ABSTRACT

The hydrogeologic characteristics of the alluvial aquifer in and adjacent to the Rocky Mountain Arsenal, Colo. are described on four maps that show the configuration of the bedrock surface, generalized water-table configuration, saturated thickness of alluvium, and transmissivity of the aquifer. The maps provide data needed to compute the rate and direction of ground-water movement. The alluvium forms a complex, nonuniform, sloping, discontinuous, and heterogeneous aquifer system.

INTRODUCTION

Ground-water contamination in the vicinity of the Rocky Mountain Arsenal, near Denver, Colo., is related to the disposal of liquid industrial wastes into ponds (Petri, 1961; Walker, 1961; and Walton, 1961). The movement of contaminants away from the ponds or other possible sources is partly controlled by the rates and directions of ground-water flow within the shallow alluvial aquifer that underlies most of the area. The rate and direction of ground-water flow, in turn, is controlled by the hydraulic gradient, transmissivity, and boundary conditions of the aquifer. Thus, the calculation of rates of movement and flow paths followed by contaminants in the aquifer can only be accomplished if the hydrogeologic characteristics of the aquifer are known in detail.

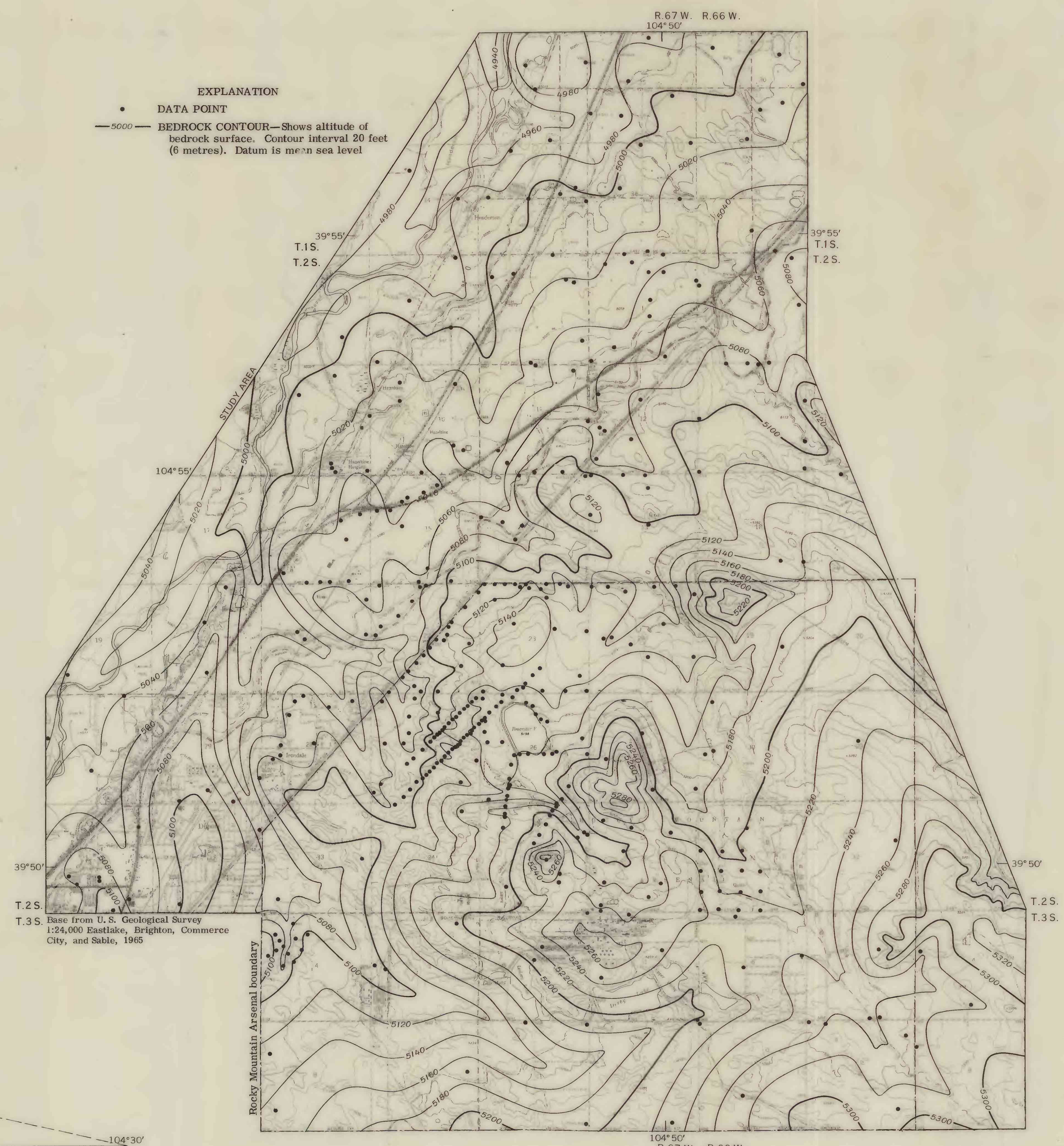
The purpose of this report is to present maps that depict the detailed variations in the hydrogeologic properties of the alluvial aquifer in an area of 63 mi^2 (163 km^2) in and adjacent to the Rocky Mountain Arsenal. Included are four maps that show (1) the configuration of the bedrock surface beneath the alluvial aquifer, (2) the general water-table configuration in the alluvial aquifer, (3) the saturated thickness of the alluvial aquifer, and (4) the transmissivity of the alluvial aquifer. These data provide a basis for making quantitative predictions of both ground-water flow and the movement of contaminants in this aquifer.

