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STATE OF NEW JERSEY
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT

DIVISION OF WATER POLICY
AND SUPPLY

SPECIAL REPORT 19

GROUND-WATER RESOURCES OF MERCER COUNTY, N. J.

PREPARED IN COOPERATION WITH
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

1962

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GROUND-WATER RESOURCES OF MERCER COUNTY, N. J.

By

John Vecchioli and Mark M. Palmer

U.S. Geological Survey

Special Report No. 19

1962

Prepared by the U.S. Geological Survey

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State of New Jersey

STATE OF NEW JERSEY
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT

H. MAT ADAMS, *Commissioner*

DIVISION OF WATER POLICY AND SUPPLY

GEORGE R. SHANKLIN, *Chief Engineer and Acting Director*

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LETTER OF TRANSMITTAL

Honorable H. Mat Adams, Commissioner
Department of Conservation and Economic Development

DEAR SIR:

I am transmitting herewith a report on the ground-water resources of Mercer County. It presents the results of an investigation that was completed by the Ground Water Branch, Water Resources Division, U. S. Geological Survey, in cooperation with the Division of Water Policy and Supply, as part of the State-wide program authorized by the 1958 Water Supply Law.

The report discusses the quantity and quality of the ground water occurring in the important aquifers of Mercer County in reference to their present use and possible future demand.

This report will be of value as a guide for the proper development of the ground-water resources of Mercer County as its economy develops. I therefore recommend that it be published as a Special Report of the Division of Water Policy and Supply.

Respectfully submitted,

GEORGE R. SHANKLIN

Chief Engineer and Acting Director

September 17, 1962

GROUND-WATER RESOURCES OF MERCER COUNTY, N. J.

By John Vecchioli and Mark M. Palmer

ABSTRACT

Mercer County is an industrial and agricultural area in west-central New Jersey. Trenton, its largest city, is the State capital. The climate of Mercer County is characterized by a moderate range of temperatures and by a generally dependable precipitation that averages about 44 inches per year.

Ground-water supplies are obtained from aquifers in consolidated rock in the northern three-fifths of the county and in unconsolidated rock in the southern two-fifths. The daily ground-water withdrawal of 12 million gallons in 1958 was divided almost equally between the two types of aquifers. The Stockton Formation and the Brunswick Shale constitute the principal consolidated-rock aquifers, and the Raritan and Magothy Formations the principal unconsolidated-rock aquifers.

The aquifers of the Raritan and Magothy Formations are the best potential sources of large ground-water supplies in the county. Moderate to large supplies can be developed generally in the outcrop areas of the Stockton Formation and the Brunswick Shale. Additional small supplies could be developed from the several other aquifers. Future development must be carefully planned, however, to avoid local overdevelopment.

Ground water, in all the aquifers throughout the county, is generally of suitable chemical quality for most uses. Locally, the water must be treated to remove iron or hardness-forming constituents, or to adjust the alkalinity.

Construction and yield data for 241 selected wells in Mercer County are included in the report. Also included are logs of 11 selected wells and chemical analysis of 41 ground-water and surface-water samples.

INTRODUCTION

PURPOSE AND SCOPE OF THE INVESTIGATION

The study of Mercer County's ground-water resources is part of a statewide program of investigation of the ground-water resources of New Jersey. The purpose and scope of these studies are to assemble the available data on the geologic and hydrologic factors affecting the occurrence, movement, availability and chemical quality of ground water in New Jersey, to evaluate and interpret the data, and to make the results of the investigations available to the public. This report presents the results of the Mercer County study.

The Mercer County study was made by personnel of the U. S. Geological Survey in cooperation with the New Jersey State Department of Conservation and Economic Development, Division of Water Policy and Supply. The investigation was conducted under the general direction of Philip E. LaMoreaux, former chief, and Henry C. Barksdale, branch area chief of the Ground Water Branch, U. S. Geological Survey, and under the immediate supervision of Allen Sinnott, district geologist.

The senior author of this report supervised the project and prepared the manuscript; the junior author collected and compiled much of the basic information and prepared many of the illustrations.

LOCATION AND EXTENT OF THE AREA

Mercer County is in the west-central part of New Jersey (fig. 1) between latitudes 40°08' and 40°26' and longitudes 74°28' and 74°56'. It is bounded on the north by Hunterdon and Somerset counties, on the east by Middlesex County, on the south by Monmouth and Burlington counties, and on the west by the Delaware River, which flows between New Jersey and Pennsylvania. The county has an area of 228.4 square miles, or about 3 percent of the total area of the State. Water accounts for only 2.4 square miles of the surface area.

PREVIOUS INVESTIGATIONS

This report represents the first detailed discussion of the ground-water resources of Mercer County. In 1958, a report on the ground-water resources in the tristate region adjacent to the lower Delaware River (Barksdale and others, 1958) included Mercer County. A report on the Millstone Watershed (Rutgers Planning Service, 1957) discussed the ground-water resources of a part of Mercer County.

