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Valley fill in the Roswell-Artesia area, New Mexico

By

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Open-file report

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Illustrations

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Abstract

Drill samples from 225 water and oil wells in an area 70 miles long and 20 miles wide in the Roswell-Artesia area, southeastern New Mexico were examined. A thickness map and a saturated thickness map of the valley-fill sediments were constructed.

Maximum depth of valley fill is about 300 feet in large closed depressions near Roswell, Hagerman, and Artesia. The depressions were formed by the solution of carbonates and evaporites that underlie the fill. Maximum saturated thickness is about 250 feet in depressions near Hagerman and Artesia and about 300 feet in a depression near Roswell.

Introduction

Water levels have declined in valley-fill sediments in the Roswell-Artesia area of New Mexico since extensive pumpage began in the early 1930's. Management of the water resources in the valley-fill sediments requires a knowledge of the character and thickness of these water-bearing materials.

This study, part of a comprehensive hydrologic investigation being made by the U.S. Geological Survey in cooperation with the New Mexico State Engineer, describes the lithology, thickness, and saturated thickness of valley fill in the Roswell-Artesia area. The study area lies within the Pecos River drainage in southeastern New Mexico (fig. 1).

Most of the data for this study were obtained from microscopic examination of drill cuttings from 225 water and oil wells. The lithologic descriptions of the cuttings are filed in the office of the U.S. Geological Survey, Albuquerque, N. Mex. Generalized lithologic data from descriptions of cuttings are illustrated on one north-south and eight east-west geologic sections. A map of the base of valley fill presented here was used to construct thickness and saturated thickness maps. The thickness map supersedes a similar map presented by Morgan (1938).

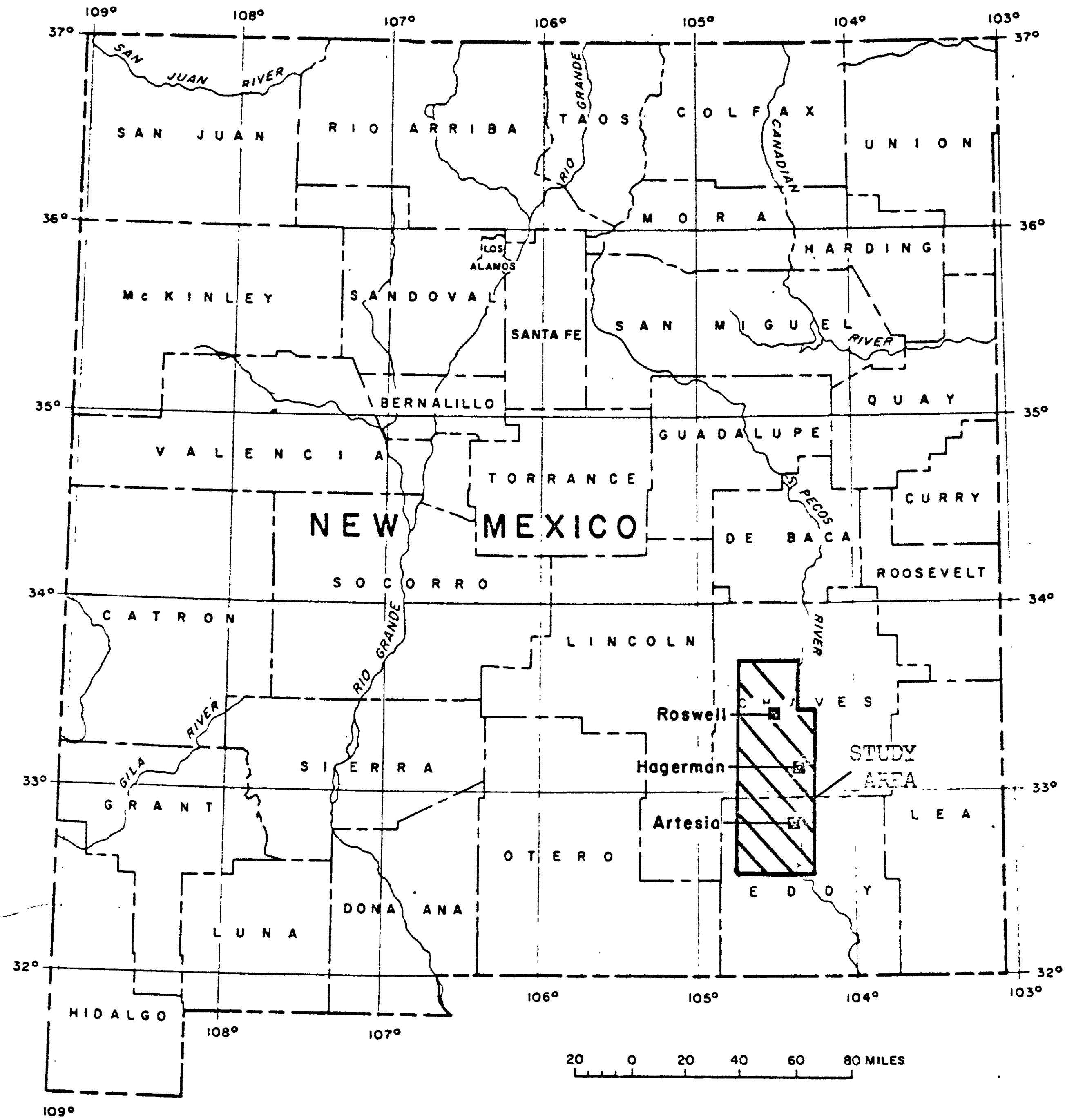

Figure 1.-- Location map.

