. These sediments cover all but a small fraction of the three counties in the Oklahoma Panhandle and extend a short distance into adjacent counties to the east. They consist of sand, gravel, and clay, which at many places is capped by a limy rock called caliche.

This deposit is probably the best aquifer in Oklahoma because of its large areal extent, its rather considerable thickness, and its high permeability--yet it is only partly filled with water. Owing to low annual precipitation and high evaporation, not enough water enters it to fill it and offset drainage by the streams that have cut into it deeply. Even so, because of its great capacity it holds a very large volume of water. Because the High Plains surface is relatively flat, with many small depressions that catch the surface runoff before it can reach a major drainage line, the loss through runoff is small, but the recharge is also probably small because much of the water is lost through evaporation and plant use before it reaches the ground-water reservoir. The water apparently takes a long time to reach the zone of saturation because graphs showing fluctuations of the water table indicate a considerable time lag between periods of drought and a lowering of the water table. Thus, the water table in the High Plains is still rising even though the past few years have been deficient in precipitations. (See exhibit C and D.) Available basic data is published in bulletins on the ground water in Texas and Cimmaron Counties. Published data is not available for the High Plains sediments in Beaver, Ellis, Roger Mills, Woodward, and Harper Counties.

(2) Alluvium. Alluvium is the material deposited by a stream. It may consist of gravel, sand, and clay in any proportion and any degree of sorting, and it underlies the flood plain or "bottom." It is generally thickest near the middle of a valley and thinnest where the flood plains adjoins the bluffs. Along major rivers, it may be more than 100 feet in thickness, but only a few feet along small streams. In many places the alluvium is an excellent aquifer, both because the coarser beds in it will transmit water freely and because replenishment of the ground-water supply is likely to be greater in the valley than in adjacent areas. The alluvium along major rivers in Oklahoma is widely tapped for municipal, industrial, irrigation, and rural water supplies. The water table in alluvium responds quickly to precipitation or drought conditions because the water table is so near the surface. (See exhibit E.)

Data on the ground water in alluvium is contained in nearly all of the published reports. Only one report is primarily concerned with alluvium; that is the report on Canadian County, which is to be published by the Oklahoma Geological Survey. Much work remains to be done on the ground water in alluvium in Oklahoma.

(3) Terrace deposits. The terrace deposits consist of materials laid down by ancient streams, which in many instances probably are the same streams that flow across Oklahoma today. Since the deposits were laid down, the streams have cut their valleys to their present levels and have left the terrace deposits on the flanks of the valleys. The deposits consist of the same kind of material as the alluvium--sand, gravel, and clay in differing proportions. They occur widely in Oklahoma on the north sides of the major streams and in smaller areas on the south sides. Replenishment of the terrace deposits comes mainly from precipitation on their surface. The water table in terrace materials generally does not respond to precipitation as rapidly as it does in alluvium because of

