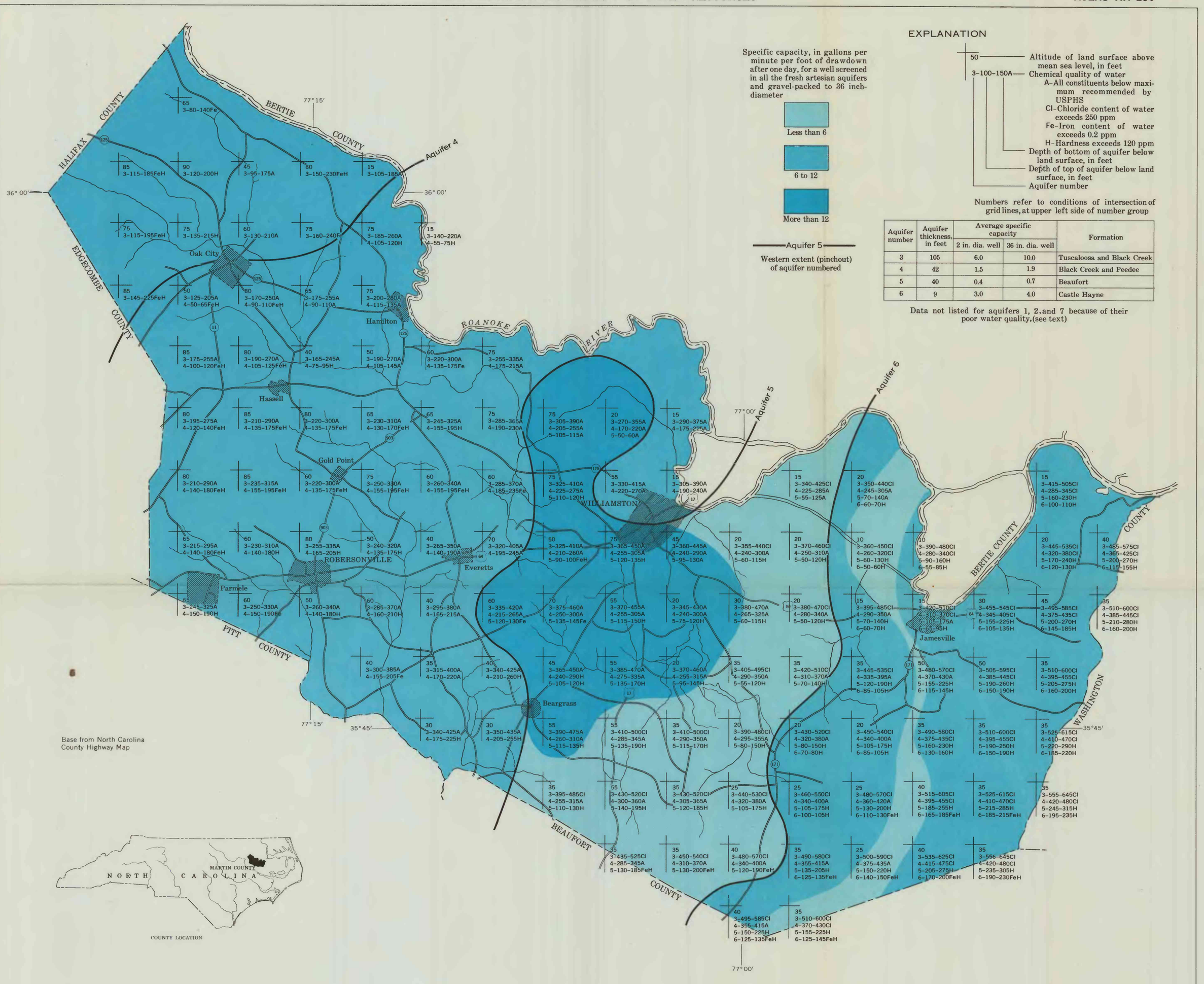
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
MARTIN COUNTY BOARD OF COMMISSIONERS
AND THE
NORTH CAROLINA DEPARTMENT OF WATER RESOURCES

