SATURATED THICKNESS

A saturated thickness map of the High Plains aquifer was prepared by superimposing 1980 water-table contours over the altitude of the base of aquifer map and constructing lines of equal saturated thickness. The resulting map shows the 1980 areal distribution of saturated thickness. Each thickness interval on the saturated thickness map shows the range in thickness of the aquifer that predominates in that area. Because of map scale, it is not possible to show small areas within each thickness interval where saturated thickness may be more or less than that indicated. Geohydrologic sections were constructed to show the distribution of saturated aquifer material, also. By use of both illustrations on this sheet, a knowledge of the saturated thickness and its relationship to the rocks underlying the High Plains aquifer can be obtained.

Sandstone beds in Triassic and Jurassic and Lower Cretaceous rocks are the principal bedrock aquifers underlying the High Plains aquifer. The north-south section along longitude 102° W. shows that these bedrock aquifers are in contact with the base of the High Plains aquifer between the Arkansas and Cimarron Rivers and south of the Canadian River. The section along latitude 36°30' N. shows that these bedrock aquifers also are in contact with the High Plains aquifer west of the Beaver River. In the vicinity of the intersection of these two sections, the bedrock units have been uplifted (Irwin and Morton, 1969) and eroded. The erosional surface was subsequently covered by deposits that formed the High Plains aquifer. As a result of this geologic structure, water can move between the High Plains aquifer and bedrock aquifers where they are in contact.

Although greatly exaggerated, the east-west sections show the eastward slope of the aquifer base. Ground water moves regionally under the force of gravity in the general direction of the slope of the aquifer base to discharge areas along streams or the aquifer boundary.

As shown on the north-south section, the North Platte River at Lake McConaughy, Arikaree, Arkansas, and Canadian Rivers have cut their channels through the aquifer into bedrock. These streams in addition to the South Platte, North Loup, Elkhorn, and North Fork Solomon Rivers are gaining streams at the locations shown in the sections. Gaining streams have their channels below the water table and receive ground-water discharge from the aquifer. At other locations, these and most other streams in the High Plains are losing streams. Losing streams have their channels above the water table such as the Beaver and Cimarron Rivers and may provide recharge to the aquifer during periods of runoff.

The east-west section along latitude 42° N. shows more than 1,000 feet of saturated thickness west of the faults in Wyoming. In this area, the aquifer consists mainly of fine-grained Arikaree Formation which yields 150-700 gallons per minute to wells (Weeks, 1964). Along the same section, the saturated thickness is about 1,000 feet just east of longitude 102° W. Here the aquifer consists of unconsolidated dune sand and the Ogallala Formation which will yield 1,000-2,000 gallons per minute.

The east-west section along latitude 36°30' N. shows the vast extent of Permian deposits underlying the aquifer. The undulating Permian surface at the base of the aquifer is probably the result of solution and collapse structures caused by dissolution of salt. The Permian outcrop, which may represent the original height of the Permian deposits, is now a residual high because the surrounding area has collapsed after the salt was dissolved.

Saturated thickness ranges from zero where the deposits comprising the High Plains aquifer are unsaturated to more than 1,000 feet in west-central Nebraska. The percentage of the area of the High Plains aquifer within each saturated thickness interval is summarized by State in the accompanying table. The tabulated results show that 46 percent of the High Plains aquifer has less than 100 feet of saturated thickness whereas only 5 percent has more than 600 feet of saturated thickness. With the exception of Nebraska, at least 40 percent of the High Plains aquifer in each State has less than 100 feet of saturated thickness. Significant areas where the saturated thickness of the aquifer is greater than 600 feet occur only in Nebraska and Wyoming.

The volume of saturated materials also is summarized in the table. The total volume of saturated material in the High Plains aquifer is 21.8 billion acre-feet of which about 64 percent is in Nebraska and only about 1 percent is in New Mexico. Based on the volume of saturated material and the area of the aquifer, the average saturated thickness of the High Plains aquifer is about 200 feet. The saturated thickness of the aquifer in Nebraska averages about 340 feet. In the area excluding Nebraska, the saturated thickness of the aquifer averages about 110 feet.

The volume of water stored in the aquifer can be estimated by multiplying the volume of saturated aquifer materials by specific yield. Specific yield is defined as the ratio of (1) the volume of water which the saturated rock will yield by gravity drainage to (2) the total volume of saturated rock. Specific yield varies both areally and veritically in the High Plains aquifer. Within a typical vertical section of the aquifer, specific yield can vary from near 0 to 0.25 depending upon the character of the sediments. Fine-grained sediments generally have lower specific yield than coarse-grained sediments. Thus, a detailed study of the distribution of specific yield needs to be made before a reliable estimate of the volume of water in storage can be made. But, to obtain an order of magnitude estimate, assume that the average specific yield is 0.15, then the volume of water in storage in the High Plains aquifer would be about 3.3 billion acre-feet.