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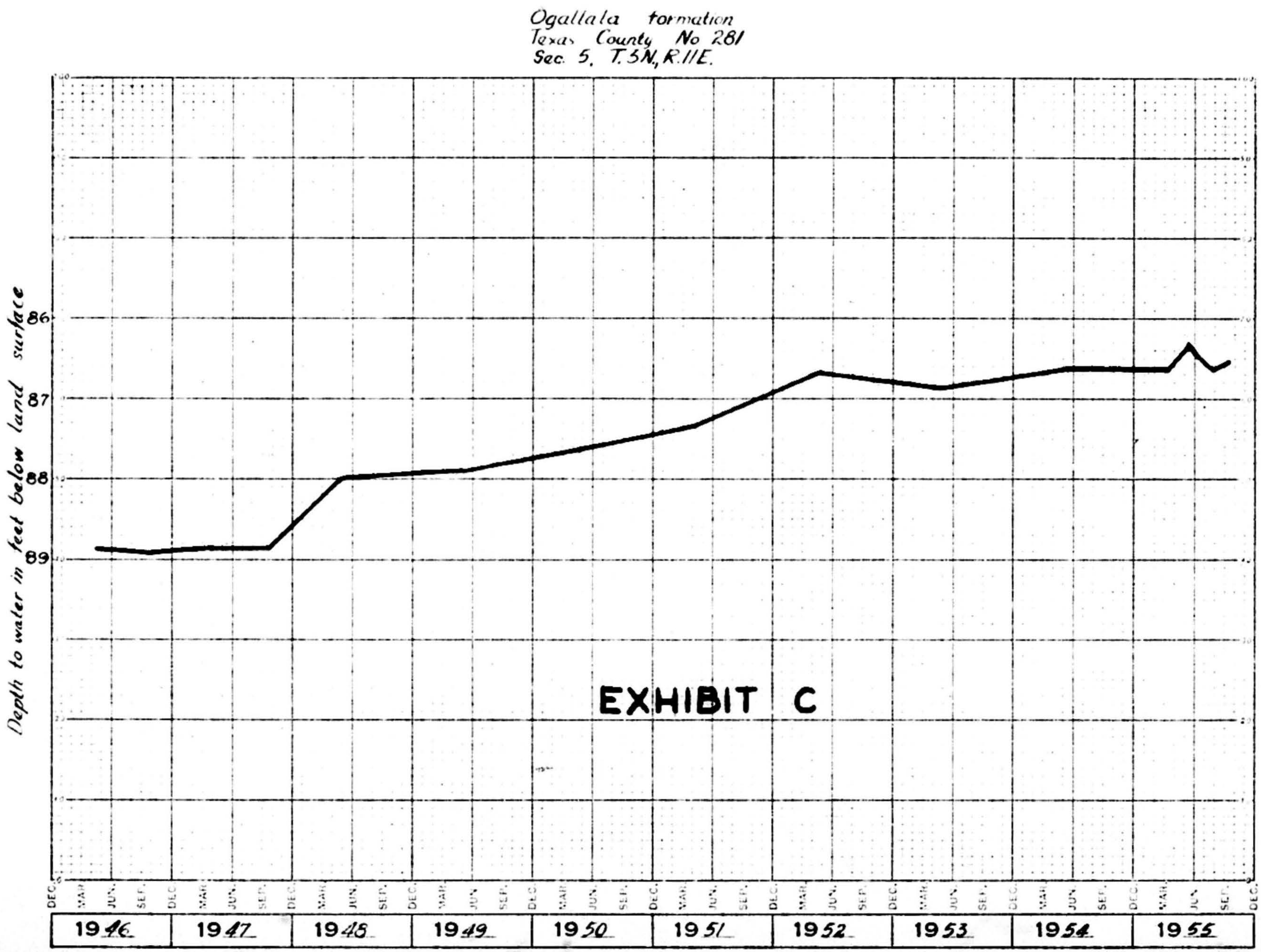


