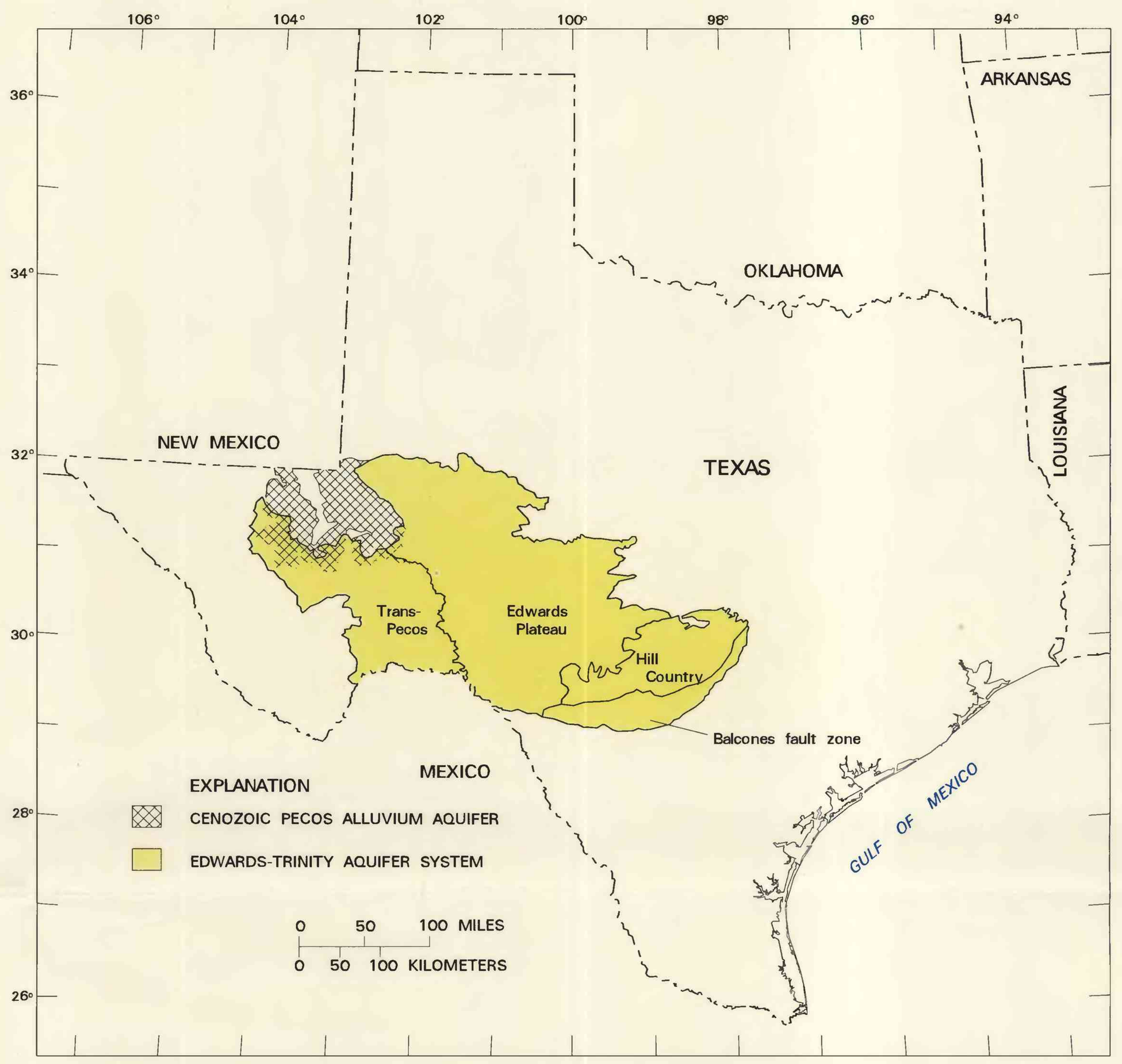

Figure 1. Map showing location and geographic subareas of the Edwards-Trinity aquifer system.