The maps were constructed from a compilation and reinterpretation of existing data; a listing of all sources of data follow. Accompanying each map is a short explanation of the methods used to construct it.

The cooperation of the U. S. Army is gratefully acknowledged. Mr. Eugene R. Hampton of the U. S. Geological Survey assisted in the preparation of several maps.

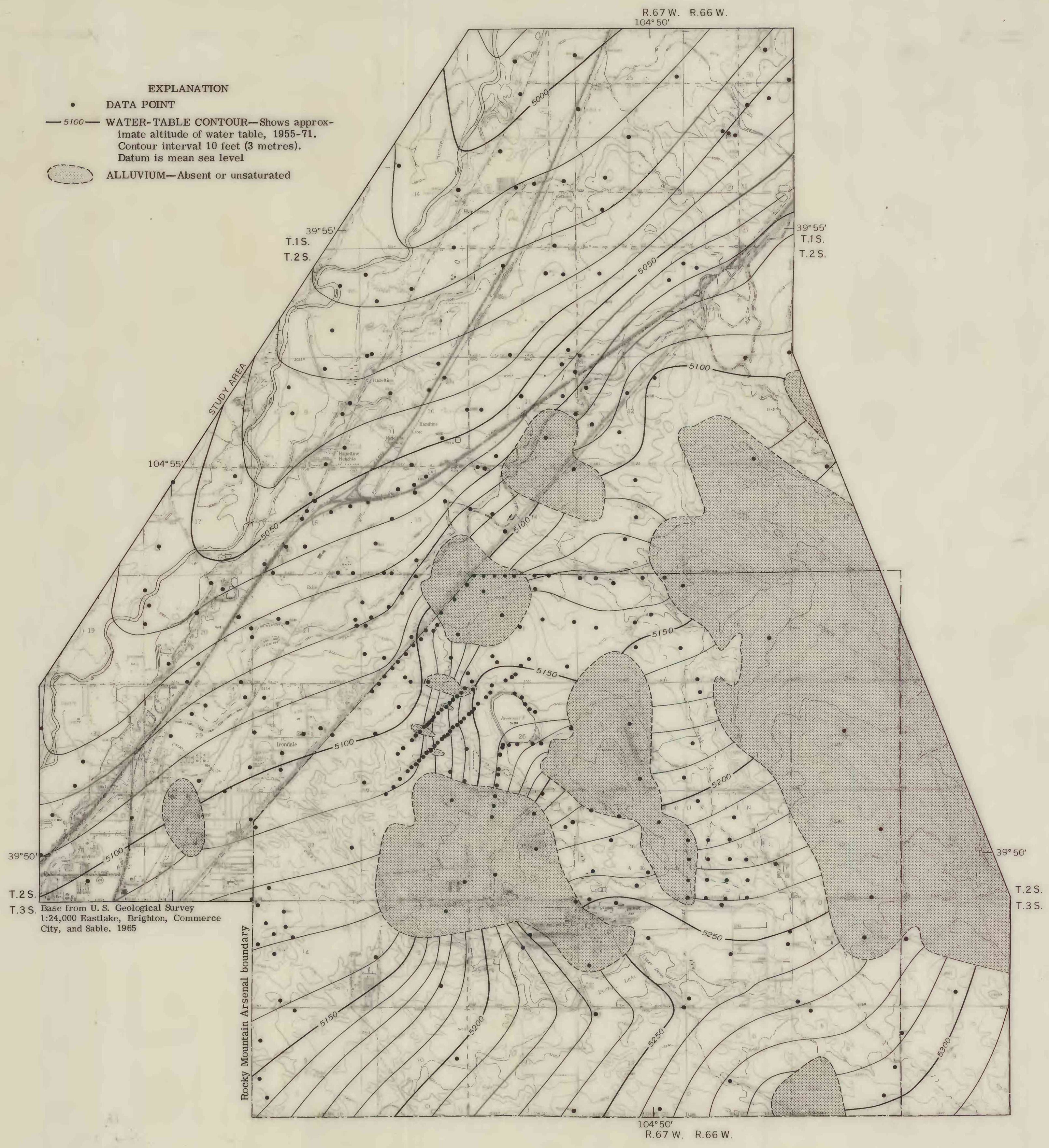
English units used in this report may be converted to metric units by the following conversion factors:

From	Multiply by	To obtain
Feet (ft)	0.3048	metres (m)
Feet squared per day (ft^2/d)	0.0929	metres squared per day (m^2/d)
Square miles (mi^2)	2.590	square kilometres (km^2)