Most of the drill cuttings described during this study were provided by the Roswell office of the New Mexico State Engineer. Several sets of cuttings were obtained from the sample library of the New Mexico State Bureau of Mines and Mineral Resources in Socorro, N. Mex., and several lithologic logs were made available by the Permian Basin Association, Inc., Roswell, N. Mex.

Well-numbering system

Wells shown on geologic sections in this report are designated with location numbers determined using a well-numbering system of the U.S. Geological Survey and New Mexico State Engineer. By this system, illustrated in figure 2, wells are given a three-digit designation following the township, range, and section number, which locates them within a 10-acre plot. If a well cannot be located accurately within a 10-acre plot, a zero is used as the third digit; if it cannot be located accurately within a 40-acre plot, zeros are used for both the second and third digits. All wells in the study area are in townships south of the principal base line and in ranges east of the principal meridian.

Numbers for wells located exactly in the center of a plot, which is common for oil and gas wells, have only one or two digits followed by the word "center."

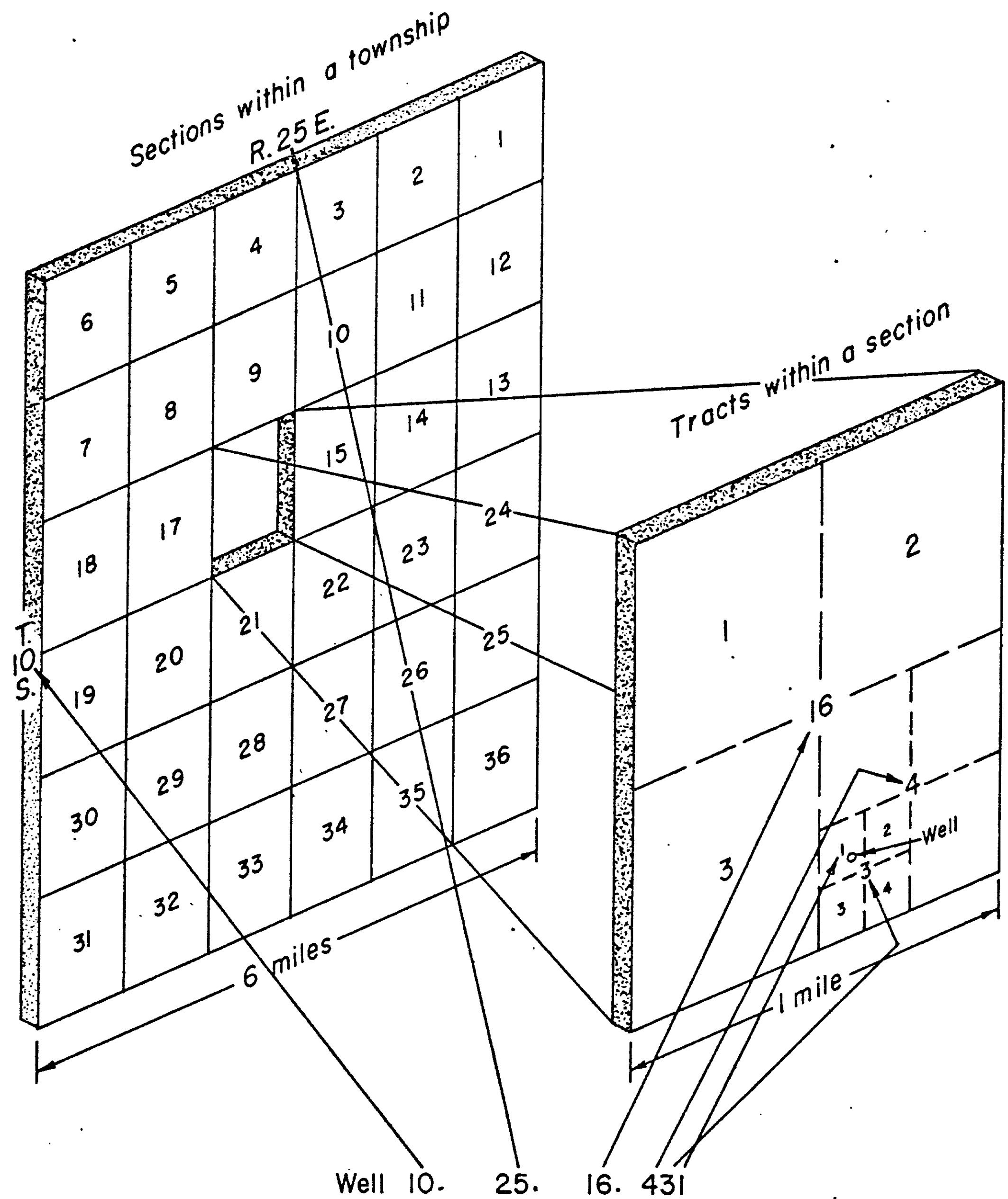

Figure 2.--Well-numbering system.

Lithology

The valley fill in the Roswell-Artesia area was deposited by streams in Pliocene(?), Pleistocene, and Holocene times on an eroded surface of eastward-dipping rocks of Permian age. These rocks include the San Andres Limestone and the Grayburg, Queen, and Seven Rivers Formations of the Artesia Group.

Three distinct units were observed in drill cuttings from the valley fill. These units are termed here quartzose, clay, and carbonate gravel.