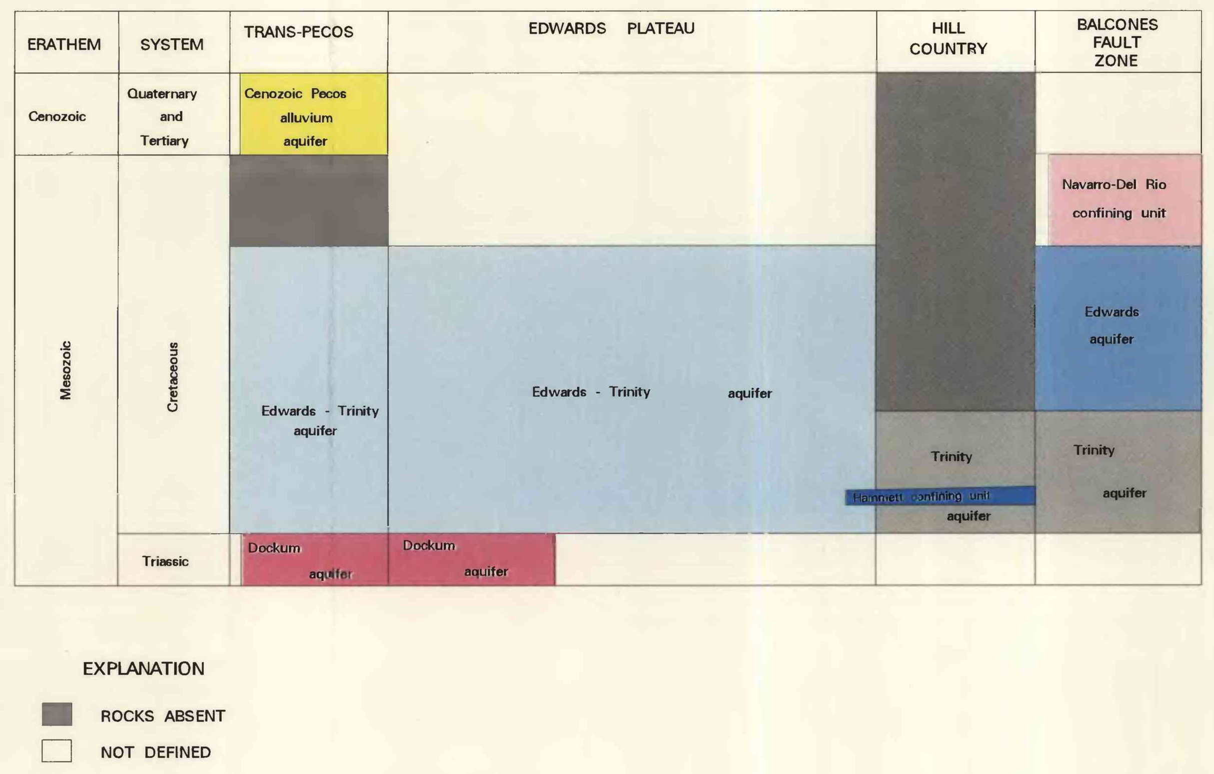

Figure 2. Correlation chart for regional hydrogeologic units of the Edwards-Trinity aquifer system and selected contiguous hydraulically connected units.