HYDROLOGIC INVESTIGATIONS
ATLAS HA-264



Aquifer number	Aquifer thickness, in feet	Average specific capacity		Formation
		2 in. dia. well	36 in. dia. well	
3	105	6.0	10.0	Tuscaloosa and Black Creek
4	42	1.5	1.9	Black Creek and Peedee
5	40	0.4	0.7	Beaufort
6	9	3.0	4.0	Castle Hayne

Data not listed for aquifers 1, 2, and 7 because of their poor water quality, (see text)

INTRODUCTION

Sedimentary rocks underlying Martin County, in the north-central part of the North Carolina Coastal Plain, thicken from about 400 feet in the western part of the county to about 1,000 feet in the eastern part. The sediments, ranging in age from Cretaceous to Recent, are clay, sand, shell, and limestone that were deposited on crystalline basement rock. Pre-Miocene sediments strike north-northeast and dip to the southeast, whereas Miocene and younger sediments are generally horizontal.

The principal aquifers are seven sand, shell, or limestone beds. Water in the lower six of the aquifers occurs under artesian conditions, and in the seventh, under water-table conditions. The average transmissibility of the artesian aquifers ranges from 4,000 gpd (gallons per day) per foot in Aquifer 4 to 18,000 gpd per foot, in Aquifer 3. The average daily recharge to the artesian aquifers in the county is computed as 22 million gpd for aquifers between 100 feet and 300 feet below land surface.

GENERAL GEOLOGY

Martin County is underlain by clay, silt, sand, and limestone beds that were deposited on crystalline basement rocks. The sedimentary beds generally slope to the southeast. They were, for the most part, deposited in shallow seas. The sedimentary beds contain material that was weathered from crystalline rocks and transported by streams to the seas, mixed with marine materials such as shells and chemical precipitates, sorted by wave and current action and deposited on the sea bottom, and covered by later sediments. The sequence of deposition was not continuous. Sea level fluctuated in relation to adjacent land masses. When sea level was relatively lower than adjacent land masses, the sediments, previously deposited, were above sea level, and were exposed to weathering and erosion. After the lowering of land masses, the eroded surfaces were inundated, and more sediments were deposited upon them.

The geologic formations from oldest to youngest are the Tuscaloosa, Black Creek, and Peedee Formations of Cretaceous age, the Beaufort Formation of Paleocene age, the Castle Hayne Limestone of middle and late Eocene age, the Yorktown Formation of late Miocene age, and the undifferentiated sediments of post-Miocene age.

AQUIFERS

ARTESIAN AQUIFERS

Aquifer 1 is near the middle of the Tuscaloosa Formation. The aquifer is composed of two sand beds and an intervening clay layer that thickens and thins across the county and may not be continuous. The upper bed contains white, very fine to fine, subangular, poorly sorted quartz sand. The lower bed is composed of white, very fine to fine, subangular to subrounded, poorly sorted quartz sand. The optimum screen openings for naturally developed screened wells tapping Aquifer 1 is from 7/1000 to 10/1000 of an inch (slot size 7-10). The specific capacity of properly constructed, naturally developed, 2-inch diameter wells tapping Aquifer 1 is calculated as 0.6 gallon per foot of drawdown at the end of one day of pumping. Throughout most of the county, the water from Aquifer 1 contains high concentrations of chloride that make it undesirable for most uses.

Aquifer 2 includes the base of the Black Creek Formation in the western part of the county and the upper part of the Tuscaloosa Formation in the eastern part.

Aquifer 2, a sand bed containing a few thin clay stringers, is composed of white, very fine to medium, subrounded to subangular, poorly sorted quartz sand. The sand includes a small amount of muscovite flakes and fine-grained marcasite crystals. The optimum screen openings for naturally developed screened wells tapping Aquifer 2 should be about 12/1000 inch (slot size 12). The specific capacity of properly constructed, naturally developed, 2-inch diameter wells tapping Aquifer 2 is calculated as 0.7 gallon per foot of drawdown at the end of one day of pumping. Aquifer 2 is tapped by few wells because the water contains concentrations of chloride in excess of 400 ppm (parts per million) throughout most of the county.