Quartzose conglomerate of Pliocene(?), Pleistocene, and Holocene ages was first described by Fiedler and Nye (1933) and has received attention from other investigators (Morgan, 1938; Bretz and Horberg, 1949; and Kelley, 1971). The quartzose unit described here probably correlates for the most part with the quartzose conglomerate described by others. This unit apparently occurs throughout most of the study area and generally rests on Permian rocks. In general, the quartzose unit consists of fragments of sandstone, quartzite, quartz, chert, and igneous and carbonate rocks, but quartz and igneous rocks predominate. The particles range in size from medium grained (¼ mm) to pebble (16 mm) and commonly are cemented to various degrees of hardness by calcium carbonate. This unit crops out on the Rio Felix, on Walnut Creek, and in several stream and road cuts between the Rio Felix and the Chaves-Eddy County line. The quartzose unit, with thicknesses generally less than 250 feet, is the major water-bearing unit in the valley fill.

The quartzose unit in the vicinity of the Pecos River consists principally of medium to coarse, uncemented quartz grains. This may be a fairly recent river deposit that is much younger than the quartzose conglomerate observed in deeper valley-fill sediments. The similarity of the lithologies, however, precludes distinguishing the two in cuttings.

Silt and clay deposits of the clay unit are not continuous throughout the basin but occur as isolated lenses, generally overlying the quartzose unit. These deposits, which consist of light- to medium-gray silt and clay, probably were deposited in localized ponds and lakes resulting from solution and collapse of the underlying Permian rocks. Gastropod and pelecypod fossils and dark organic material were observed in a few samples taken from the clay unit. Silt and clay of this unit underlie a large area near Roswell.

The carbonate-gravel unit blankets other valley-fill units and forms a fairly uniform slope from the Permian outcrop area on the west to the Pecos River flood plain. This unit generally consists of coarse carbonate gravel along the major tributaries to the Pecos River such as the Rio Hondo, Rio Felix, and Rio Penasco. In interstream areas this unit contains much light-brown to pale-brown calcareous silt and thick beds or zones of caliche in addition to the carbonate gravel. Minor quantities of quartz and igneous sand and gravel are common in the unit; gravel near the Rio Hondo contains much igneous rock material. Carbonate-gravel lenses occur in the clay unit near Roswell.

The three valley-fill units and the position of the water table in 1969 are shown in eight east-west sections and one north-south section (figs. 3-11). Locations of the sections are shown on figure 12.

Figure 3.--Section A-A' showing the water table and the lithology of valley fill.

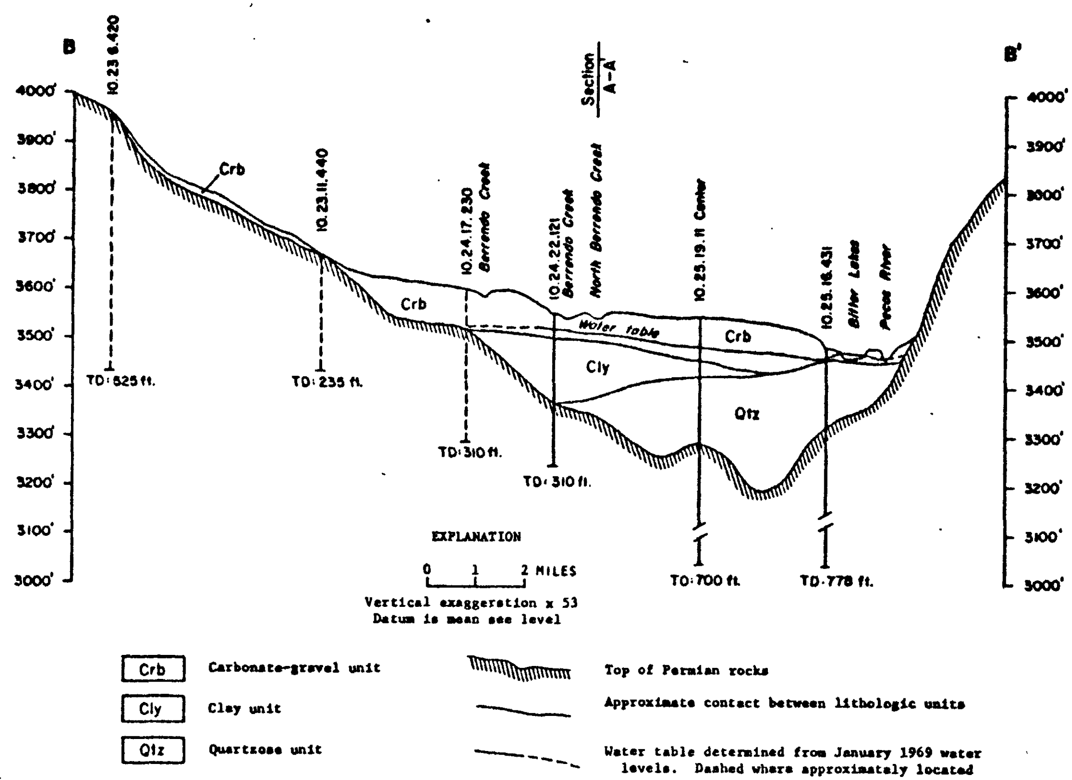

Figure 4.--Section B-B' showing the water table and the lithology of valley fill.