Ogallala formation
Beaver County No 591
Sec 12, T 5N, R 21E

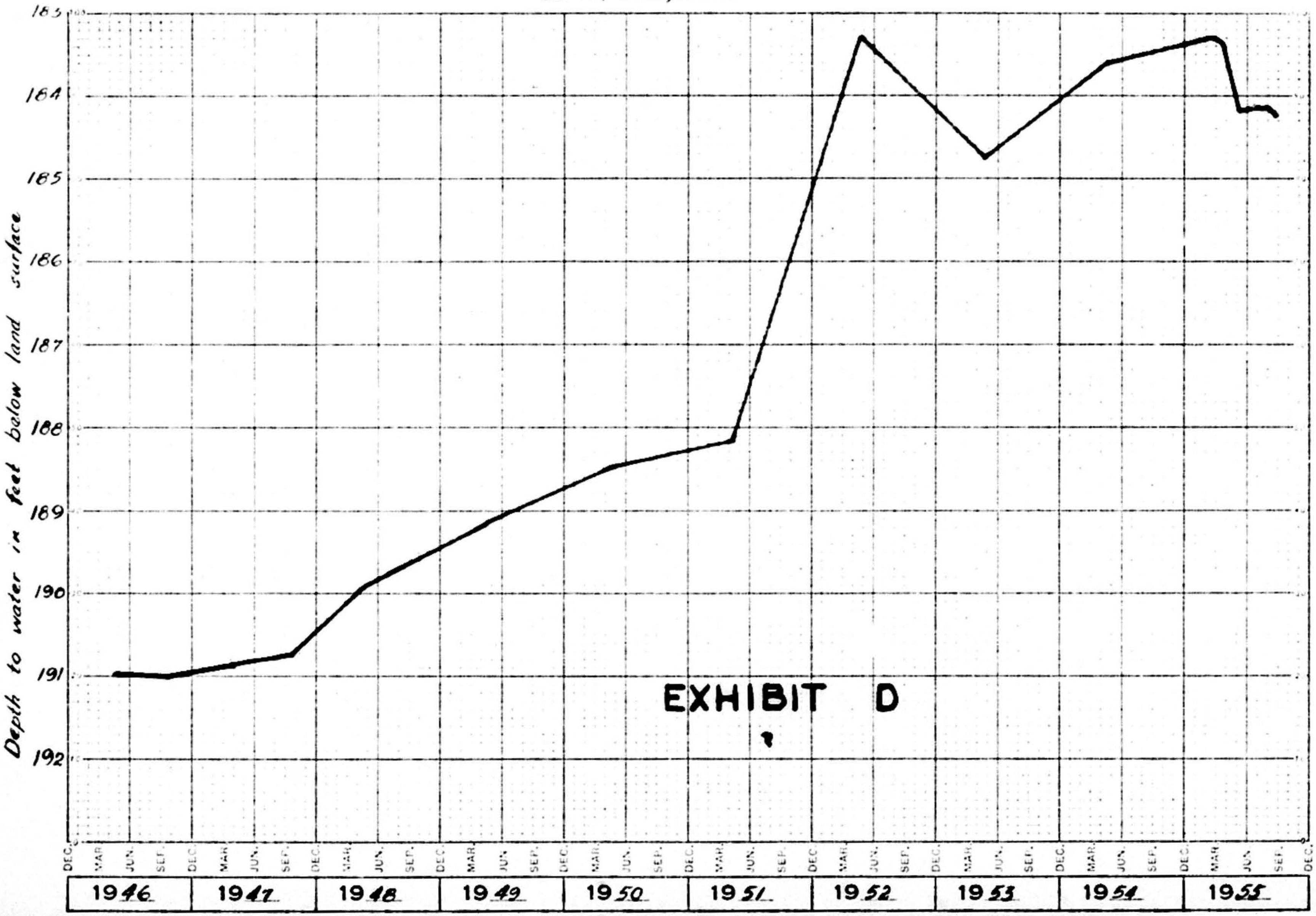
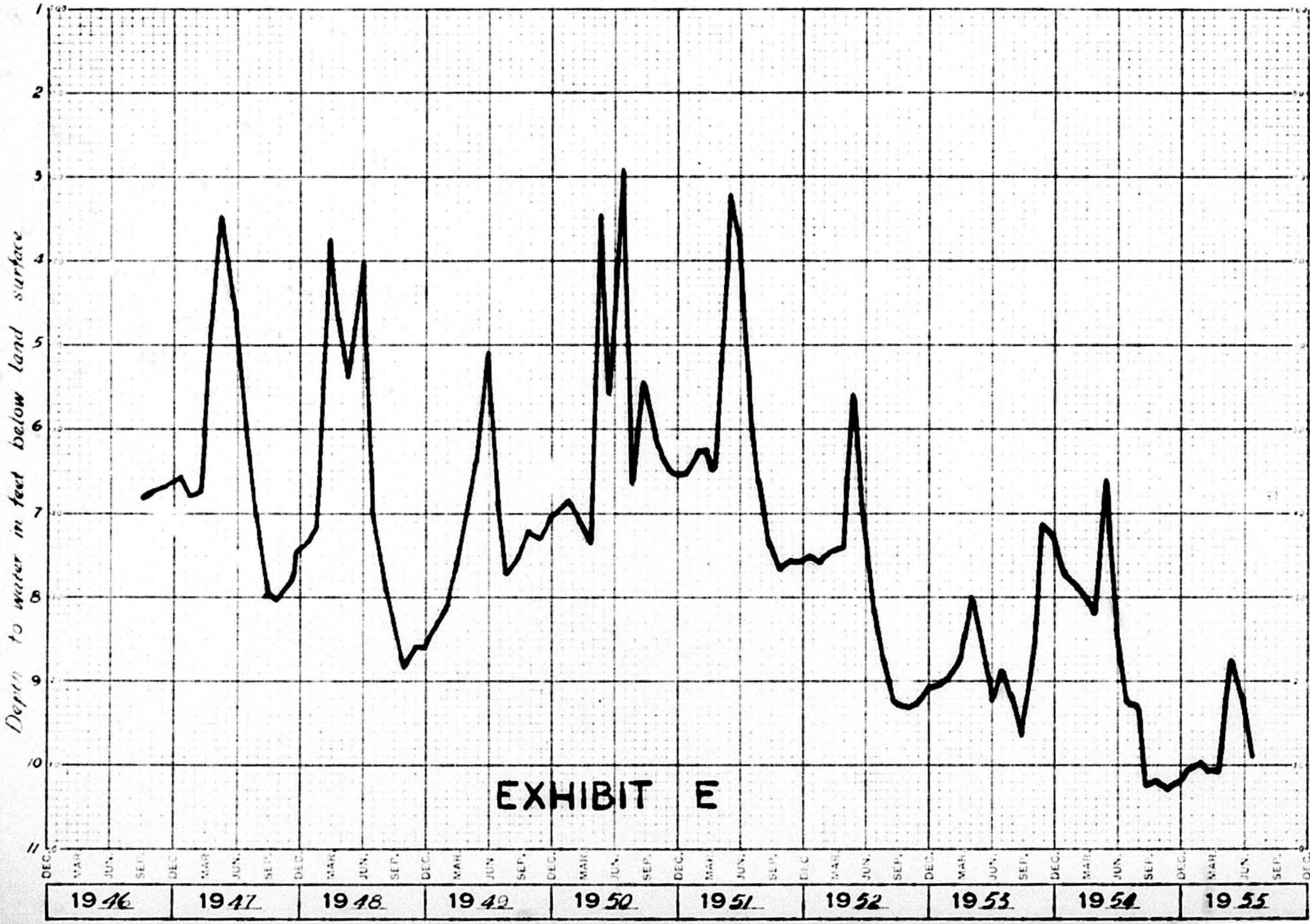


