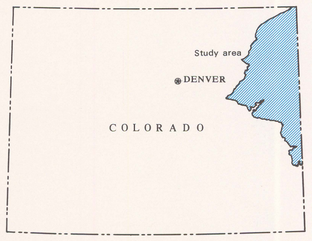
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
CENTRAL YUMA, FRENCHMAN, MARKS BUTTE, AND SANDHILLS
GROUND WATER MANAGEMENT DISTRICTS
AND THE COLORADO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RESOURCES
OFFICE OF THE STATE ENGINEER

WATER-RESOURCES INVESTIGATIONS 79–54



INTRODUCTION

The northern High Plains of Colorado, an area of about 9,500 mi^2 in the eastern part of the State (index map), is underlain by the Ogallala Formation of late Tertiary age. The northern High Plains of Colorado extend from the Colorado State line on the east to the edge of the Ogallala Formation on the north, west, and south. The Ogallala Formation is an unconsolidated or partly consolidated deposit of sand, gravel, clay, silt, and caliche of late Tertiary age, and is the major aquifer in the northern High Plains.

The Ogallala Formation is the major source of irrigation water in much of the northern High Plains. Information about the altitude and configuration of the water table and depth to water is necessary for the knowledgeable development and management of the ground-water resource.

Annual water-level records for the northern High Plains of Colorado are collected by the U.S. Geological Survey in cooperation with the Colorado Department of Natural Resources, Division of Water Resources, Office of the State Engineer. Measurements are made in the winter, when water levels generally have recovered from pumping during the previous irrigation season. The maps showing altitude and configuration of the water table and the depth to water were drawn using water-level measurements from the wells shown, the altitude and shape of the land surface, and the altitude of water in perennial streams.

This report was prepared in cooperation with the Central Yuma, Frenchman, Marks Butte, and Sandhills Ground Water Management Districts, and the Colorado Department of Natural Resources, Division of Water Resources, Office of the State Engineer.

ALTITUDE AND CONFIGURATION OF THE WATER TABLE

The altitude of the water table ranges from a high of about 5,700 ft along the most western extent of the Ogallala Formation to a low of about 3,400 ft along the Colorado State line in east-central Yuma County and northeastern Sedgwick County. Ground water moves at right angles to the water-table contours from higher altitudes in the western part of the northern High Plains to lower altitudes in the east.

The configuration of the water table is governed by aquifer properties, the rate of ground-water recharge and discharge, and the shape of the bedrock surface. The water-table altitude contours in the eastern part of the northern High Plains are more widely spaced than in the western part because of the generally larger transmissivities of the Ogallala Formation in the east. Eastward, or downgradient, bends in the water-table contours near Cope in Washington County indicate relatively large rates of recharge along the intermittent reaches of the Arikaree River. Similarly, downgradient bends in the contours in northeastern Yuma County indicate relatively large rates of recharge in the sandhills north of Wray. Westward, or upgradient, bends in the water-table contours along the North and South Forks of the Republican River and the Arikaree River indicate ground-water discharge from the Ogallala Formation to the perennial reaches of these rivers.

DEPTH TO WATER

The depth to water in the northern High Plains of Colorado ranges from less than 50 ft in several stream valleys in northeastern Yuma County north of Wray and near Towner in Kiowa County, to between 300 and 350 ft in part of Sedgwick County and in two small areas south of Otis in Washington County. Much of the northern High Plains has a depth to water of between 100 and 250 ft.

SELECTED REFERENCES

Boettcher, A. J., 1966 [1967], Ground-water development of the High Plains of Colorado: U.S. Geological Survey Water-Supply Paper 1819-I, p. I1-I22.

Borman, R. G., 1978, Water-level records for the northern High Plains of Colorado, 1974-78: Lakewood, Colo., U.S. Geological Survey Open-File Report 78-499, 31 p.

Borman, R. G., and Major, T. J., 1977, Water-level changes in the northern High Plains of Colorado, 1964 to 1976 and 1972 to 1976: Lakewood, Colo., U.S. Geological Survey Water-Resources Investigations 77-42, map, scale 1:500,000.

Ellis, M. J., and Pederson, D. T., 1978, Groundwater levels in Nebraska 1977: Nebraska Water Supply Paper 45, 96 p.

Hofstra, W. E., and Luckey, R. R., 1973, Water-level records, 1969-73, and hydrogeologic data for the northern High Plains of Colorado: Colorado Water Conservation Board Water-Resources Basic-Data Release 28, 52 p.

Hofstra, W. E., Major, T. J., and Luckey, R. R., 1972, Hydrogeologic data for the northern High Plains of Colorado: Colorado Water Conservation Board Water-Resources Basic-Data Release 23, 143 p.

Kapple, G. W., Luckey, R. R., and Hofstra, W. E., 1976, Digital ground-water model of the Ogallala aquifer in parts of Washington and Yuma Counties, northern High Plains of Colorado: Colorado Water Conservation Board Water-Resources Circular 34, 25 p.

———1977, Digital ground-water model of the Ogallala aquifer in parts of Cheyenne and Kiowa Counties, northern High Plains of Colorado: Colorado Water Conservation Board Water-Resources Circular 35, 20 p.