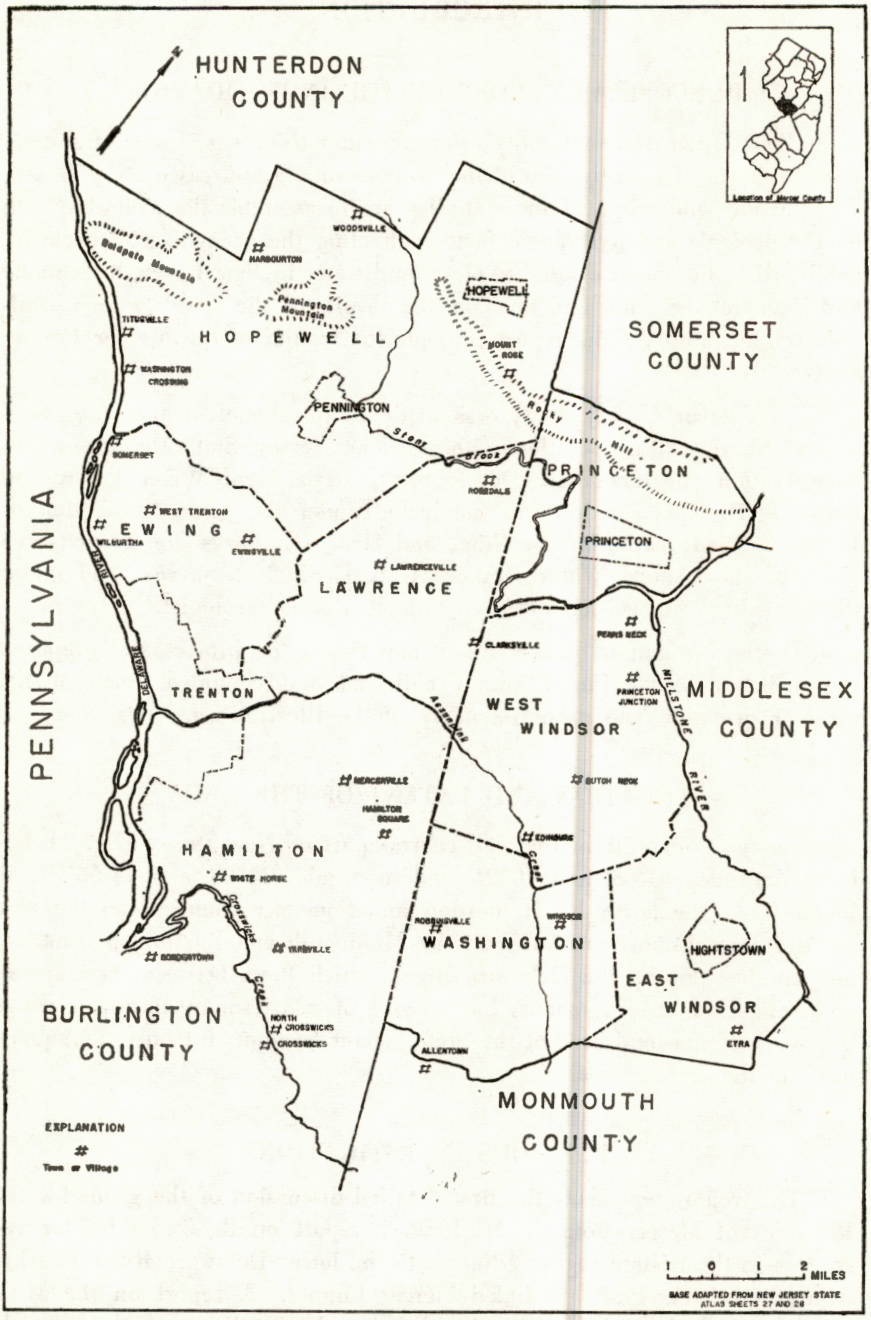


Figure 1.—Map showing political subdivisions, towns and major topographic features of Mercer County, N. J.

The geology of Mercer County is described in detail in the Trenton Folio (Bascom and others, 1909), and many other regional studies have touched briefly on the geology and hydrology of the county. Some of these papers have been cited in this report.

ACKNOWLEDGMENTS

Acknowledgment is made for the records and logs of the wells that were furnished the Geological Survey from the files of the New Jersey Bureau of Geology and Topography. Private individuals and officials in charge of public water supplies and industrial plants furnished information on withdrawals of ground-water and permitted use of their wells for water-level observations, for obtaining water samples, and for pumping tests. Many well drillers supplied well records and samples of drill cuttings. The authors are grateful for this assistance.

GEOGRAPHY

TOPOGRAPHY

Mercer County lies partly in the Appalachian Highlands and partly in the Atlantic Plain, two of the eight major physiographic divisions of the United States (Fenneman, 1938). The Appalachian Highlands division is subdivided into several provinces. One of these, the Piedmont province, constitutes the northwestern three-fifths of the county. The Piedmont province is underlain in this area by crystalline rocks of Precambrian and Paleozoic age, the oldest rocks in the county, and by Triassic shale, sandstone, argillite, and diabase. The Atlantic Coastal Plain province is the part of the Atlantic Plain division present in Mercer County and constitutes the southeastern two-fifths of the county. It is underlain by unconsolidated or poorly consolidated gravel, sand, and clay of Cretaceous age.

The two physiographic divisions are separated by the Fall Line. This "line" is actually a zone of varying width that contains the outcrop of the contact between the unconsolidated rocks of the Atlantic Plain and the consolidated rocks of the Appalachian Highlands. The zone, where crossed by streams entering the lower and flatter Atlantic Plain, is marked by many falls and rapids, and therefore has been called the Fall Line. Large cities, such as Trenton, Philadelphia, and Wilmington, have been established along the Fall Line because of the water power available at the falls and because the Fall Line constitutes the head of navigation of the streams crossing it. In Mercer County, the Fall Line extends from Trenton to Princeton Junction.