BEDROCK SURFACE

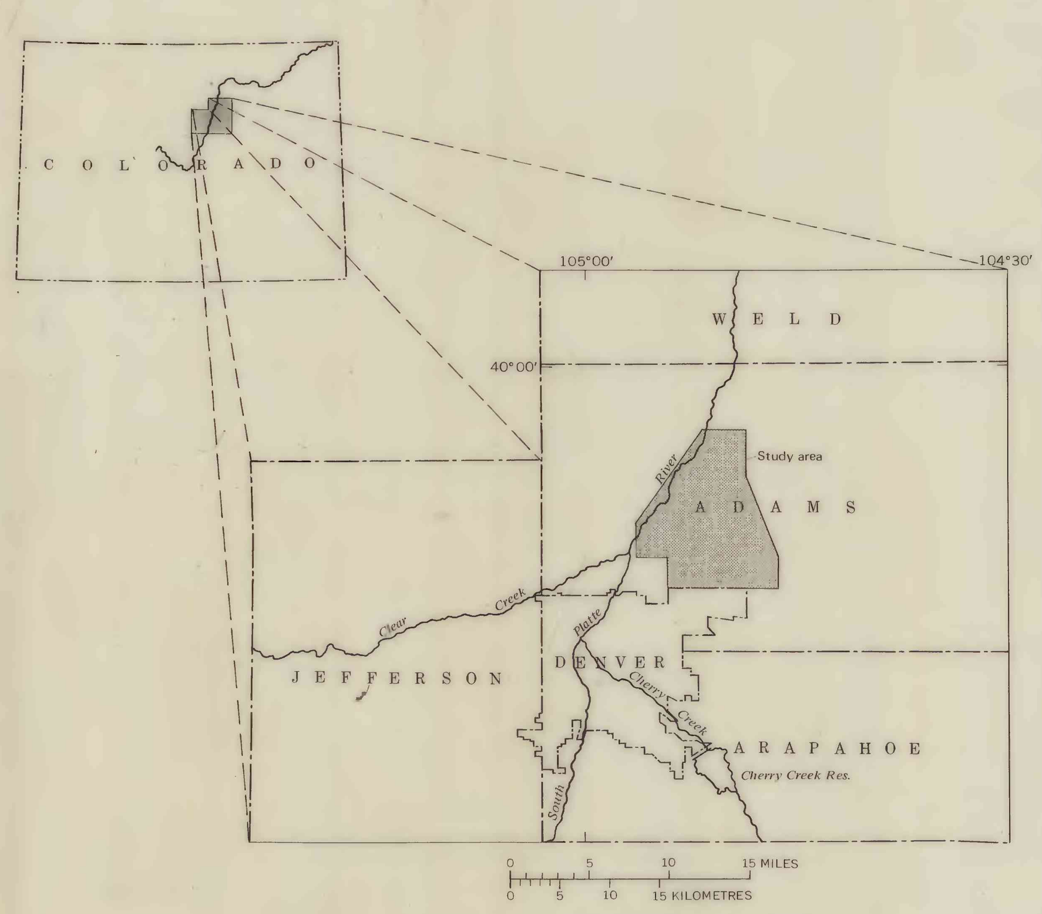
The altitudes of the bedrock surface for data points shown on this map were determined from lithologic logs. The actual bedrock surface is undoubtedly more complexly eroded than depicted. The density of control points indicates the accuracy with which major bedrock highs and buried valleys are located.



WATER TABLE

The water-table configuration shown in the above map was contoured from water-level measurements made between 1955 and 1971. Because the measurements in different wells were made at different times over a period of years, a numerical dispersion of several feet is introduced into the data primarily due to the indeterminate effects of time-varying ground-water recharge and discharge during the period. Futhermore, land-surface altitudes at many wells were determined from topographic maps with a 10-ft (3-m) contour interval, rather than from a field survey, thereby introducing a possible error of several feet. Because of these considerations, in areas where conflicting data existed, water-table contours were located on the basis of an areal average. Thus, it follows that some individual data points may not necessarily agree in value with an interpolation between adjacent contours. Supplemental control for contours in parts of the study area was provided by the land-surface altitude, which was considered an upper limit for the water table. Conversely, the bedrock surface represented a lower limit for the water table in the alluvial aquifer. Comparison of water-table and bedrock altitudes indicated that about 20 percent of the study area is underlain by areas in which the alluvium either is absent or is unsaturated most of the time. These areas are enclosed by the dashed lines that represent the approximate limit of saturated alluvium.

The general direction of ground-water movement is from regions of higher water-table altitudes to lower water-table altitudes and approximately perpendicular to the water-table contours. Deviations from the general flow pattern may occur in some areas because of local variations in aquifer properties, recharge, or discharge. The rate of ground-water flow will be proportional to the hydraulic gradient, which can be computed from the spacing between adjacent contours. Several anomalous areas on the water-table map are not attributed to errors in the data. These indicate that the approximate limit of saturated alluvium does not consistently represent a no-flow boundary, but rather that at some places there may be significant flow across this line. Such a condition can readily occur in areas where the bedrock possesses porosity and hydraulic conductivity properties comparable to the alluvium, or where recharge from irrigation, unlined canals, or other sources is concentrated.