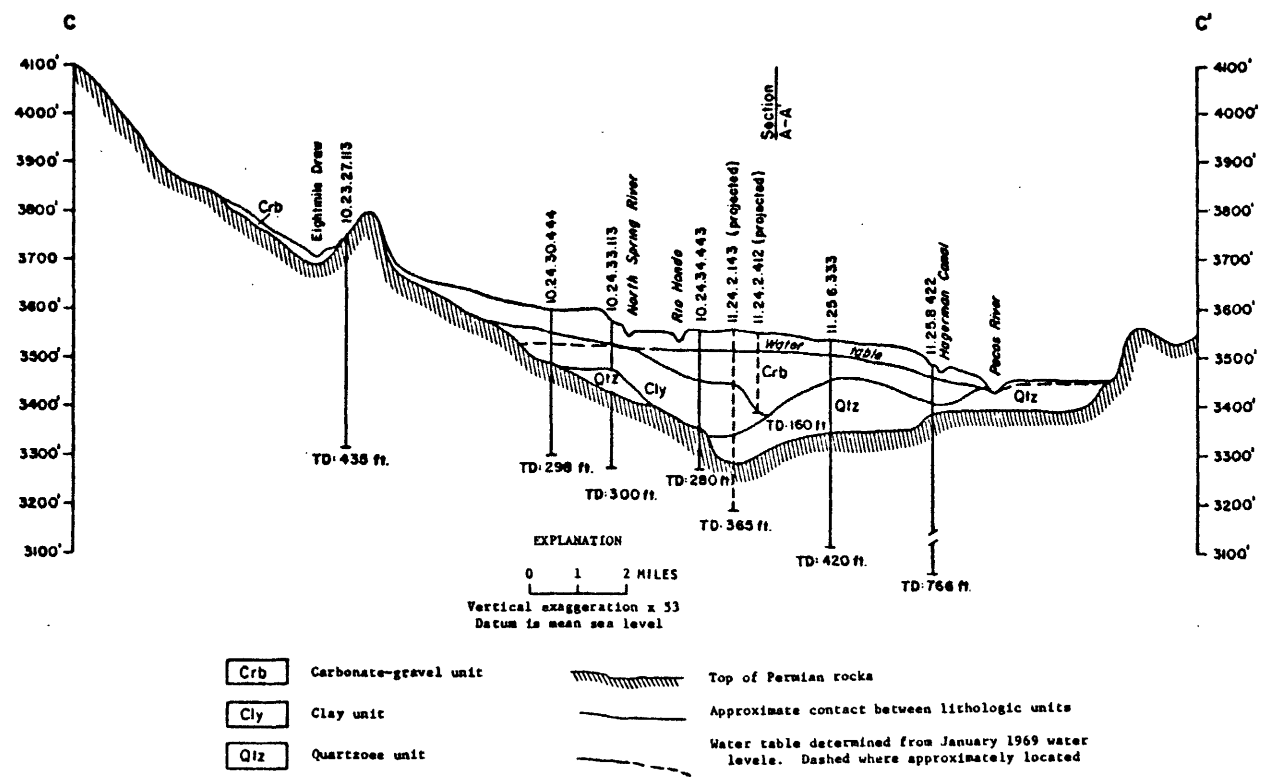

Figure 5.--Section C-C' showing the water table and the lithology of valley fill.

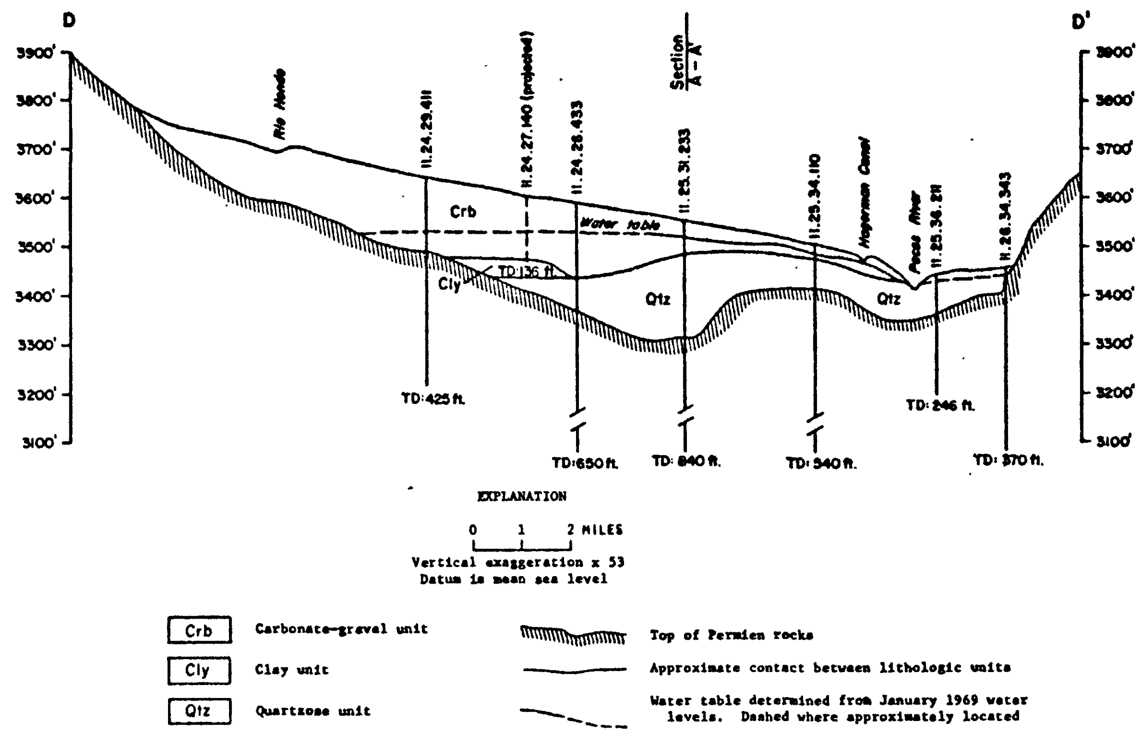

Figure 6.--Section D-D' showing the water table and the lithology of valley fill.