The topography of the Piedmont province is almost identical with that of the Atlantic Coastal Plain province where they meet in Mercer County, because the consolidated rocks have been eroded almost as low as the un-

consolidated rocks. Furthermore, the surface has been modified by geologically recent deposits of Quaternary age. For these reasons, the division into physiographic units is based largely upon the extension of physiographic boundaries from adjacent areas into the county.

Although several different rock types are present, Mercer County has little relief. Altitudes range from sea level in the southwestern part to about 500 feet above sea level along the northern edge of the county, giving a total relief of 500 feet. The part of the county in the Piedmont province is marked by rounded hills separated by broad valleys. Resistant rocks, such as diabase and argillite, form the ridges and the less resistant shales form the valleys. These hills and valleys are elongated in a northeast-southwest direction and they diminish in magnitude rapidly toward the Fall Line. The largest ridges in the county are Rocky Hill, Pennington Mountain, and Baldpate Mountain. (See fig. 1.) The total relief in the Piedmont province of Mercer County is about 480 feet.

The topography of the Atlantic Coastal Plain province consists of a gently undulated plain which slopes toward the Fall Line. Most of this area lies at altitudes between 80 and 120 feet and has very gentle relief; however, the total relief of the Atlantic Coastal Plain in Mercer County is about 160 feet.

Mercer County lies within the Delaware and the Raritan River basins. The drainage divide runs northwest-southeast and roughly bisects the county. Streams to the west and south of the divide drain into the Delaware River, and those to the north and east flow into the Raritan River. Major streams in the area include the Delaware River, Millstone River, Stony Brook, Crosswicks Creek, and Assunpink Creek (fig. 1).

CLIMATE

The climate of Mercer County reflects average conditions in the State as a whole. It is characterized by a relatively moderate range of temperatures, by mild winters, and by generally dependable rainfall.

Although Mercer County is only about 40 miles from the Atlantic Ocean, its climate is largely continental, mainly owing to the predominance of winds from the interior of North America. Prevailing winds are from the northwest from November through April, from the south from May through August, and from the north in September and October. They generally are of moderate strength and seldom are strong enough to be damaging.

The Appalachian Mountains have an important moderating influence on the climate of the county. They reduce the intensity of cold air masses

in the winter and hot air masses in the summer coming from the central part of the country. The Atlantic Ocean and the Great Lakes also help moderate the climate. At the Trenton station of the U. S. Weather Bureau, a temperature of zero or below has been recorded only 11 times from 1931 to 1958 and 100°F or above has been recorded only 8 times. The highest temperature recorded was 106°F, in July 1936, and the lowest was —14°F, in February 1934. The average date of the last killing frost in spring is April 10 and of the first killing frost in autumn is November 2, giving this area an average growing season of 205 days.

Precipitation is moderate and well distributed throughout the year, as shown in Table 1. The average annual precipitation at Trenton and Hightstown for the period 1901 to 1958 was about 43 and 45 inches, respectively. (See fig. 2.) Most of the precipitation during the warm months is produced by short showers and thunderstorms, whereas during the cool season it is a result of more widespread storms. The highest monthly precipitation recorded was 15.22 inches in July 1880, and the lowest was 0.06 inch in June 1949.

Mean annual sunshine is about 60 percent and is relatively constant, the summer percentages being only slightly higher than winter percentages.

Table 1.—Monthly and annual air temperatures and precipitation at Trenton, N. J. [average based on period of record 1893-1958]

	Average air temperature (°F)	*Precipitation (inches)*				
		Average	*Maximum*	*Year*	*Minimum*	*Year*
January	32.5	3.28	7.55	1878	.22	1876
February	32.6	3.14	6.25	1866	1.06	1901
March	41.3	3.90	8.86	1899	.83	1927
April	51.4	3.37	10.12	1874	.93	1867
May	62.0	3.69	10.75	1894	.30	1903
June	70.6	3.70	9.19	1867	.06	1949
July	75.7	4.61	15.22	1880	.37	1944
August	73.5	5.11	14.10	1955	.92	1869
September	67.2	3.61	10.49	1934	.19	1941
October	56.7	3.24	7.56	1890	.20	1924
November	45.6	3.27	8.41	1877	.62	1922
December	35.3	3.24	7.54	1901	.19	1955
Annual	53.7	44.16	67.23	1889	28.79	1957

Source: U.S. Weather Bureau, 1958, Local climatological data, with comparative data. Extremes from earlier reports in same series.