Lappala, E. G., 1978, Quantitative hydrogeology of the Upper Republican Natural Resources District, southwest Nebraska: U.S. Geological Survey Water-Resources Investigations 78-38, 200 p.

Luckey, R. R., and Hofstra, W. E., 1973, Digital model of the hydrologic system, northern High Plains of Colorado--A preliminary report: Colorado Water Conservation Board Water-Resources Circular 19, 40 p.

———1974, Digital model of the Ogallala aquifer of the northern part of the northern High Plains of Colorado: Colorado Water Conservation Board Water-Resources Circular 24, 22 p.

McGovern, H. E., 1964, Geology and ground-water resources of Washington County, Colorado: U.S. Geological Survey Water-Supply Paper 1777, 46 p.

Pabst, M. E., 1978, January 1978 water levels, and data related to water-level changes since 1940 or 1950, western Kansas: Lawrence, Kans., U.S. Geological Survey Open-File Report 78-409, 179 p.

Pabst, M. E., and Gutentage, E. D., 1977, Water-level changes in west-central Kansas, 1950-77: Kansas Geological Survey Journal, October 1977, 18 p.

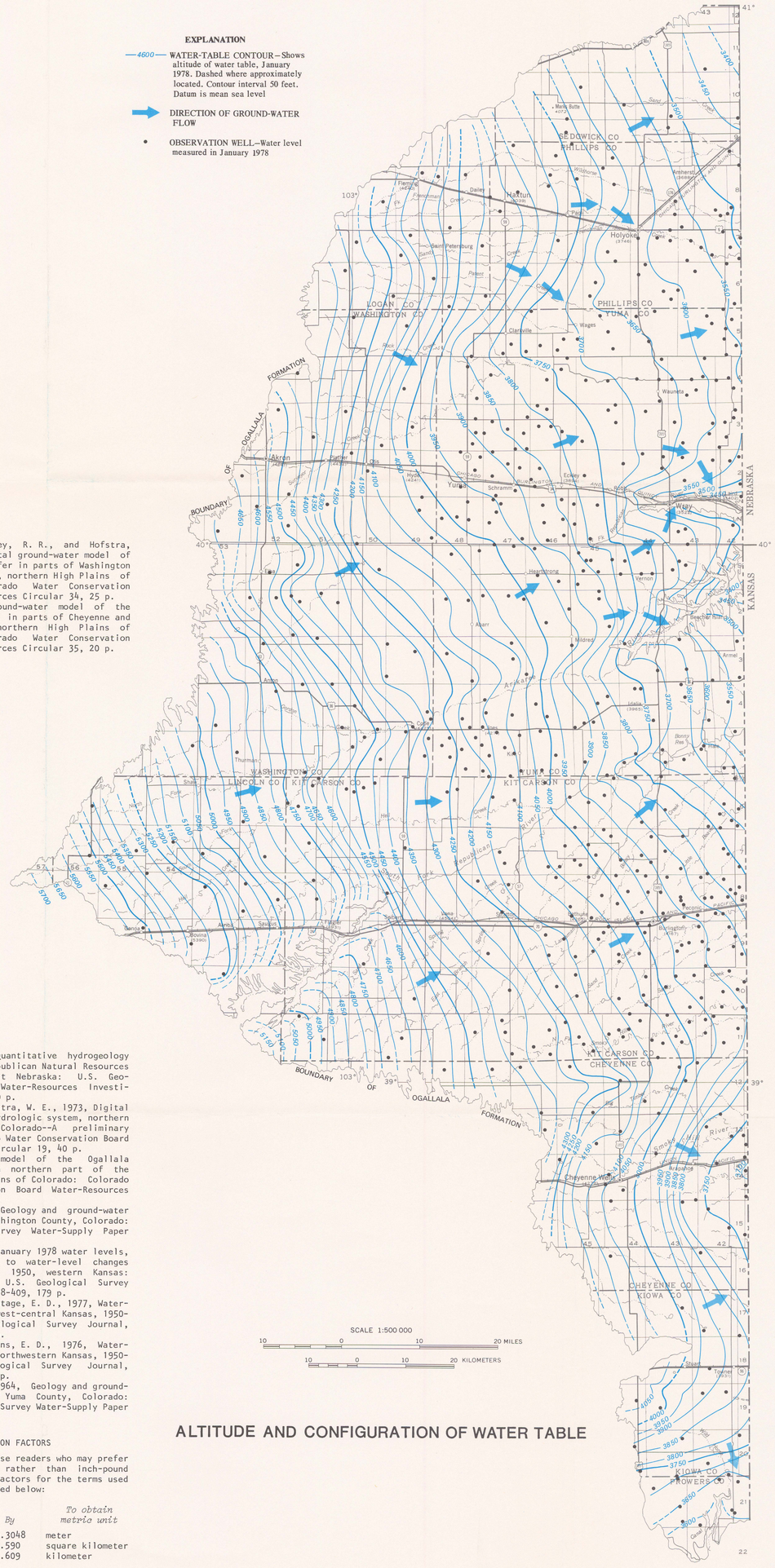
Pabst, M. E., and Jenkins, E. D., 1976, Water-level changes in northwestern Kansas, 1950-76: Kansas Geological Survey Journal, December 1976, 20 p.