LOCATION OF STUDY AREA IN COLORADO

REFERENCES CITED

Petri, L. R., 1961, The movement of saline ground water in the vicinity of Derby, Colorado: *in* Ground Water Contamination Symposium: Robert A. Taft Sanitary Eng. Center Tech. Rept. W61-5, pp. 119-121.

Walker, T. R., 1961, Ground-water contamination in the Rocky Mountain Arsenal area, Denver, Colorado: Geol. Soc. America Bull., v. 72, p. 489-494.

Walton, G., 1961, Public health aspects of the contamination of ground water in the vicinity of Derby, Colorado, *in* Ground Water Contamination Symposium: Robert A. Taft Sanitary Eng. Center Tech. Rept. W61-5, p. 121-125.

SOURCES OF DATA

Finch, W. C., and Mathews, R. D., 1971, Hydro-geological investigation of waste water evaporation pond site: Houston, Tex., Shell Oil Company, 12 p.

Hurr, R. T., Schneider, P. A., Jr., and others, 1972, Hydrogeologic characteristics of the valley-fill aquifer in the Brighton reach of the South Platte River valley, Colorado: U. S. Geol. Survey open-file report, 2 p., 5 pls., 1 fig.

McConaghy, J. A., Chase, G. H., Boettcher, A. J., and Major, T. J., 1964, Hydrogeologic data of the Denver Basin, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 15, 224 p.

Petri, L. R., and Smith, R. O., 1956, Investigation of the quality of ground water in the vicinity of Derby, Colorado: U. S. Geol. Survey open-file report, 77 p.

Schneider, P. A., Jr., 1962, Records of logs and selected wells and test holes, and chemical analyses of ground water in the South Platte River basin in western Adams and southwestern Weld Counties, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 9, 84 p.

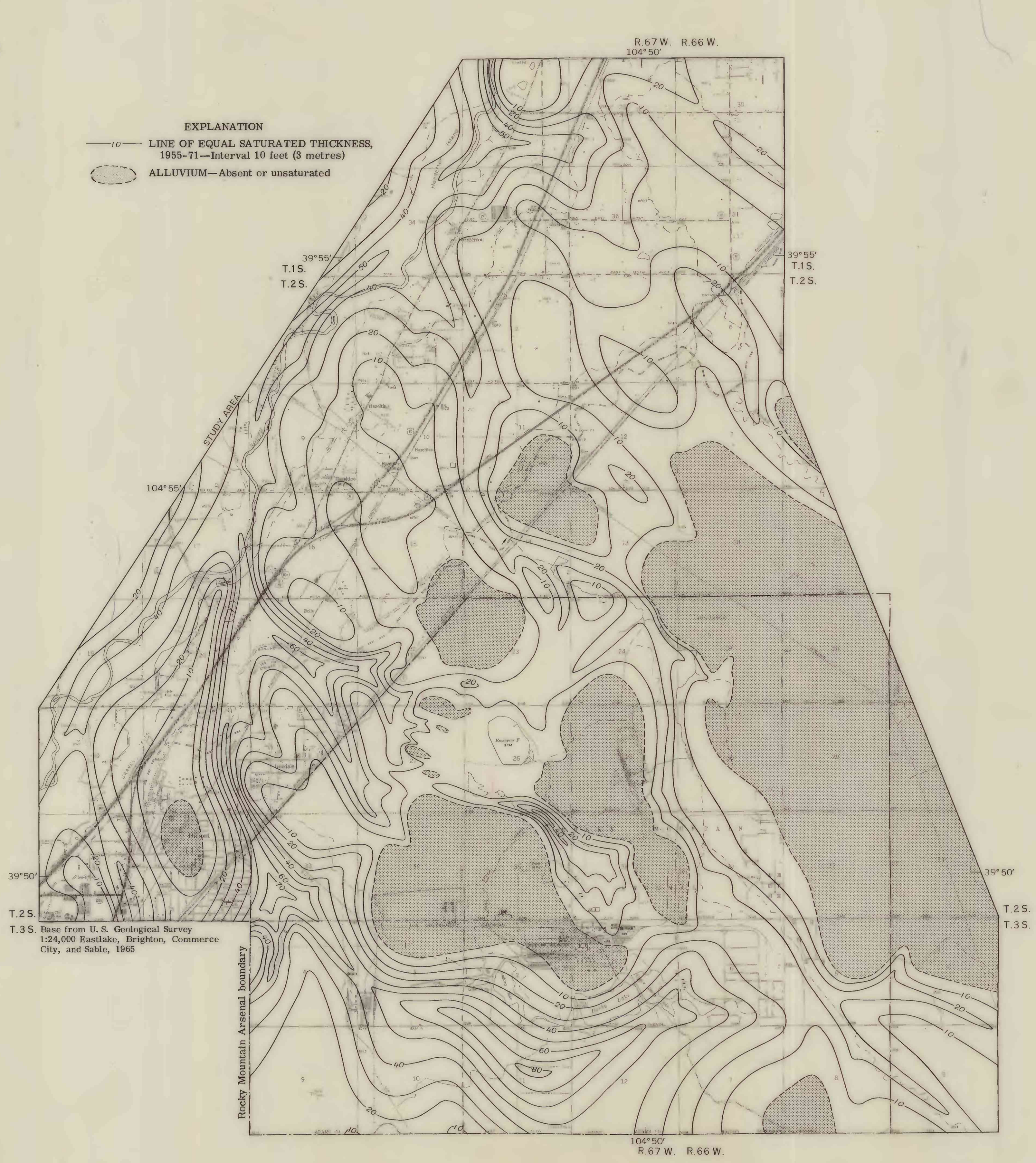
Smith, R. O., Schneider, P. A., Jr., and Petri, L. R., 1964, Ground-water resources of the South Platte River basin in western Adams and southwestern Weld counties, Colorado: U. S. Geol. Survey Water-Supply Paper 1658, 132 p.