EXHIBIT D

Aluvium of North Canadian River
Canadian G-53
SW¼ Sec. 3, T.10N, R.7W.



the greater depth to water in the terrace deposits. (See exhibit F.) Two reports--the one on the Cimarron terrace and the one on western Tillman County are concerned principally with ground water in terrace sediments. Several of the other reports contain information on terrace deposits even though the emphasis is on other aquifers.

(4) Sandstone aquifers. Sandstone is the bedrock in many parts of Oklahoma and is represented in the formations of many different geologic ages. It is a sedimentary rock, and although originally deposited in an approximately horizontal position, the sandstones have been folded or tilted so that everywhere they now lie at angles to the horizontal ranging from less than 1 degree to 90 degrees. As the adjacent formations in many instances are impermeable shale, the interbedded sandstones are artesian aquifers. In their outcrop areas, of course, the water in them occurs under water-table conditions. Among the sandstone formations of Oklahoma, the following are especially significant as ground-water reservoirs: the Trinity sand, the Rush Springs sandstone, the Garber sandstone, the Vamoosa formation, the Roubidou formation, and the Simpson group.

The Trinity sand occurs in southern Oklahoma from Love County eastward to the Arkansas State line, and in places attains a thickness of 2,200 feet. It includes many lenticular layers of clay, and some of the sand is so loose and find grained that it cannot be kept out of the wells except with great difficulty, but in general the Trinity affords a relatively abundant supply of good water. One of the Hugo municipal water wells yields more than 450 gallons per minute from a gravel-packed well in this formation. The pending report on McCurtain County contains data on the Trinity sand. Data are lacking in Love, Marshall, Bryan, Johnson, Atoka, Pushmataha, and Choctaw Counties.

The Rush Springs sandstone crops out widely in western Oklahoma from Grady County northwest to the Panhandle and west to the Texas State line. This formation is more than 400 feet thick in places and some wells in it have yields of more than 1,000 gallons per minute. Many hundreds of water wells tap water in the Rush Springs, but so far the water table has not been measurably affected by pumping, except locally. The source of the ground water in the Rush Springs is from precipitation directly upon the outcrop. Changes in climatic conditions are readily reflected in the altitude of the water table. Thus, the subnormal precipitation of the past few years has caused a steady drop in the water table since 1950. (See exhibits G and H.) Data has been published on the Rush Springs sandstone in Grady County, and an Oklahoma Geological Survey Mineral Report deals with the Rush Springs in the Pond Creek basin in Caddo County. A comprehensive investigation was begun in September 1955 on the ground water in the Rush Springs sandstone on the north side of the Anadarko basin in Oklahoma, which underlies most of the outcrop area. The Rush Springs is also being studied as a part of a county-wide investigation in Woodward County.

The Garber sandstone occurs in central Oklahoma and consists of alternating sandstones and shales. The formation has been extensively developed for municipal and industrial water supplies, mainly in Cleveland and Oklahoma Counties. At Norman, Oklahoma, there was a decided drop in the water level when the Navy bases were activated during the war and again when they reactivated in 1951. Both times the drop in water level reflected the increased demand made upon the aquifer. (See exhibit I.) The Garber sandstone is presently being studied as part of the investigation of Cleveland and Oklahoma Counties.