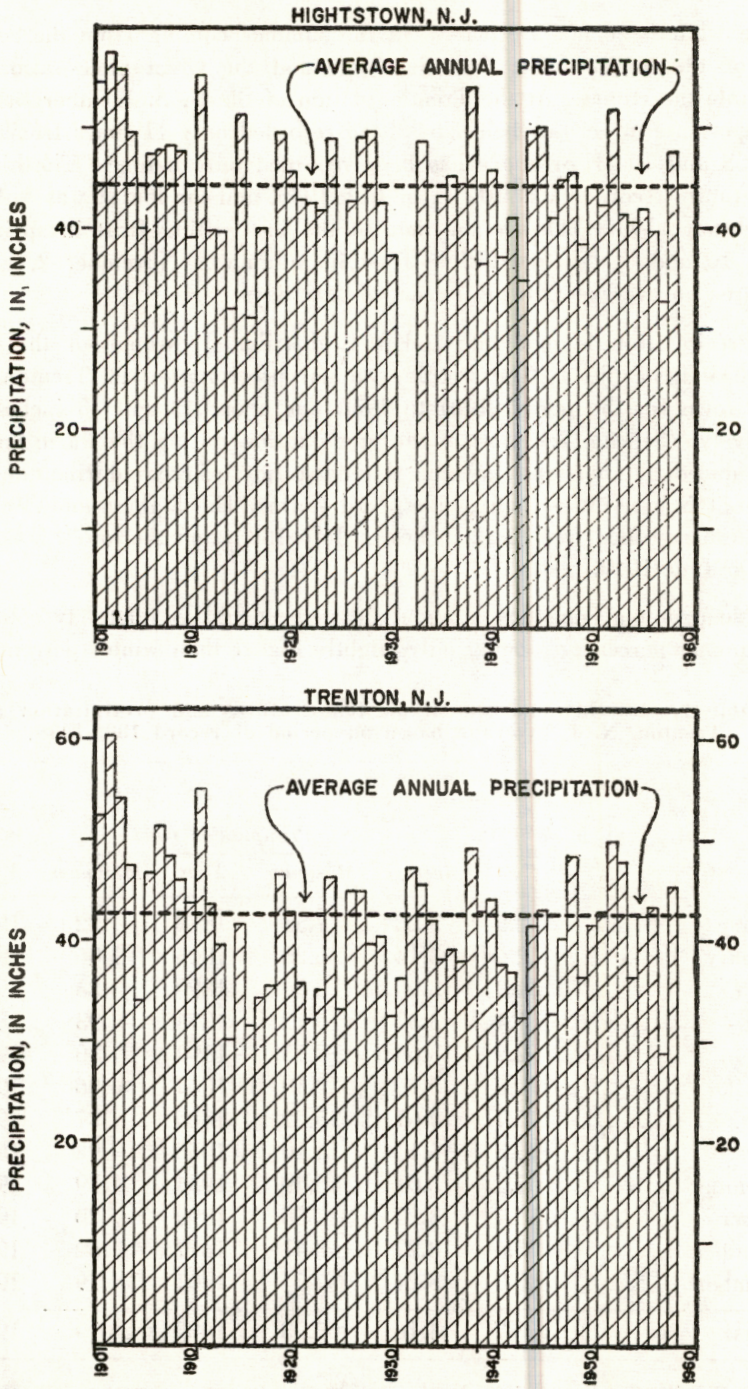


Figure 2.—Annual and average annual precipitation at Hightstown and Trenton, N. J., 1901-58. [Data from U.S. Weather Bureau.]

POPULATION AND ECONOMY

Mercer County ranked eighth among the State's 21 counties in the 1950 census, and ninth according to the 1960 census. Population increased from 229,781 in 1950 to 266,392 in 1960 — a change of 15.93 percent. New Jersey's population increased 25.47 percent during this same period. The county is subdivided into 13 municipalities (figure 1) as follows: the city of Trenton; Hightstown, Hopewell, Pennington, and Princeton Boroughs; and East Windsor, Ewing, Hamilton, Hopewell, Lawrence, Princeton, Washington, and West Windsor Townships. Almost half the county's population lives within the city of Trenton. (See table 2.)

The county has mainly an industrial economy. Among the employed residents, 38 percent are engaged in manufacturing, whereas only 2 percent are in agriculture (Candeub and Fleissig, 1957, p. 10). The remaining labor force is employed in a variety of occupations. Principal manufactured items include fabricated and primary metal products; stone, clay, and glass products; rubber products; machinery and electrical goods; and textiles.

Farmland composes about 52 percent of the county area (New Jersey Department of Agriculture, 1957, p. 9). The principal crops are potatoes, wheat, corn, soybeans, and garden vegetables. Dairy and poultry farms constitute the bulk of livestock farming in Mercer County.

Table 2.—Population of municipalities in Mercer County, N. J., since 1940.

	1940 Census	*1950 Census*	*Percent change 1940 to 1950*	*1960 Census*	*Percent change 1950 to 1960*
East Windsor Twp.	845	1,284	52.0	2,298	78.97
Ewing Twp.	10,146	16,840	66.0	26,628	58.12
Hamilton Twp.	30,219	41,156	36.2	65,035	58.02
Hightstown Borough	3,486	3,712	6.5	4,317	16.30
Hopewell Borough	1,678	1,869	11.4	1,928	3.16
Hopewell Twp.	3,738	4,731	26.6	7,818	65.25
Lawrence Twp.	6,522	8,499	30.3	13,665	60.78
Pennington Borough	1,492	1,682	12.7	2,063	22.65
Princeton Borough	7,719	12,230	58.4	11,890	—2.79
Princeton Twp.	3,251	5,407	66.3	10,411	92.55
City of Trenton	124,697	128,009	2.7	114,167	—10.82
Washington Twp.	1,365	1,843	35.0	2,156	16.98
West Windsor Twp.	2,160	2,519	16.6	4,016	59.43
County Total	197,318	229,781	16.5	266,392	15.93
State Total	4,160,165	4,835,329	16.2	6,066,782	25.47

Source: U. S. Bureau of the Census.

Table 3.—Stratigraphic table of the formations in Mercer County, N. J.