Aquifer 3 is perhaps the most productive and widely used aquifer in Martin County. In the central and western sections of the county it is in part of the Black Creek Formation; in the eastern section, it is in the upper part of the Tuscaloosa Formation.

Aquifer 3 is composed of thick sand beds containing many thin clay layers. The sand in the top 50 feet of the aquifer is white, medium to coarse grained, angular to subangular, poorly sorted, quartz sand containing a trace of muscovite flakes, marcasite crystals, and lignitized wood fragments. The composition of the lower part of the aquifer is the same, except that the sand grains are smaller and range from medium to very fine grained. The optimum screen openings for naturally developed screened wells tapping the upper part of Aquifer 3 should be 20/1000 inch (slot size 20). The screen openings for the lower part of Aquifer 3 should be about 12/1000 inch (slot size 12). The specific capacity of a properly constructed, naturally developed, 2-inch diameter well tapping Aquifer 3 is calculated as 6.0 gallons per foot of drawdown at the end of one day of pumping.

The chemical quality of water from Aquifer 3 generally is acceptable for most uses in the western and central parts of the county. In the eastern part of the county, water from this aquifer usually contains concentrations of chloride in excess of 400 ppm and is not desirable for most uses.

Aquifer 4 occurs along the Black Creek-Peedee Formation contact. In the eastern part of the county, the upper part of Aquifer 4 is in the base of the Peedee Formation; elsewhere it is in the Black Creek Formation.

The aquifer is composed of a thick sand bed, overlain and underlain by massive clay beds. The sand is white, very fine to coarse, angular to subangular, poorly sorted quartz sand containing a trace of phosphatic and glauconitic sand, pyrite crystals, and muscovite flakes. The optimum screen openings for naturally developed, screened wells tapping this aquifer is about 16/1000 inch (slot size 16). The specific capacity of properly constructed, naturally developed 2-inch diameter wells tapping Aquifer 4 is calculated as 1.5 gallons per foot of drawdown after one day of pumping. The chemical quality of water from Aquifer 4 generally is acceptable for most uses.

Aquifer 5 is in the Beaufort Formation. The aquifer is composed of about 60 percent silt-sized to medium-grained, green to black, glauconitic sand, and about 40 percent silt-size to fine-grained, clear quartz sand. The sands are poorly sorted. The proper screen openings for naturally developed, screened wells tapping Aquifer 5 is about 8/1000 inch (slot size 8). The specific capacity of a properly constructed, naturally developed, 2-inch diameter well tapping Aquifer 5 at its greatest thickness, is calculated as 0.4 gallon per foot of drawdown after one day of pumping. The chemical quality of the water generally is acceptable for most uses.

Aquifer 6 includes most of the Castle Hayne Limestone, and, in some places, it includes a basal shell bed in the Yorktown Formation.

Aquifer 6 is composed of shell and shell limestone beds. The limestone is sufficiently indurated so that open-end wells may be constructed. The specific capacity of open-end, 2-inch diameter wells, where Aquifer 6 is 10 feet thick, is calculated as 3.0 gallons per foot of drawdown after one day of pumping. The water from Aquifer 6 generally is hard to very hard, otherwise it is of acceptable chemical quality for most uses. Aquifer 6 is the uppermost of the artesian aquifers in Martin County. Overlying these artesian aquifers are confining layers consisting of massive clay beds of the Yorktown Formation.

WATER-TABLE AQUIFER

Aquifer 7, the water-table aquifer, is composed of sand, silt, and clay of post-Miocene age. The aquifer extends from land surface to depths ranging from 5 to 70 feet in the county. Sand and silt beds predominate, but there are numerous clay lenses, and clay is disseminated through the sand beds.

The sand beds in Aquifer 7 are composed of very fine to coarse-grained, well-rounded to angular, quartz sand that is frequently stained by iron oxides. The sand beds are heterogeneous and lack continuity, therefore, it is not practical to determine a standard screen size for wells tapping this aquifer. The optimum screen size should be determined, individually, for each well constructed.

Many 2-inch wells have specific capacity of less than 0.1 gallon per foot of drawdown; none had a specific capacity of more than 0.3 gallon per foot of drawdown after one day of pumping. Therefore, the use of Aquifer 7 is limited to small-diameter wells having small yields, or large-diameter wells that have a large reservoir storage capacity. Most farm ponds in the area that have no surface inflow, or outflow, are large-diameter wells developed in Aquifer 7.