The Vamoosa formation crops out in a north-south strip from Osage County to Seminole County. This formation is the source of municipal water supply for Seminole and other cities along its outcrop area. Wells in it yield about 150 gallons per minute. Basic data is almost completely lacking on this reservoir.

The Roubidou formation yields water to deep wells in northeastern Oklahoma. This water supply appears to have been overdeveloped. Some of the wells in the Miami area

Terrace Deposits
Tillman County No. 1
Sec. 25, T. 1 S., R. 19 W.

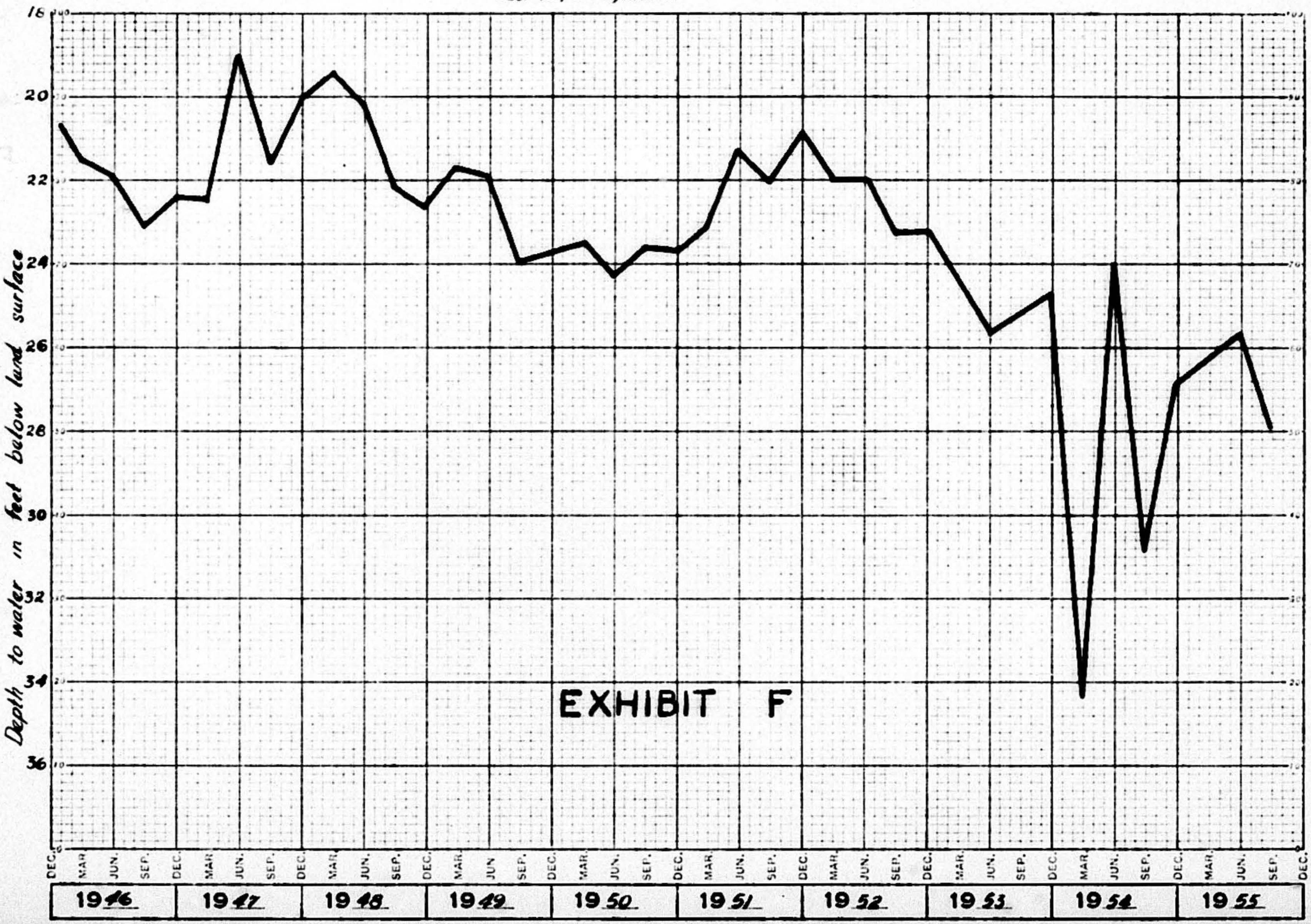


EXHIBIT F

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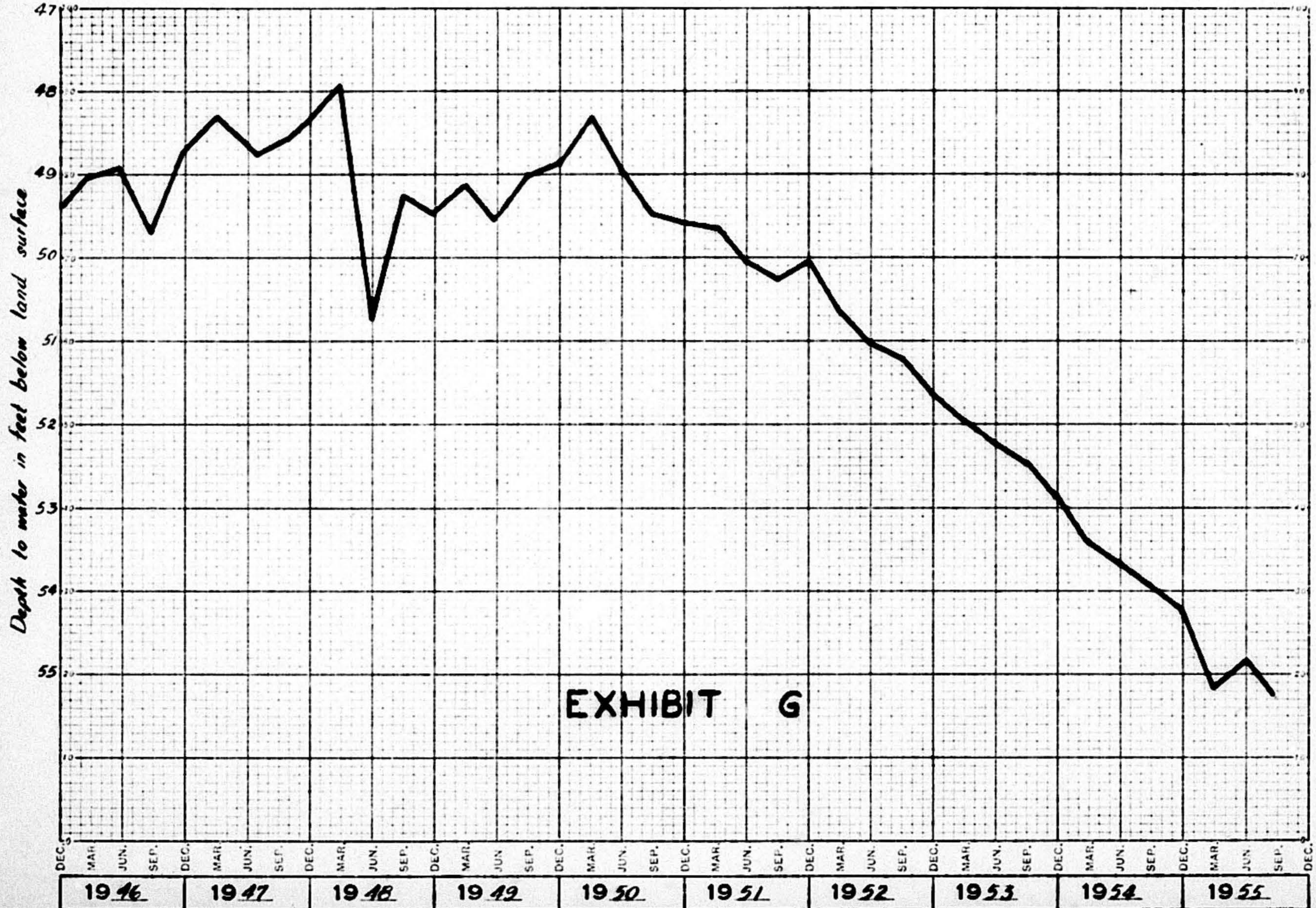
Rush Springs sandstone
Caddo County No 1
Sec. 2, T. 7 N., R. 12 W.