U. S. Army Corps of Engineers, 1953, Report on water supply investigation, Rocky Mountain Arsenal, Denver, Colorado: Omaha, Nebr., U. S. Army Corps of Engineers, 11 p.

_____Unpublished logs of test holes and observation wells.

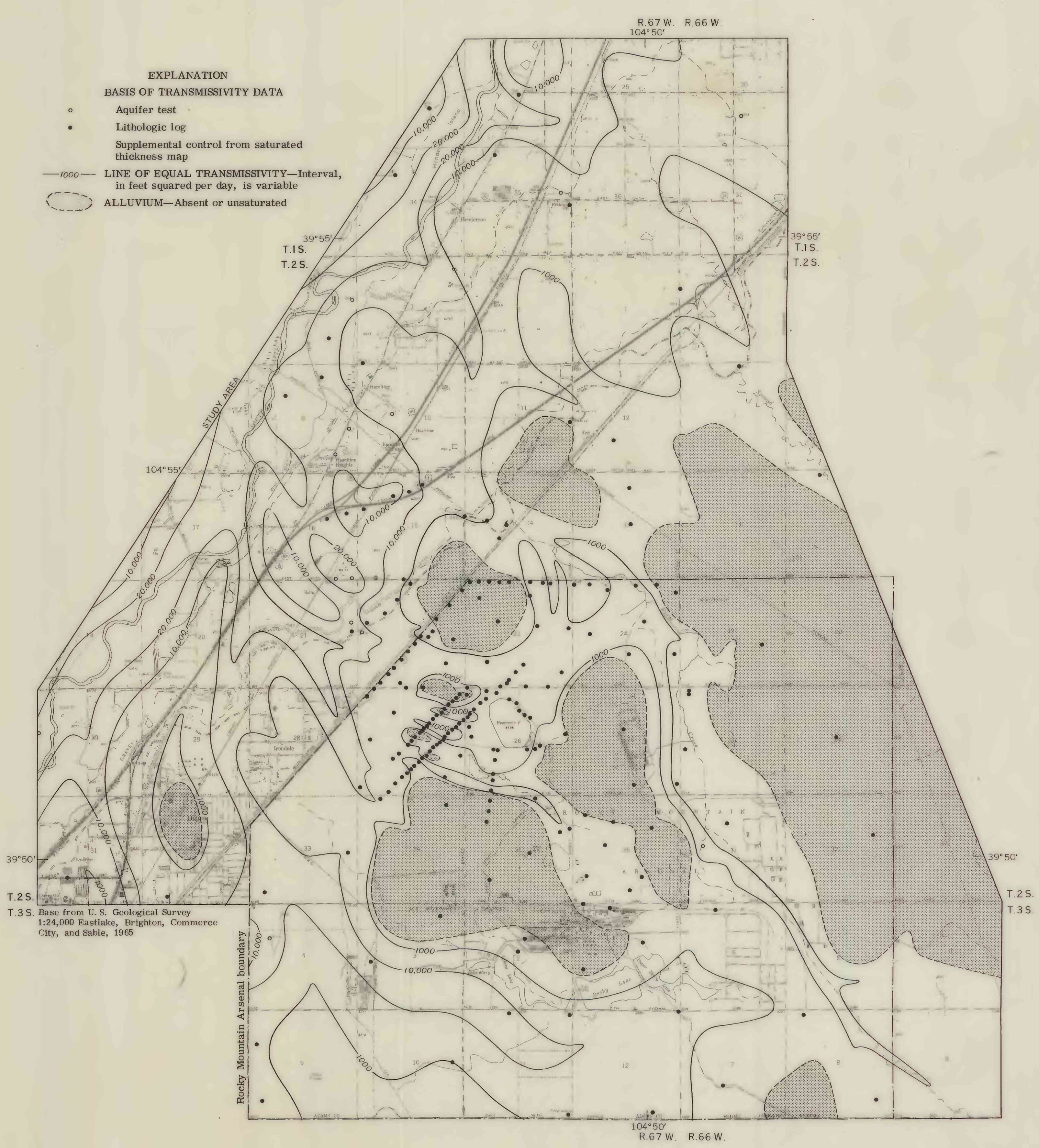
U. S. Geological Survey, Unpublished records of wells in the files of the Colorado District office, Water Resources Division, Lakewood, Colo.

Wilson, W. W., 1965, Pumping tests in Colorado: Colorado Water Conserv. Board Water-Resources Circ. 11. 361 p.



SATURATED THICKNESS

The saturated thickness of the alluvial aquifer is shown in the above map. The lines of equal saturated thickness were plotted by measuring the difference between the water-table altitude and the altitude of the bedrock surface throughout the study area. Because the water-table altitude may change over time, so will the saturated thickness. Zero saturated thickness will correspond with the dashed line representing the approximate limit of saturated alluvium.



TRANSMISSIVITY

The average rate of ground-water flow at a point is proportional to the transmissivity of the aquifer, and estimates of transmissivity were made for wells for which detailed lithologic logs were available. Although these estimates, made by relating hydraulic conductivity to grain size, are admittedly crude, the resulting contours reflect a pattern of transmissivity variations that are consistent with both the recent geological history of the area and the areal variations in hydraulic gradient of the water table. Where values from aquifer tests were also available, the two values were usually within 20 percent of each other. Because transmissivity equals the product of hydraulic conductivity and saturated thickness, interpolation and extrapolation from data points were aided by supplemental control from the saturated thickness map.

HYDROGEOLOGIC MAPS OF THE ALLUVIAL AQUIFER IN AND ADJACENT TO THE ROCKY MOUNTAIN ARSENAL, COLORADO

By
Leonard F. Konikow

1975

☆ GPO 679-964