Era	*Period*	*Epoch*	*Formation*	*Lithology*	*Thickness (feet)*	*Water-bearing characteristics*
		RECENT	Alluvium and eolian sand	Clay, silt, and sand	0-?	Too thin in Mercer County to be exploited for water.
CENOZOIC	QUATERNARY	PLEISTOCENE	Stratified drift of Wisconsin age	Sand and gravel, some clay	0-30	These formations act as intake and storage zones for the underlying formations. Where thick enough, the formations yield small to moderate amounts of water to shallow wells.
			Cape May Formation	Sand and gravel, some clay	0-30	
			——— Unconformity ———			
			Pensauken Formation	Sand and gravel, some clay	0-90	
			——— Unconformity ———			
			Marshalltown Formation	Black sandy clay to clayey glauconitic sand	30-35	Not considered water bearing in the county.
			Englishtown Formation	White and yellow micaceous, lignitic sand; thin beds of clay	50	Average yield of 14 gpm to shallow domestic and farm wells. An important artesian aquifer downdip in Monmouth and Ocean Counties.
			Woodbury Clay	Black micaceous clay	50	These formations act as a confining layer separating the Englishtown Formation from the underlying Raritan and Magothy Formations.
			Merchantville Formation	Black to dark-green glauconitic clay	50-60	
MESOZOIC	CRETACEOUS	LATE CRETACEOUS	——— Unconformity ———			
			Magothy Formation	Alternating light-colored sands and dark-colored clay	30	An excellent source of large supplies of fairly soft water. In places the water contains objectionable amounts of iron and it has a low pH. Large-diameter industrial, municipal, and irrigation wells tapping these formations commonly yield 200-500 gpm. Maximum yield of 1,200 gpm.
			——— Unconformity ———			
			Raritan Formation	Alternating variegated sand and clay	200-400	
			——— Unconformity ———			

			Igneous intrusives	Dikes and sills of diabase	Yields small quantities of water to domestic and farm wells. Water is generally hard and high in iron.
Mesozoic	Triassic		Brunswick Shale	Red shale with some interbedded sandstone and argillite — 6,000-9,000	A reliable source of small to moderate supplies of water. Yields large supplies locally. Water is generally moderately hard to hard.
			Lockatong Formation	Blue and black argillite with intercalated thin beds of shale — 1,800-3,600	Yields small quantities of water to wells in Mercer County. Water is generally hard.
			Stockton Formation	Red and gray arkosic sandstone with interbedded shale — 2,300-3,100	An excellent source of moderate to large supplies of water. The Stockton is the most reliable consolidated aquifer in Mercer County. Average yield of 152 gpm from large-diameter industrial and municipal wells.
			Unconformity		
	Early Paleozoic(?)		Igneous intrusives	Gabbro	As a group these rocks yield small quantities of water to wells, mainly from the weathered portion of the rock near the land surface. Not important aquifers in Mercer County.
			Wissahickon Formation	Banded micaceous schist and gneiss — 5,000-8,000?	
Paleozoic			Unconformity		
	Cambrian	Early Cambrian	Chickies Quartzite	Pale-green schistose quartzite — 400?	
			Unconformity		
	Precambrian		Baltimore Gneiss	Medium-grained granite gneiss	

SUMMARY OF STRATIGRAPHY AND STRUCTURE

The rocks exposed in Mercer County range in geologic age from Precambrian to Recent (table 3; figures 3, 4). Crystalline rocks of Precambrian and Paleozoic age crop out in the Piedmont province in a narrow band at Trenton and in a small area west of Princeton Junction. Elsewhere in Mercer County, these rocks are covered by younger rocks. The crystalline rocks consist of the Baltimore Gneiss of Precambrian age, the Chickies Quartzite of Cambrian age, and the Wissahickon Formation and the Gabbro of early Paleozoic (?) age.

Triassic rocks underlie the remainder of the Piedmont province in the county. They consist of consolidated nonmarine sediments and some diabase and are referred to as the Newark Group. The sedimentary rocks of the Newark Group have been divided into three formations, the Stockton Formation, the Lockatong Formation, and the Brunswick Shale, from oldest to youngest. These formations crop out in wide bands that extend across the county in a northeast-southwest alinement and dip predominantly to the northwest at about 12° to 15°. Normal faulting has caused repetition of the Triassic strata along the northwest edge of Mercer County. The diabase occurs as sills and dikes in the Triassic sedimentary rocks.

Deposits of Late Cretaceous age underlie all the Atlantic Coastal Plain province in the county. These deposits consist mainly of unconsolidated or poorly consolidated layers of gravel, sand, and clay. The Cretaceous formations present in Mercer County include the Raritan, Magothy, and Merchantville Formations, the Woodbury Clay, and the Englishtown and Marshalltown Formations. They crop out in parallel bands which trend northeast-southwest, and which dip gently southeast at a rate of 35 to 60 feet per mile, the younger beds dipping more gently than the older beds. The Cretaceous strata thicken seaward, and this thickening is most pronounced in the lower beds.

Unconsolidated deposits of Quaternary age form a discontinuous veneer over the Atlantic Coastal Plain part of the county and occur as small, isolated patches in the Piedmont part. These deposits consist generally of stratified gravel, sand, and clay. They include the Pleistocene Series composed of the Pensauken Formation, the Cape May Formation, and stratified drift of Wisconsin age; and the Recent Series composed of alluvium and eolian sand.