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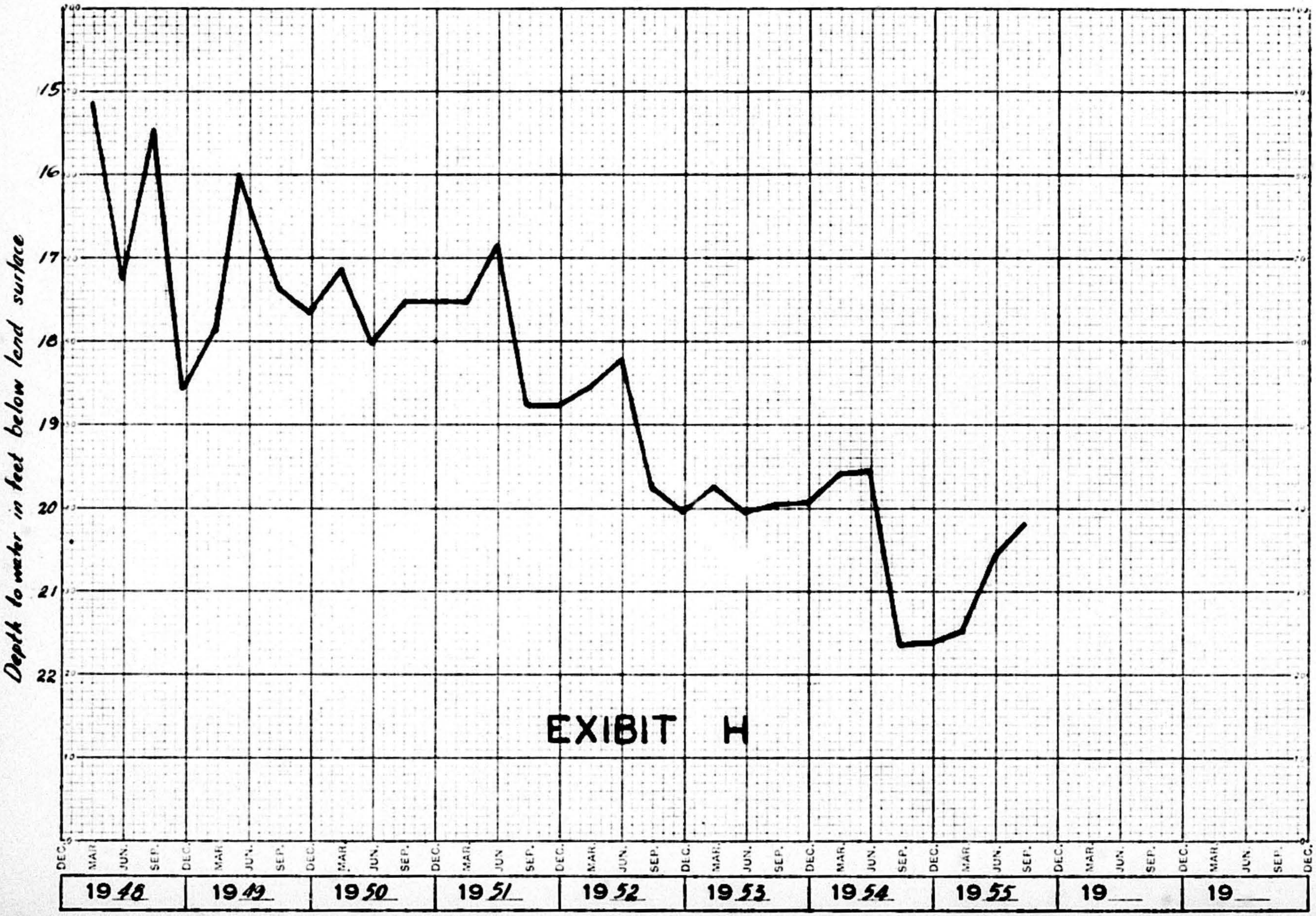
Rush Springs sandstone
Caddo County No 4
Sec. 5, T. 8N, R. 12N.