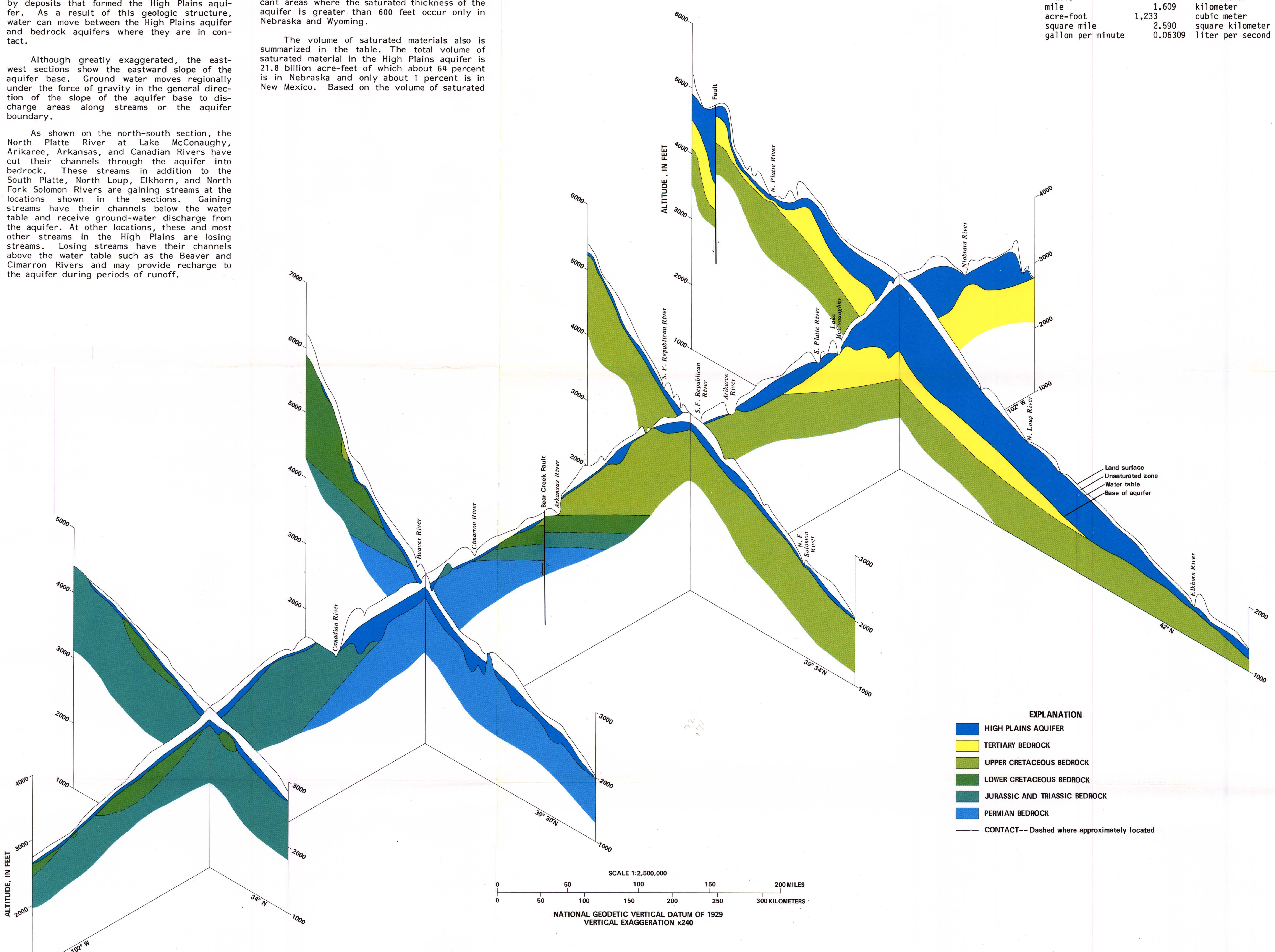
DISTRIBUTION AND VOLUME OF SATURATED MATERIAL, HIGH PLAINS AQUIFER, 1980

State	Area of High Plains aquifer within State (square miles)	Percentage of area within each saturated thickness interval							Volume of saturated aquifer material (Millions of acre-feet)
		0-100 feet	100-200 feet	200-400 feet	400-600 feet	600-800 feet	800-1,000 feet	1,000-1,200 feet	
Colorado------	14,870[1]	76	18	6	--	--	--	--	750
Kansas--------	31,050[2]	66	21	12	1	--	--	--	2,000
Nebraska------	64,400	14	21	29	22	10	3	1	14,000
New Mexico----	9,710[3]	85	15	--	--	--	--	--	320
Oklahoma------	7,350	58	25	11	6	--	--	--	610
South Dakota--	5,290	44	13	25	18	--	--	--	700
Texas---------	36,080	61	25	14	--	--	--	--	2,500
Wyoming-------	8,190	46	26	18	4	4	1	1	920
TOTAL----	176,940[4]	46	22	18	9	4	1	--	21,800