Weist, W. G., Jr., 1964, Geology and ground-water resources of Yuma County, Colorado: U.S. Geological Survey Water-Supply Paper 1539-J, p. J1-J56.

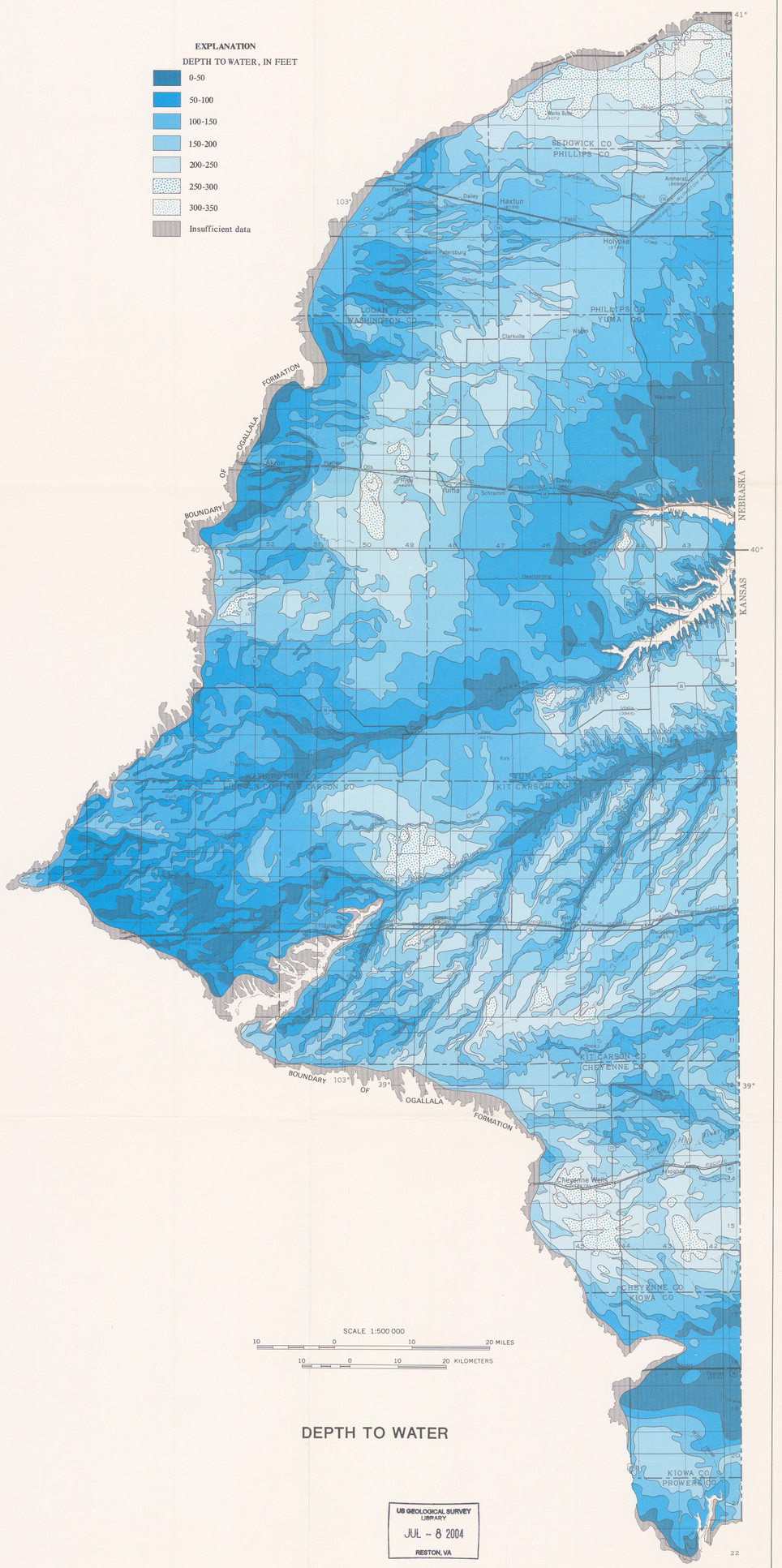
CONVERSION FACTORS

For the use of those readers who may prefer to use metric units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound unit	*By*	*To obtain metric unit*
foot (ft)	0.3048	meter
square mile (mi^2)	2.590	square kilometer
mile (mi)	1.609	kilometer



ALTITUDE AND CONFIGURATION OF WATER TABLE



DEPTH TO WATER

Base from U.S.Geological Survey
State base map, 1969

OPEN-FILE REPORT

* U.S. GOVERNMENT PRINTING OFFICE: 1979-677-026/54

ALTITUDE AND CONFIGURATION OF THE WATER TABLE AND DEPTH TO WATER IN THE NORTHERN HIGH PLAINS OF COLORADO, JANUARY 1978

By
R. G. Borman

1979