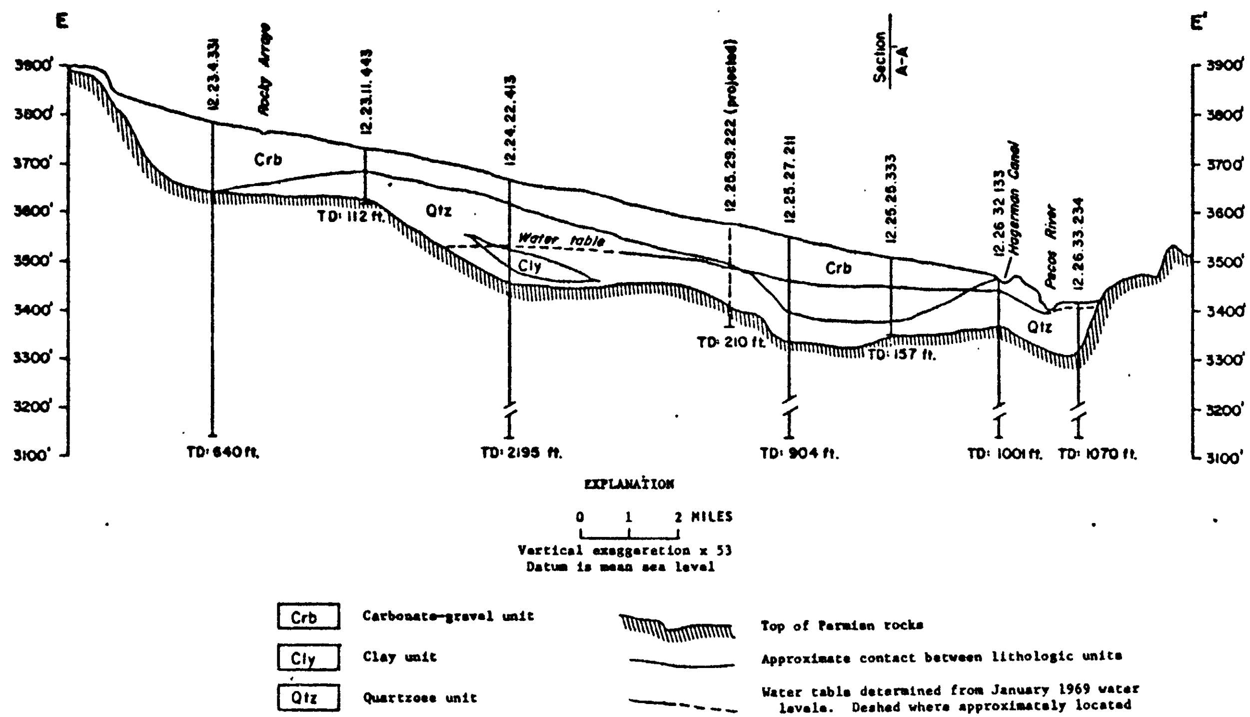

Figure 7.--Section E-E' showing the water table and the lithology of valley fill.