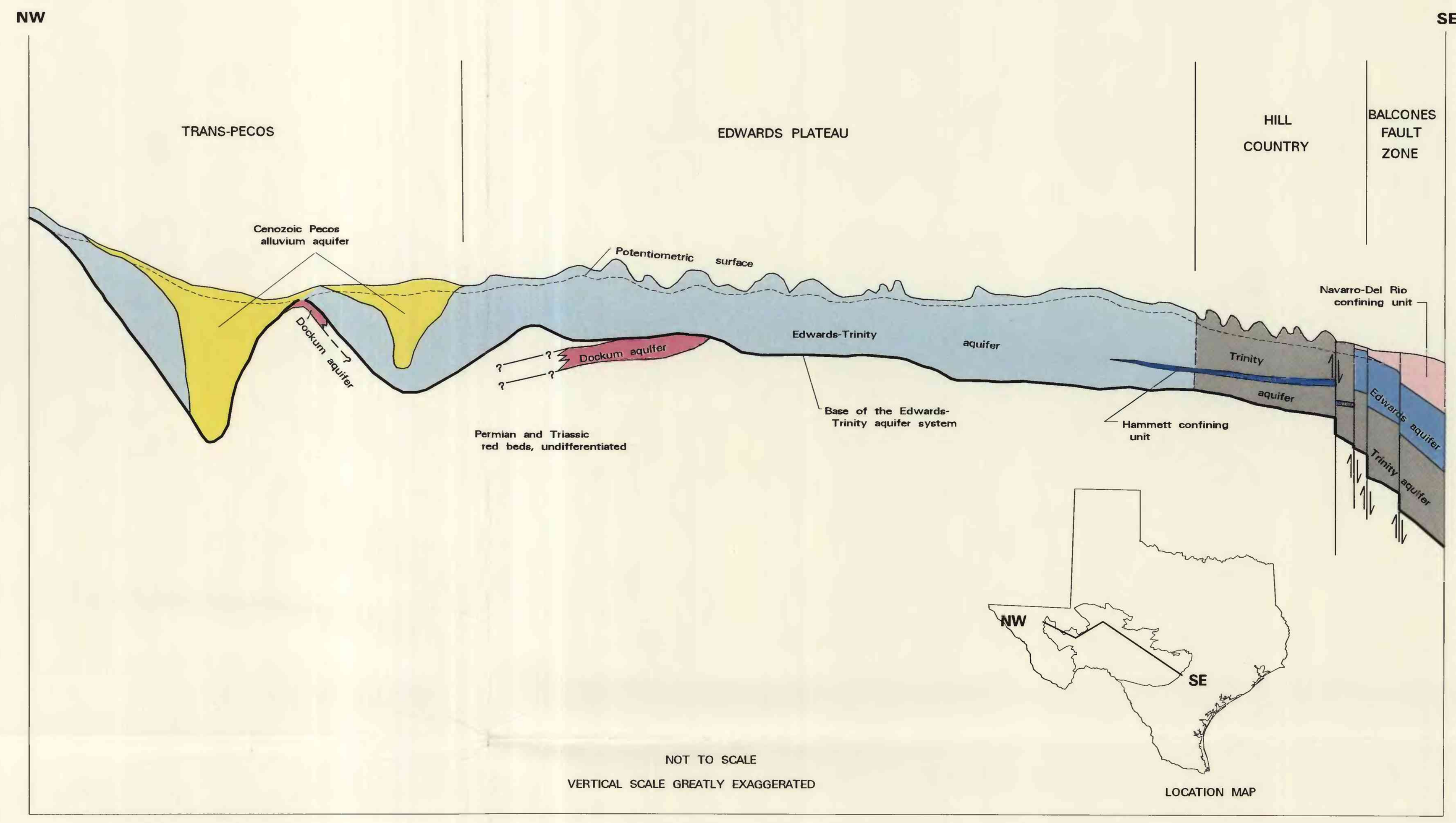

Figure 3. Diagrammatic hydrogeologic section through the Edwards-Trinity aquifer system and selected contiguous hydraulically connected units.

INTRODUCTION

The Edwards-Trinity Regional Aquifer-System Analysis (RASA) is one of 25 completed or ongoing studies conducted by the U.S. Geological Survey on regional aquifer systems that individually provide essential quantities of ground water to large parts of the country. Underlying about 42,000 mi^2 of west-central Texas, the Edwards-Trinity aquifer system extends approximately from Atascosa County in the southeast to Culberson County in the northwest and from the Rio Grande in the southwest to the Colorado River in the northeast (sheet 2). The Edwards-Trinity aquifer system spans four geographic subareas: Trans-Pecos, Edwards Plateau, Hill Country, and Balcones fault zone (fig. 1). The names of all aquifers in the study area were adopted for RASA purposes directly from nomenclature mandated by the Texas Water Plan (Texas Water Development Board, 1990).

The Cretaceous rocks that compose the Edwards-Trinity aquifer system are primarily limestone and dolomite rock, with lesser quantities of terrigenous sand. Although the lithology varies locally and the rocks are not everywhere permeable in all directions, they combine to form a single regional aquifer system. The aquifer system comprises three aquifers and two confining units (figs. 2 and 3). The water-yielding units are the Edwards aquifer of the Balcones fault zone, the Trinity aquifer of the Balcones fault zone and Hill Country, and the Edwards-Trinity aquifer of the Edwards Plateau and Trans-Pecos. The confining units are the Hammett confining unit, which confines basal parts of the Trinity aquifer in the Hill Country and the Edwards-Trinity aquifer in the eastern part of the Edwards Plateau, and the Navarro-Del Rio confining unit, which confines the Edwards and Trinity aquifers along the southeastern margin of the Balcones fault zone. Parts of the aquifer system not overlain by one of these confining units are unconfined, or nearly so.

The purposes of this report are to illustrate the historical distribution of saturated thickness (hereafter referred to as the saturated thickness) in the Edwards-Trinity aquifer system, summarize the reasons for the variation in the saturated thickness, and relate the regional effects of this variation to the distribution of transmissivity. The saturated thickness map (sheet 2) was determined for most of the area by subtracting the altitude of the base of the aquifer system (Barker and Ardis, 1992) from the altitude of the historical potentiometric surface (Bush and others, 1993). Where the Edwards and Trinity aquifers are confined in the Balcones fault zone, the saturated thickness is defined by the thickness of the aquifer system, which was determined by subtracting the altitude of the base of the aquifer system from the altitude of the base of the Navarro-Del Rio confining unit (G.E. Groschen and W.G. Stein, U.S. Geological Survey, written commun., 1990).

