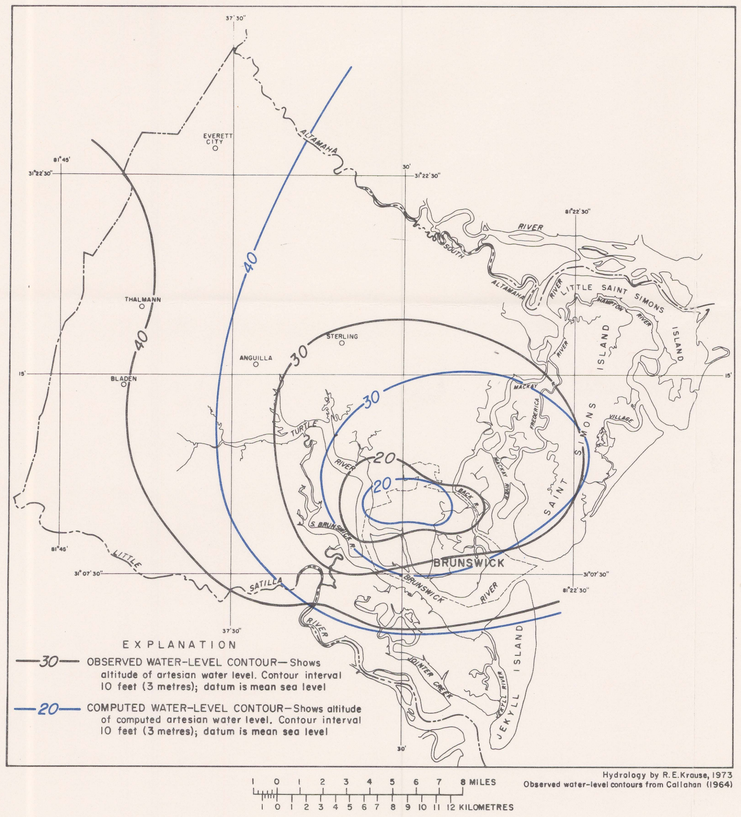
Department of the Interior
United States Geological Survey
V. E. McKelvey, Director

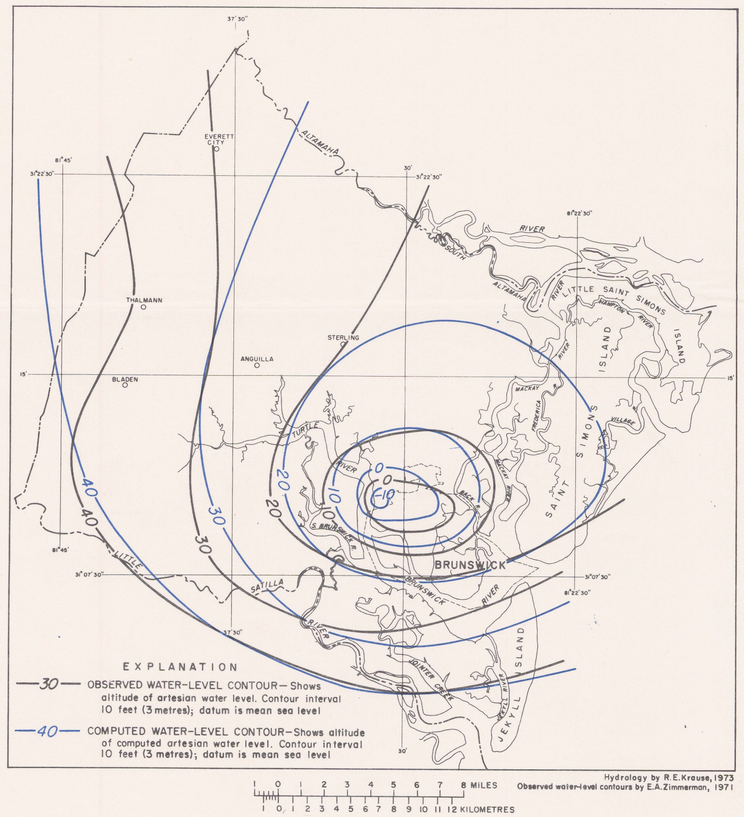
Prepared in cooperation with the
City of Brunswick
Glynn County
Georgia Department of Natural Resources,
Earth and Water Division