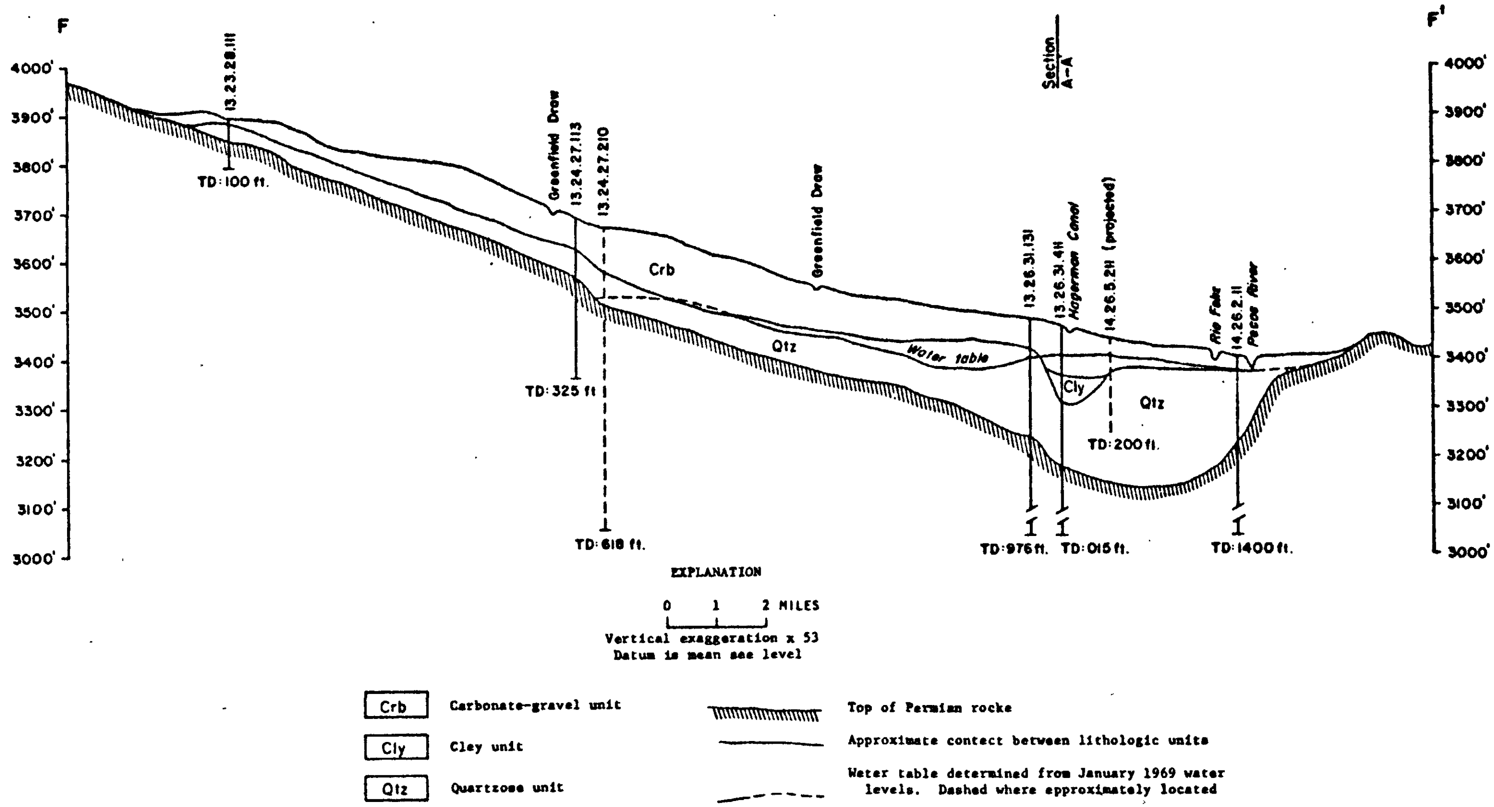

Figure 8.--Section F-F' showing the water table and the lithology of valley fill.

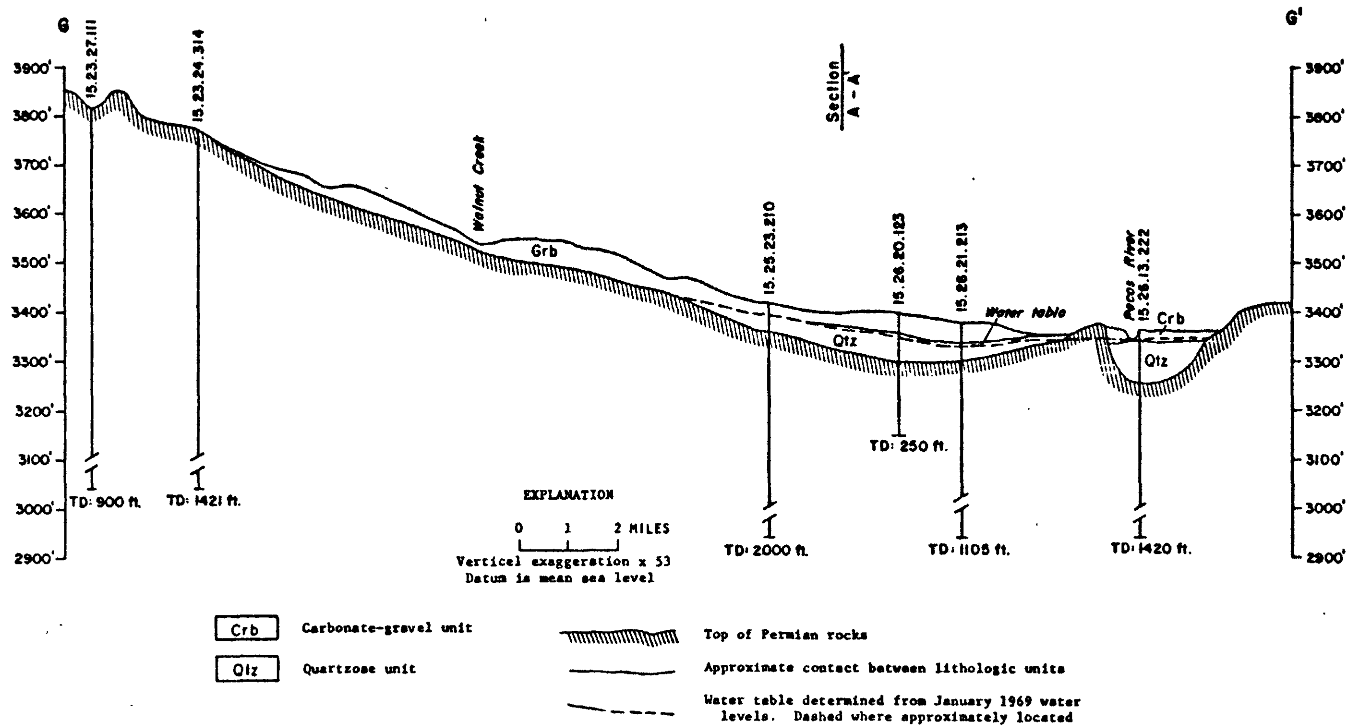

Figure 9.--Section G-G' showing the water table and the lithology of valley fill.