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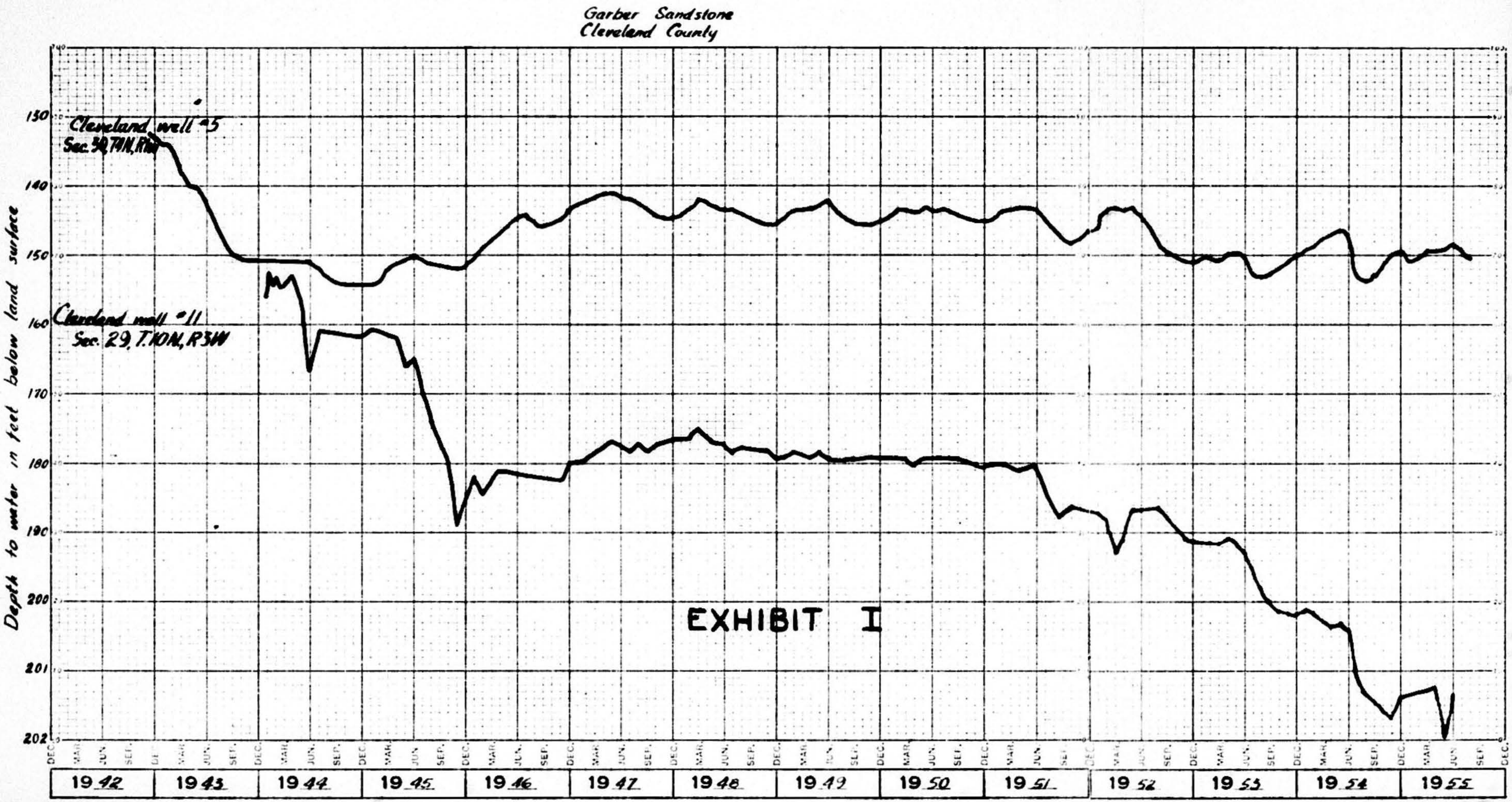

flowed at the surface 40 years ago, but now the static water levels are about 250 feet below the surface. Basic data on this reservoir is published in Oklahoma Geological Survey Bulletin 72, "Ground water resources of Ottawa County, Oklahoma."

The Simpson group includes several formations, each containing thick sandstone beds. In the outcrop area in south-central Oklahoma and for some distance down the dip away from it, potable water may be obtained from these sandstones. Large flowing wells tap the sandstones of the Simpson group at Sulphur, but in most of Oklahoma the Simpson group is too far beneath the surface and the water in it is too mineralized to make it a desirable ground-water reservoir. No basic data is available for the Simpson group.

In the aggregate, Oklahoma has very large reserves of ground water. However, the ground water reservoirs are localized, which means that large supplies of water cannot be obtained everywhere in the State. However, in a great many areas sufficient ground water is available for small scale irrigation or small industry. Many more areas can be developed for moderate to large supplies of ground water if water-quality requirements are not too rigid.

It is obvious, from the preceding remarks, that the work of ground-water investigations in Oklahoma must continue at an accelerated rate if a logical program of development is to be established.