Aquifer 7 contains water having two objectionable characteristics: The water may have high concentrations of dissolved iron which stain laundry, plumbing fixtures, and cooking utensils. Water from Aquifer 7 is easily polluted by organic and inorganic sources, such as septic tanks or chemical fertilizers.

AQUICLUDES

The aquicludes in the county are the less permeable beds which separate the aquifers and retard the flow of water between the aquifers. Generally, the aquicludes are clay beds, but they may contain various amounts of sand, or shell, which increase the permeability of the clay, and allow the slow percolation of water from aquifer to aquifer in response to head differences. The aquicludes that separate the various aquifers in the county are briefly described as follows:

A. A reddish-brown clay layer, approximately 75 feet thick, separates Aquifer 1 from Aquifer 2.
B. A gray clay layer, approximately 20 feet thick, separates Aquifer 2 from Aquifer 3.
C. A dark-brown clay layer, approximately 70 feet thick, separates Aquifer 3 from Aquifer 4.
D. A dark-brown clay layer, approximately 80 feet thick, separates Aquifer 4 from Aquifer 5.
E. A gray to cream clay layer, approximately 70 feet thick, separates Aquifer 5 from Aquifer 6.
F. A blue clay layer, approximately 90 feet thick, separates Aquifer 6 from Aquifer 7.

THE YIELD OF WELLS

SPECIFIC CAPACITY

The specific capacity of a well is the amount of water, in gallons per minute (gpm), that the well will yield for each foot of drawdown in water level, in the well, after a given period of continuous pumpage. Specific capacity is given in gallons per minute for each foot of drawdown after one day of pumping. The values for specific capacity are based upon aquifer constants determined by pumping test and assume 100 percent well efficiency. Wells used in the test, generally, had better than 90 percent well efficiency and the indications are that properly constructed and developed wells in the county should have an actual specific capacity within about 10 percent of that given on the map.

WELL YIELD FROM SPECIFIC CAPACITY

The specific capacity of wells is expressed in two ways on the map: (1) A table is given in the explanation which assumes two diameters of wells, each well tapping a single aquifer, for Aquifers 3 through 6; (2) The map is shaded in color to indicate the specific capacity of wells tapping all underlying fresh artesian aquifers. The table may be used to determine the yield of less expensive, lower yield wells for domestic supplies. For example, if a 2-inch diameter domestic well were screened through Aquifer 6 and equipped with a shallow-well pump set for 20 feet of drawdown, the well should yield 60 gpm after one day of pumping. If the same type of well, having the same pump setting, were tapping Aquifer 4 the yield would be 30 gpm after one day of pumping. The above example shows that the yield from a well tapping a given aquifer may be determined by multiplying the specific capacity of a well in that aquifer by the allowable amount of drawdown. In Aquifer 6 the specific capacity is 3.0 gpm per foot per day (from the table) and the allowable drawdown (from the pump setting) is 20 feet after one day. Thus, the well would yield 60 gpm.

The map is shaded in color to indicate the specific yield of a well tapping all fresh-water aquifers underlying the well site. High yield municipal and industrial wells are generally gravel packed to about 36-inch diameter and may be screened in all fresh artesian aquifers. The dark shading between Williamston and Beargrass indicates that this is the most productive area for the construction of industrial and municipal wells. In the lightest shaded area, wells would have a lower specific capacity because the higher yielding aquifers are either absent or the water has a chloride content in excess of the maximum recommended by the U. S. Public Health Service. Aquifer 7 has not been included in the calculations for multiple-screened wells, because it commonly has low yield and is not generally tapped by multiple-screened wells in the county.

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WATER-BEARING CHARACTERISTICS AND OCCURRENCE OF AQUIFERS IN MARTIN COUNTY, NORTH CAROLINA

By
Granville G. Wyrick

SCALE 1:125 000

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2 0 2 4 6 8 10 KILOMETERS

1967

For sale by U.S. Geological Survey, price 50 cents