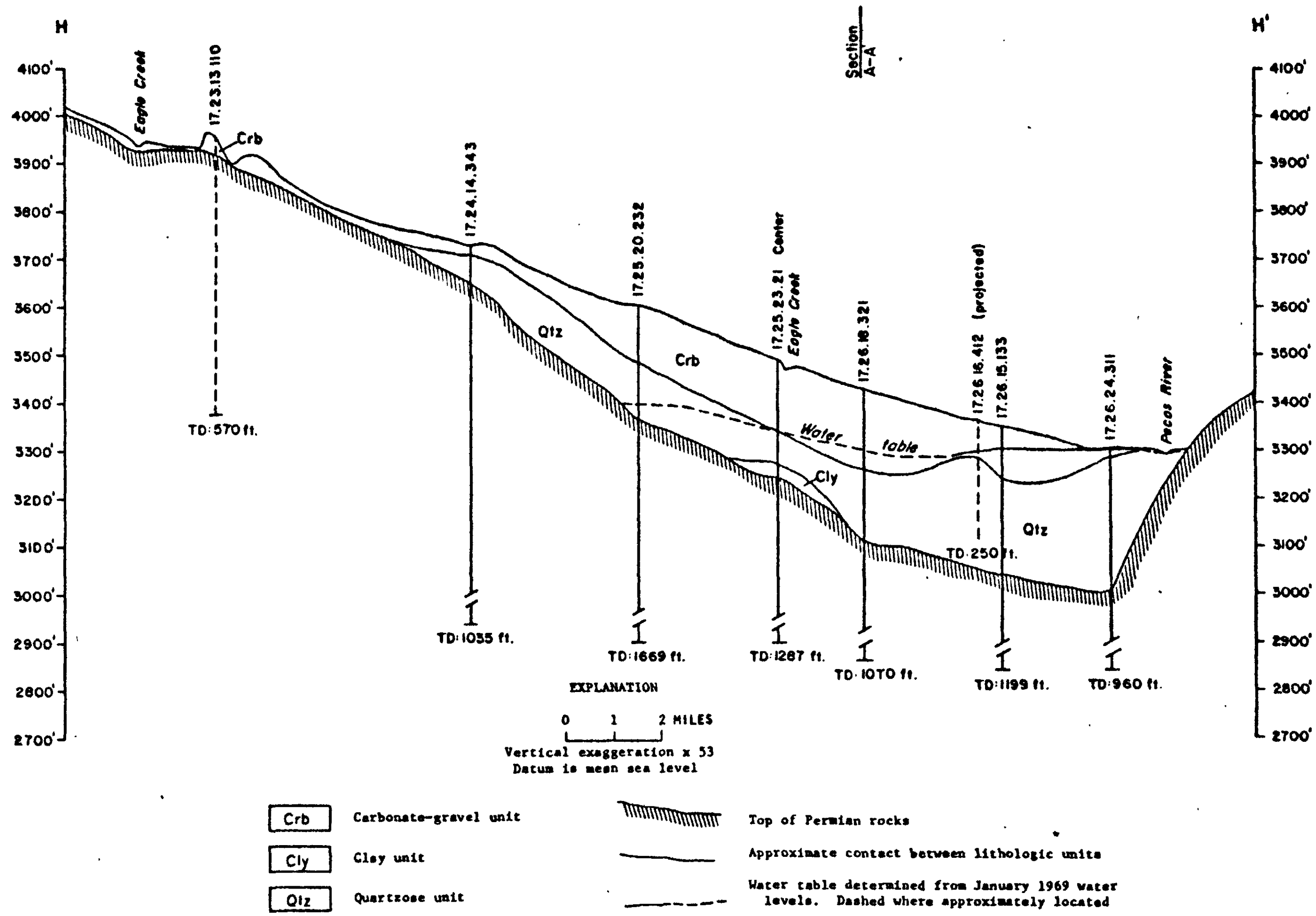

Figure 10.--Section H-H' showing the water table and the lithology of valley fill.