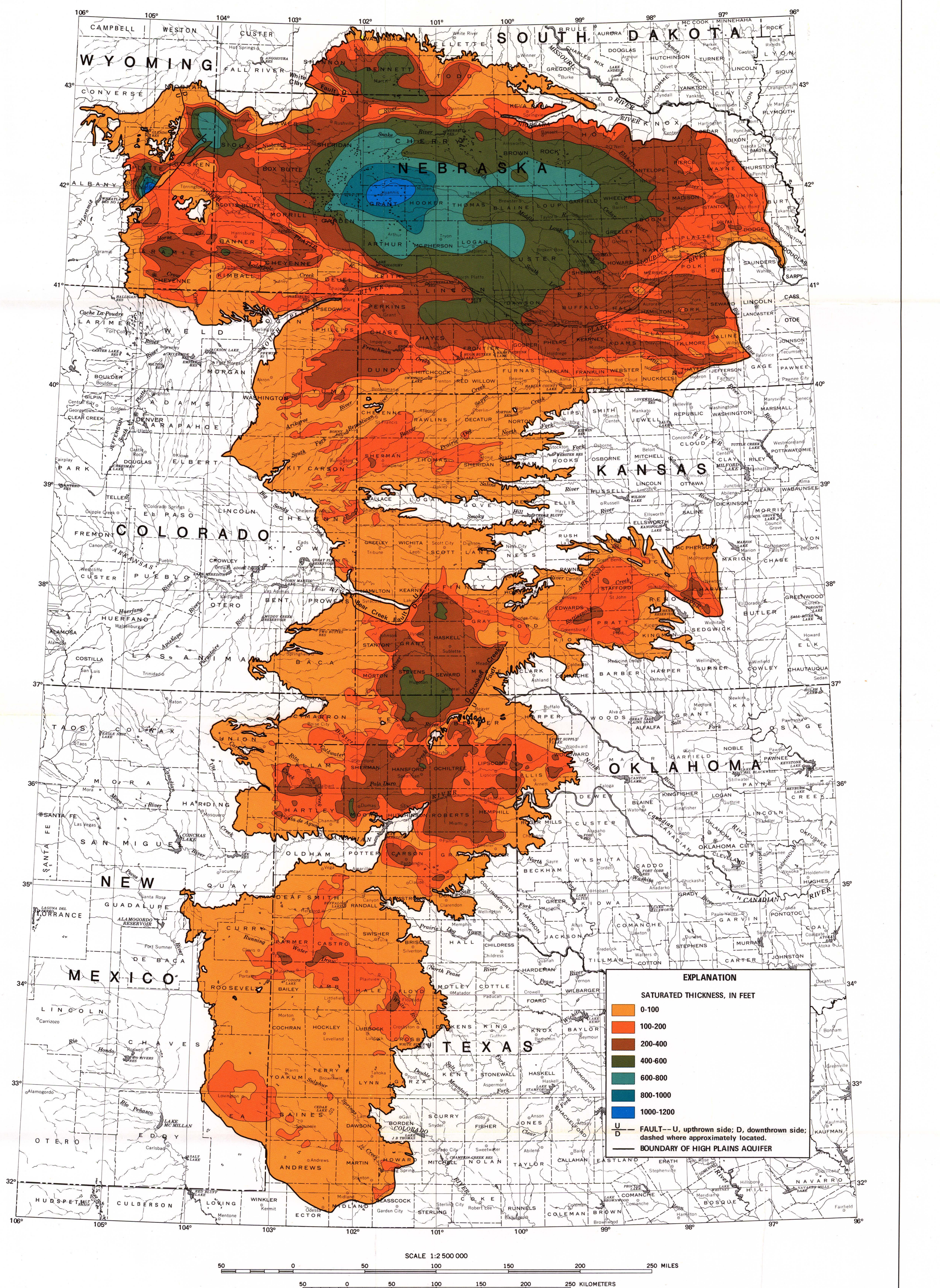
[1]Includes 1,200 square miles with little or no saturated thickness.
[2]Includes 3,200 square miles with little or no saturated thickness.
[3]Includes 2,600 square miles with little or no saturated thickness.
[4]Includes 7,000 square miles with little or no saturated thickness.

CONVERSION FACTORS

Multiply inch-pound units	*By*	*To obtain SI units*
foot	0.3048	meter
foot per mile	0.1894	meter per kilometer
mile	1.609	kilometer
acre-foot	1,233	cubic meter
square mile	2.590	square kilometer
gallon per minute	0.06309	liter per second



GEOHYDROLOGIC SECTIONS THROUGH AQUIFER



SATURATED THICKNESS OF AQUIFER

Base from U.S. Geological Survey
United States base map, 1972

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BEDROCK GEOLOGY, ALTITUDE OF BASE, AND 1980 SATURATED THICKNESS OF THE HIGH PLAINS AQUIFER IN PARTS OF COLORADO, KANSAS, NEBRASKA, NEW MEXICO, OKLAHOMA, SOUTH DAKOTA, TEXAS, AND WYOMING

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