HISTORICAL SATURATED THICKNESS

The map of saturated thickness (sheet 2) shows conditions in the aquifer system before major development of ground water, which in most areas began about 1945. Because differences between the historical and present conditions of saturated thickness are important only in a few areas and they mostly are local in extent, these differences are disregarded in the following (regional) descriptions of saturated thickness. Between 0 and 500 ft, the saturated thickness is shown in intervals of 100 ft. The saturated thickness generally is greater than 1,000 ft in the southern part of the aquifer system, and decreases to less than 100 ft near the northern limits. The saturated thickness is about 1,000 ft or more throughout the Balcones fault zone. In the Hill Country, the saturated thickness is greater than 500 ft, except in northern parts of the area, where it decreases to less than 100 ft as the Trinity aquifer thins toward the Llano uplift (fig. 4). In the Edwards Plateau, the saturated thickness grades from greater than 1,000 ft along the southern margin to less than 100 ft along the northern margin. In and north of the Trans-Pecos, the saturated thickness varies over short distances from greater than 1,000 ft to less than 100 ft, reflecting the rugged relief on the base of the aquifer system and adjacent contiguous hydraulically connected units.

Local variations in saturated thickness may result from structural troughs or ridges on the pre-Cretaceous surface upon which the aquifer system rests. The areas of greatest saturated thickness in Sutton and Terrell Counties result from northwest-to-southeast plunging troughs in the pre-Cretaceous rocks that form the base of the aquifer system. A lobate-shaped area of less than 100 ft of saturation trends from north to south across western Menard County into northwestern Kimble County, as the result of a ridge of Permian rocks that underlies the Edwards-Trinity aquifer in that area.

Stream erosion has carved a dendritic drainage pattern into the landscape, and the resulting topography greatly affects the shape of the potentiometric surface (fig. 4) and the areal variation in saturated thickness (sheet 2). Highs and lows on the potentiometric surface map of Bush and others (1993) show a distinct relation to topographic highs and lows. Areas of lesser saturated thickness associated with lower potentiometric levels caused by stream dissection exist throughout the study area, particularly in the Hill Country and along the northeastern margin of the Edwards Plateau. The effect is evident along upper reaches of the Concho, San Saba, Llano, Pedernales, Blanco, and Guadalupe Rivers.

The saturated thickness data extend beyond the boundary of the Edwards-Trinity aquifer in parts of Reeves, Ward, Pecos, Crane, and Upton Counties. In part of this area, the map depicts greater than 1,000 ft of saturated thickness for the Cenozoic Pecos alluvium aquifer (sheet 2 and fig. 3), which is hydraulically connected to the Edwards-Trinity aquifer system (Ashworth, 1990, p. 12). The saturated thickness map was extended to include data for the Cenozoic Pecos alluvium aquifer because that aquifer is the principal source of water for irrigation in Reeves and northwest Pecos Counties, and for industrial and public-supply use in Ward County.

In western parts of the Trans-Pecos and Edwards Plateau, the Edwards-Trinity aquifer is underlain directly by terrigenous red beds of Triassic age. Where these sediments are predominantly sand, with minimal clay and shale, they form the Dockum aquifer (Ashworth, 1990, p. 6). The Edwards-Trinity and Dockum aquifers are hydraulically connected in some areas (sheet 2). According to maps by Ogilbee and others (1962, pls. 5-7) and Walker (1979, fig. 13), the thickness of the Dockum aquifer probably averages about 200 ft. Because of its relative unimportance, variable hydraulic conductivity, and questionable extent (Barker and Ardis, 1992), the saturated thickness of the Dockum aquifer is not included on sheet 2.

The transmissivity of the Edwards-Trinity aquifer system is the product of saturated thickness and hydraulic conductivity. Transmissivity values for the Edwards aquifer in the Balcones fault zone range from about 10,000 to greater than 1,000,000 ft^2/d (Maclay and Land, 1988, p. A26), and average about 750,000 ft^2/d (Maclay and Small, 1986, fig. 20). The extremely large transmissivity values in the Balcones fault zone result mostly from zones of enhanced hydraulic conductivity, which result from the extensive dissolution of fractured carbonate rock. Transmissivity values range from about 100 to about 50,000 ft^2/d, and average about 5,000 ft^2/d over the Hill Country, Edwards Plateau, and Trans-Pecos (E.L. Kuniansky, U.S. Geological Survey, written commun., 1991). The largest transmissivity values (greater than about 5,000 ft^2/d) outside the Balcones fault zone are associated closely with areas having a saturated thickness of greater than 500 ft. Accordingly, the smallest values of transmissivity (less than about 2,500 ft^2/d) are in the northern part of the mapped area, where saturated thickness generally is less than 300 ft.