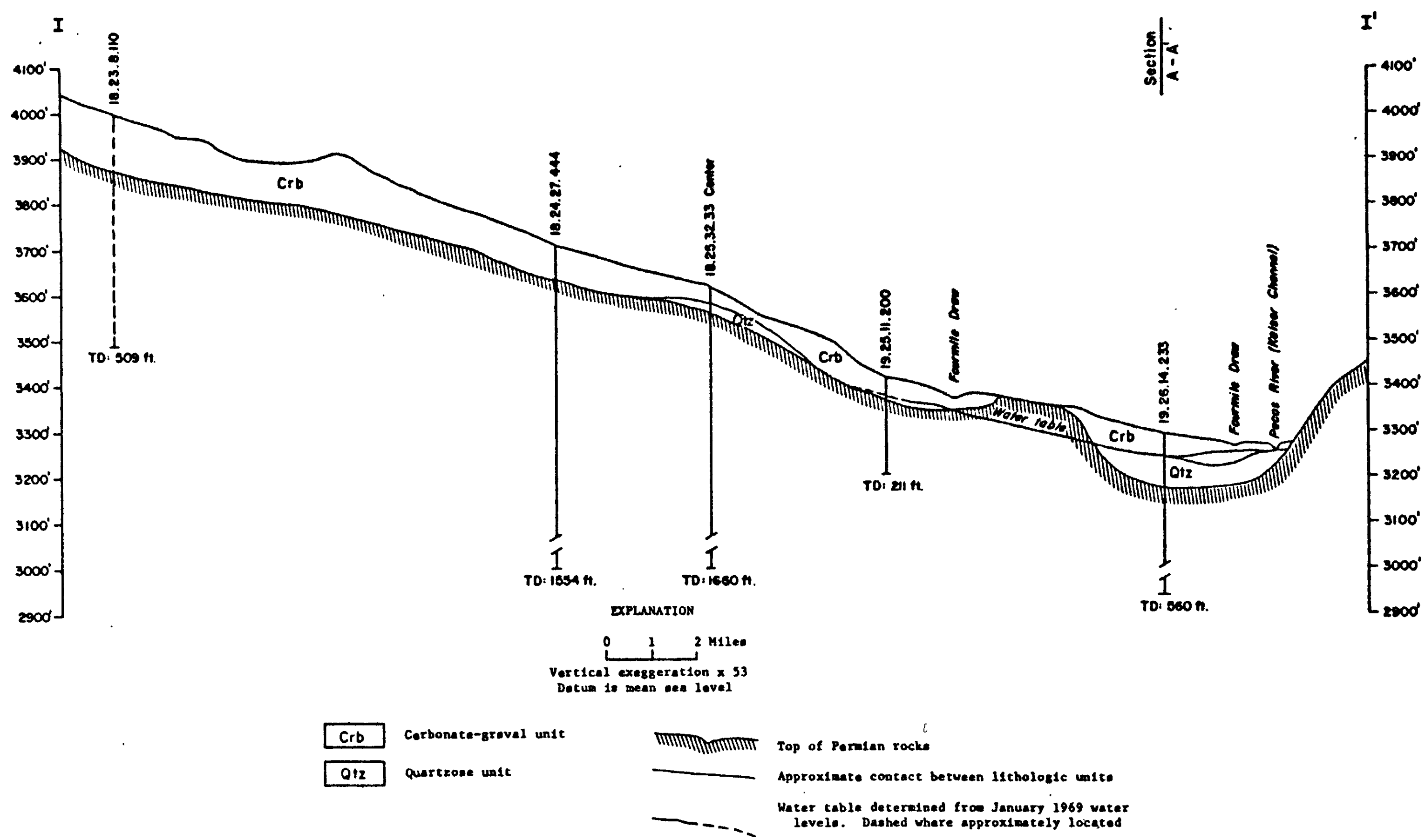

Figure 11.--Section I-I' showing the water table and the lithology of valley fill.

Thickness

A contour map showing the base of valley fill (fig. 12) was drawn using descriptions of cuttings from 171 wells that penetrated rocks of Permian age and from 54 wells that did not reach Permian rocks. The depths and altitudes of the depths of wells that did not penetrate Permian rocks are shown on figure 12 to indicate the maximum possible altitudes at these points. Drill cuttings from the valley fill were not collected in four of the deeper wells. Depths and altitudes of the first samples in these deeper wells are shown to indicate the minimum possible altitude of Permian rocks at these points.

The contour map (fig. 12) shows several closed depressions on the Permian rock surface. The depressions apparently resulted from the solution and collapse of underlying rocks. It should be noted that gypsum is generally absent in the upper 50 feet or more of Permian rocks under areas with large depressions though it is present in adjacent areas, particularly to the east; probably the gypsum has been removed by solution.

Figure 13 shows the thickness of valley-fill sediments in the Roswell-Artesia area. This map was drawn by overlaying a topographic contour map on the map showing the base of valley fill (fig. 12). Thicknesses were determined at points where contours of the two maps intersected. Thicknesses of 300 feet occur in closed depressions near Hagerman, Artesia, and Roswell. Figure 13 differs significantly from Morgan's (1938) thickness map, drawn mainly from data in drillers' logs, which showed valley-fill thicknesses of 200 feet or more but no closed depressions.

Saturated thickness

The saturated-thickness map of the valley fill (fig. 14) was drawn by placing a 1969 water-level map of the "shallow aquifer" (Welder, 1971) on the base of valley-fill map (fig. 3). Thicknesses were determined at points where contours on the two maps intersected.

The term "shallow aquifer" is used by the New Mexico State Engineer Office in the administration of water rights. For the most part, the "shallow aquifer" consists of the valley fill as described in this report though some "shallow" wells may partly penetrate Permian rocks.

Maximum saturated thicknesses are about 250 feet in the closed depressions near Hagerman and Artesia, and about 300 feet in a depression near Roswell.

No 1969 water-level data are available for wells completed in valley fill in the Arroyo del Macho area at the north end of the study area. Historical water-level data from a few wells show that saturated thickness generally is less than 50 feet in this area.

Summary

Three distinguishable units of valley fill in the Roswell-Artesia segment of the Pecos Valley are: (1) Quartzose sand and gravel that generally rests on Permian rock and is composed mainly of quartz and igneous rock particles; (2) clay composed of light- to medium-gray silty clay with scattered gastropod and pelecypod fossils and small amounts of organic matter; and (3) carbonate gravel fill that generally blankets other valley-fill sediments and is composed of carbonate gravel with interbedded silt, clay, and caliche. The quartzose unit is the principal water-bearing unit of the valley fill.

Large depressions, which resulted from the solution of Permian age carbonates and evaporites, are important features of the surface of Permian rocks beneath younger valley fill.

Maximum saturated thicknesses of the valley fill are about 250 feet in depressions near Hagerman and Artesia, and about 300 feet in a depression near Roswell.

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FIGURE 12.--MAP SHOWING CONFIGURATION OF THE BASE OF THE VALLEY FILL, ROSWELL-ARTESIA AREA, NEW MEXICO

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U.S. Geological Survey
1962 and Carlsbad, 1954
Scale 1:250,000

0 1 2 3 4 5 MILES

Compiled by F.P. Lyford, 1973

FIGURE 13.--MAP SHOWING THICKNESS OF THE VALLEY FILL, ROSWELL-ARTESIA AREA, NEW MEXICO

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Base from U.S. Geological Survey
Roswell, 1962 and Carlsbad, 1954
Scale 1:250,000

0 1 2 3 4 5 MILES

Compiled by F.P. Lyford, 1973

FIGURE 14.--MAP SHOWING SATURATED THICKNESS OF THE VALLEY FILL DURING JANUARY 1969, ROSWELL-ARTESIA AREA, NEW MEXICO