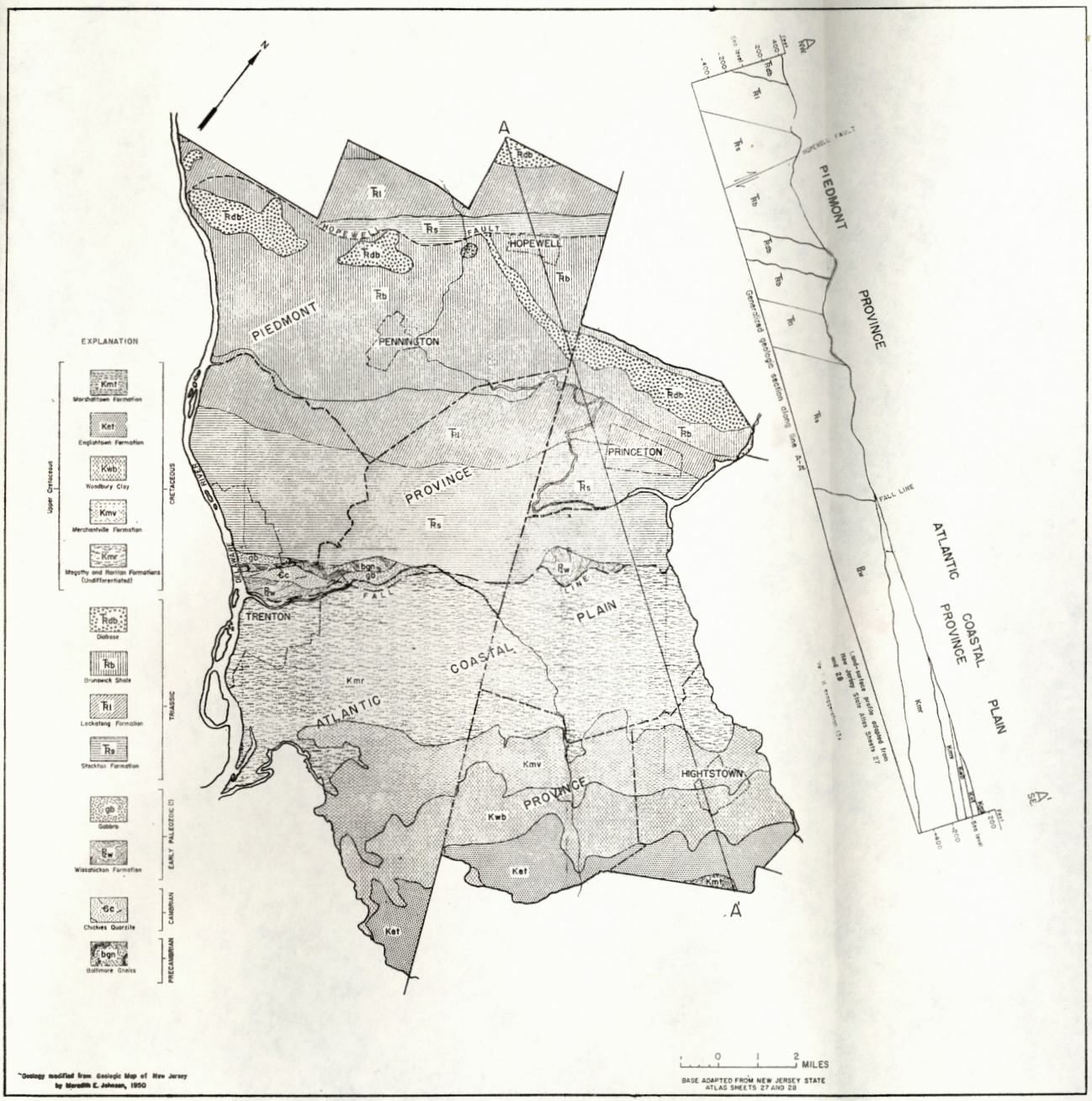


Figure 3.—Geologic map of pre-Quaternary Formations in Mercer County, N. J.