WATER RESOURCES INVESTIGATIONS
1-75
OPEN-FILE REPORT
SHEET 2 OF 4

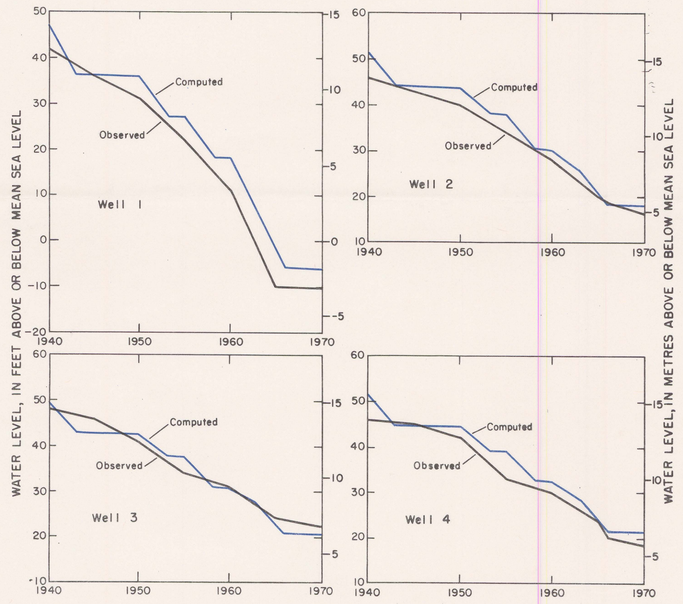
TRANSIENT MODEL WITH PUMPAGE



MAP SHOWING MEASURED AND COMPUTED WATER-LEVEL CONFIGURATION OF THE PRINCIPAL ARTESIAN AQUIFER, 1960



MAP SHOWING MEASURED AND COMPUTED WATER-LEVEL CONFIGURATION OF THE PRINCIPAL ARTESIAN AQUIFER, 1970



HYDROGRAPHS OF OBSERVED AND COMPUTED WATER-LEVEL TRENDS OF FOUR WELLS, 1940-70 (SEE STEADY-STATE MODEL MAP FOR WELL LOCATIONS)

Pumpage and recharge data were added to the steady-state model to make the transient model. Simulation time began in 1915 when available data showed that significant amounts of ground water were withdrawn from the aquifer, causing the hydrologic system to depart from equilibrium conditions. Warren's 1880 water level was again used as the initial (1915) water level for the model, the only data available that represented steady-state conditions, and there was probably very little change during this period. An ending date of 1970 was used because the most accurate pumpage and water-level data included that date.

Pumpage from the aquifer since the early 1900's has increased at varying rates. Because of this, pumpage data were introduced in steps; seven pumping periods were used, with the transition between periods usually coinciding with a relatively marked increase in pumpage and the availability of water-level maps. Pumping periods and the amount pumped, in million gallons per day, used in the model are:

Period	1915-30	1930-40	1940-50	1950-55	1955-60	1960-63	1963-70
Pumpage (Mgal/d)	45	65	100	125	175	200	235

Although the area of main interest for computing the water level is Glynn County, pumpage in the Savannah, Jesup, and Riceboro areas are also included in the model.

Equations used and methods of calculation for the transient model were the same as those for the steady-state model. Calculations were made using the 1915-30 pumpage and the predevelopment water level, producing a theoretical 1930 water-level matrix. These 1930 water-level data were then used with the 1930-40 pumpage data in the next series of computations, which produced the 1940 water level, and so forth through 1970.

Calculations are made in the same way in the transient model as in the steady-state model except there are more than one pumping period. As new pumpage is added, the time steps revert to the initial time increment and are increased incrementally by a factor of 1.5 times as calculations continue through that pumping period. A single model run is made from 1915 through 1970, with the pumpage automatically being entered into the model after head values are calculated for each period. The water level, although calculated for each time step within all pumping periods, is printed only at times requested by the modeler. Water-level data are usually printed after each pumping period and at enough other times to construct hydrographs and maps for model verification.

The maps above show both the measured and computed water-level contours for the Brunswick area in 1960 and 1970. The hydrographs show the measured water-level trend from 1940 to 1970 for four wells in the Brunswick area tapping the principal artesian aquifer, and also water-level trends for four hypothetical wells located in those nodes corresponding to the actual wells. The maps indicate good areal match of computed to actual water level, and the hydrographs show that the computed trend matches the trend of the measured water levels. The hydrographs also show that the computed water-level trend flattens before a pumping period is completed. This is because each new set of pumpage data is introduced at one time (the beginning of that pumping period) and remains constant throughout that period. The model hydrologic system reaches equilibrium after less than a year of pumping. This corresponds to the actual conditions when the increase in pumpage (coinciding with the beginning of a pumping period) causes an initial decline in water level, followed by a stabilization of the trend until another increase in pumpage is experienced.

Cartography by W. G. Hester

DIGITAL MODEL ANALYSIS OF THE PRINCIPAL ARTESIAN AQUIFER, GLYNN COUNTY, GEORGIA

By
R. E. Krause and H. B. Counts

1975