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot (ft)	0.3048	meter
foot squared per day (ft^2/d)	0.09290	meter squared per day
square mile (mi^2)	2.590	square kilometer

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

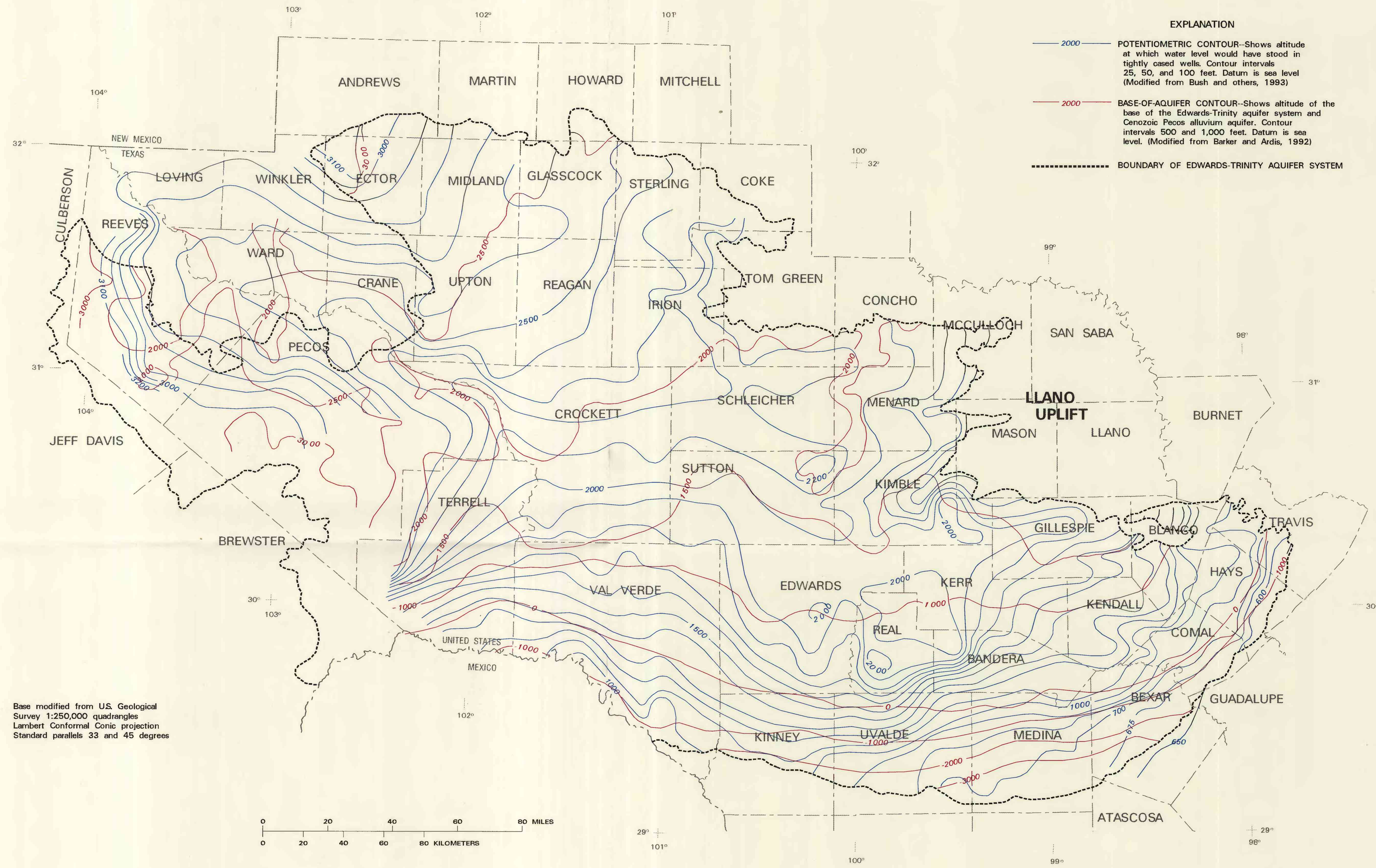

Figure 4. Map showing historical potentiometric surface and configuration of the base of the Edwards-Trinity aquifer system and Cenozoic Pecos alluvium aquifer.

HISTORICAL SATURATED THICKNESS OF THE EDWARDS-TRINITY AQUIFER SYSTEM AND SELECTED CONTIGUOUS HYDRAULICALLY CONNECTED UNITS, WEST-CENTRAL TEXAS

By

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1993

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