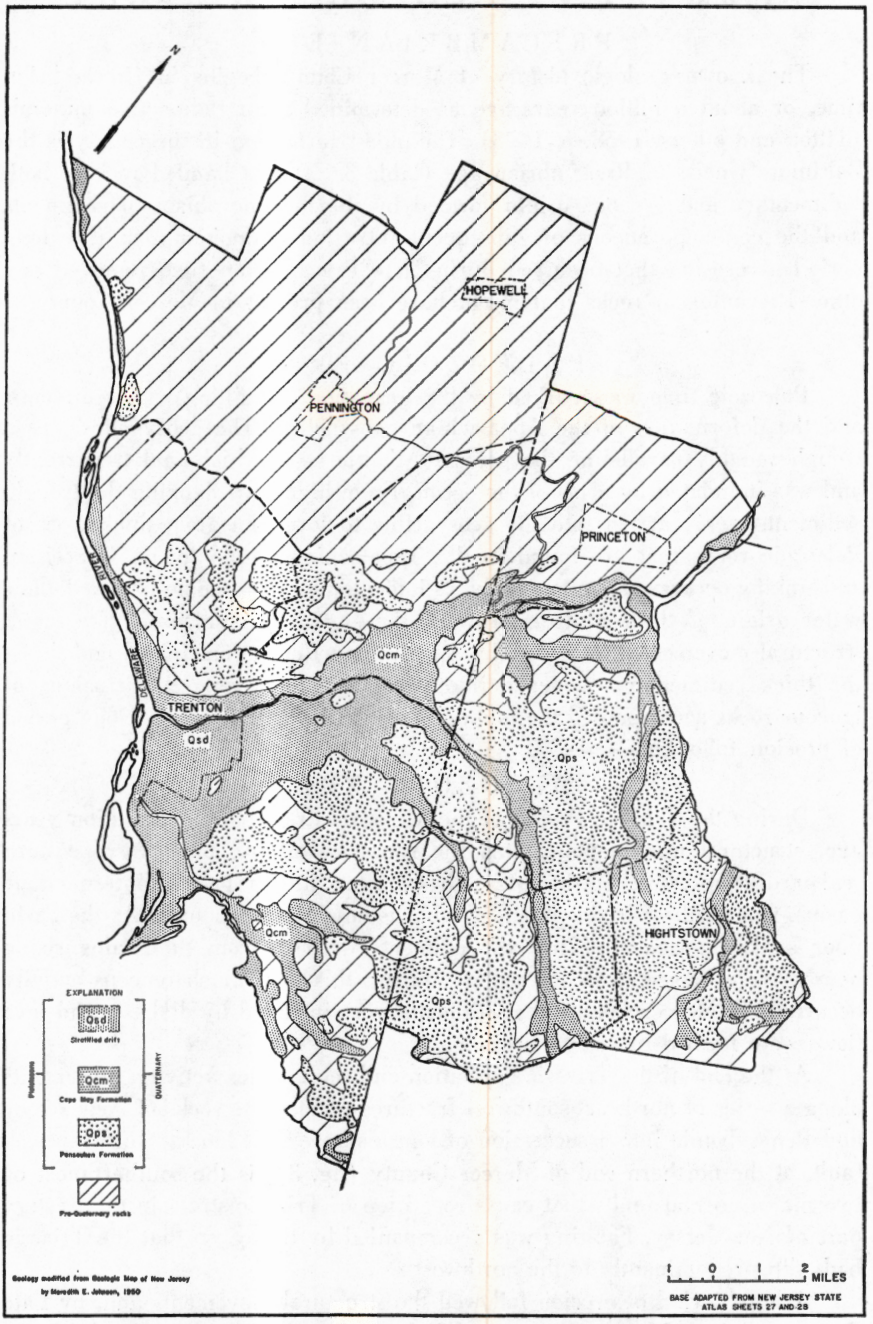


Figure 4.—Geologic map of Pleistocene Formations in Mercer County, N. J.

SUMMARY OF GEOLOGIC HISTORY

PRECAMBRIAN ERA

The known geologic history of Mercer County begins in Precambrian time, or about a billion years ago as determined from radioactive minerals (Tilton and others, 1958, p. 1473). The oldest formation in the county is the Baltimore Gneiss of Precambrian age (table 3). It is a banded rock of both sedimentary and igneous origin formed by the metamorphism of sediments and the contemporaneous or subsequent intrusion of molten rock. The long period of erosion that occurred during late Precambrian time removed any other Precambrian rocks that might have been present in Mercer County.

PALEOZOIC ERA

Paleozoic time was marked by the formation, the filling with sediments, and the deformation of the Appalachian geosyncline. The geosyncline was a trough roughly paralleling the present Atlantic coast which sank recurrently and was inundated by arms of the ocean. From highlands flanking the trough, sediments were carried into the geosyncline to form the great thicknesses of Paleozoic rocks that are found in the Appalachian region today. Deposition and sinking occurred simultaneously, as indicated by the predominantly shallow water origin of the sediments. Toward the end of the Paleozoic Era, great structural movements, known as the Appalachian Revolution, folded and thrust the thick sedimentary sequence into great mountain ranges. Intrusions of igneous rocks accompanied the folding of the sedimentary rocks. A long period of erosion followed.

MESOZOIC ERA

During the Triassic Period of the Mesozoic Era, about 225 million years ago, structural movements faulted the rocks underlying the present eastern seaboard from Nova Scotia to North Carolina into a belt of intermontane basins. One of these basins included what is now Mercer County. As the basin floor sank, thousands of feet of sediments derived from mountains rising nearby were deposited in the valley. During this time much igneous activity occurred: in Mercer County the sediments were intruded by diabase, and lava flows were formed in nearby areas.

At the end of the Triassic deposition and the igneous activity, movements along a series of northeast-southwest fractures divided the rocks of New Jersey and Pennsylvania into a succession of long narrow fault blocks. The Hopewell fault, at the northern end of Mercer County (fig. 3), is the southernmost of two major normal faults that cause repetition of Triassic strata in the western part of New Jersey. Faulting was accompanied by tilting, so that the Triassic beds dip predominantly to the northwest.

A long period of erosion followed the structural movements and, by Late Cretaceous time, Mercer County was a plain of moderate relief. The land was gradually depressed, and streams deposited layers of gravel, sand, and clay

along their channels and in bays and estuaries. As sinking of the land continued, the ocean advanced, and the deposition of gravel, sand, and clay continued in waters of varying depths. The entire Upper Cretaceous suite of rocks is not present in Mercer County, either because later erosion removed part of the suite or because it was never deposited there.

CENOZOIC ERA

Cretaceous deposition was followed by uplift of the land, recession of the sea, and renewal of erosion. In the Tertiary Period of the Cenozoic Era, which began about 70 million years ago, the ocean encroached upon the land and deposited clay, sand, and marl over much of southern New Jersey. However, erosion has removed any Tertiary formations that might have been deposited in what is now Mercer County.

The Quaternary Period includes the million or so years from the beginning of the Ice Age until the present. It is distinguished by four major advances of continental glaciers into the northern part of the United States. No evidence exists that any of these glaciers covered Mercer County, and it is certain that the last one, called the Wisconsin, did not reach this far south. During interglacial stages, however, the sea advanced and drowned the lower parts of the river valleys of southern and central New Jersey. As the streams were readjusting their gradients to the new conditions, a heterogeneous deposition of gravel, sand, and clay was occurring in the bays and valleys.

The last great ice sheet began its retreat about 25 thousand years ago from the area north of Mercer County. During its stagnation and retreat, meltwaters from the glacier deposited stratified gravel, sand, and clay in the Trenton area and to the north along the Delaware River. Since that time, except for continued erosion and deposition of recent alluvium along stream channels, there have been few geologic changes in Mercer County.

GROUND WATER

OCCURRENCE AND MOVEMENT OF GROUND WATER

The occurrence of ground water in Mercer County varies according to the geology. In the consolidated rocks of the Piedmont province, fractures and solution cavities provide almost the only means of storage and travel of water. These openings constitute a very small part of the total volume of the consolidated rocks, and their capacity to store and transmit water, therefore, is very low. Very different conditions exist in the unconsolidated sediments underlying the Atlantic Coastal Plain province and in the unconsolidated Pleistocene deposits which occur in both provinces. Ground water occurs in interstitial openings among the individual grains of these unconsolidated sediments. Sand and gravel deposits have relatively high porosity and permeability and their capacity to store and transmit water is therefore much greater

than that of the consolidated rocks. Clays may have high porosity also, but they generally have very low permeability, so that although their capacity to store water may be great, their capacity to transmit water is generally very low. (The reader is referred to Meinzer 1923a and 1923b for a more detailed discussion.)

The principal sources of ground water (aquifers) in Mercer County are the sand and gravel layers of the Raritan and Magothy Formations, the Stockton Formation, and, to a lesser degree, the Brunswick Shale. In general, moderate to large supplies of ground water can be developed from these aquifers. All the other geologic formations in the county, except the Merchantville Formation, the Woodbury Clay, the Marshalltown Formation, the alluvium, and the eolian sand, generally yield at least small supplies of ground water to wells and can be considered minor aquifers.

Ground water occurs in Mercer County under water-table, semiartesian, and artesian conditions. Water-table conditions are present at shallow depths throughout the county. Semiartesian conditions are most prevalent in the outcrop areas of the Stockton and Brunswick Formations. Local artesian conditions exist at depth in the outcrop areas of the Stockton, Raritan and Magothy, and Englishtown Formations; and widespread artesian conditions are present in the Raritan and Magothy Formations southeast of their outcrop area where they are overlain by the confining clay of the Merchantville Formation.

The aquifers in Mercer County are recharged almost entirely by local precipitation on their outcrop areas. Barksdale and others (1958, p. 29) estimate that a little more than 1 mgd (million gallons of water per day) per square mile of intake area is available for recharge from precipitation in this region after demands for evaporation and transpiration have been met. The actual amount of recharge to the aquifers is probably somewhat less, however, because of inadequate storage space in the formations.

Movement of water in the aquifers is generally controlled by the natural hydraulic gradients. The rate of movement is very slow, a few inches to a few feet per day. In the Piedmont aquifers, ground water moves from high-level intake areas on hills to low-level discharge areas in nearby stream valleys. Ground water is generally discharged from the Piedmont aquifers near their intake areas so that the distance water travels through these formations is not very great.

The natural pattern of movement in the Atlantic Coastal Plain aquifers also is from high-level intake areas to low-level discharge areas. However, besides being discharged to streams in the outcrop areas, water also moves downdip through these aquifers in response to broad regional hydraulic gradients. It is then discharged by wells, by interformational leakage, and by seepage across subaqueous outcrops of the aquifers many miles from the

intake area. The natural pattern of ground-water flow in Mercer County probably has been modified in areas of heavy pumping, but available data are insufficient to indicate where modification has taken place.

FLUCTUATIONS OF WATER LEVELS

Fluctuations of water levels in wells indicate the seasonal and long-term trends in the water storage of the individual aquifers. They also provide an index to the net effects of recharge and discharge, both natural and artificial. Many factors are responsible for the continuous fluctuation of the level of water in wells. Some of the more common causes are recharge to the aquifer, removal of ground water by natural or artificial discharge, fluctuations of atmospheric pressure, and loading and unloading of the land surface above the aquifer, as by tides or even by the movement of heavy trains. Earth tides and earthquakes also are responsible for water-level fluctuations. The important long-term trends in water-level fluctuations are controlled by the recharge to the aquifer and the discharge from the aquifer.

As part of the study of hydrologic conditions in Mercer County, a series of measurements of water-level fluctuations was begun in September of 1944. From September 1944 through December 1946, most of the wells were measured every week, and from January 1947, they have been measured monthly, with few exceptions.

Long-term fluctuations of water levels in two representative water-table observation wells in Mercer County are shown in figure 5. The John Hofling well is in the outcrop area of the Raritan and Magothy Formations, about 1.5 miles northwest of Edinburg and about 2.3 miles southwest of Dutch Neck. The P. Mullronay well is in the outcrop area of the Stockton Formation, about 0.8 mile south of Penns Neck and about 1 mile west of Princeton Junction. The graphs show that there has been no decline of water levels during the period of record.

Water levels in water-table wells in Mercer County are characteristically highest in spring and lowest in fall, even though precipitation is generally slightly greater during the summer. Large withdrawals by vegetation of soil moisture that might otherwise descend to the water table are mainly responsible for the decline of water levels during the summer and early fall. "Thus, only when vegetation is inactive does the rate of ground-water recharge consistently exceed the rate of natural ground-water discharge, causing the water table to rise." (Barksdale and others, 1958, p. 34.)

As a general rule, seasonal fluctuations of the water table are greater in consolidated rocks than in unconsolidated rocks. This is attributed to the smaller water-storing capacities of the consolidated rocks. Seasonal fluctuations of the water levels in the two selected wells in 1957 and 1958 are shown

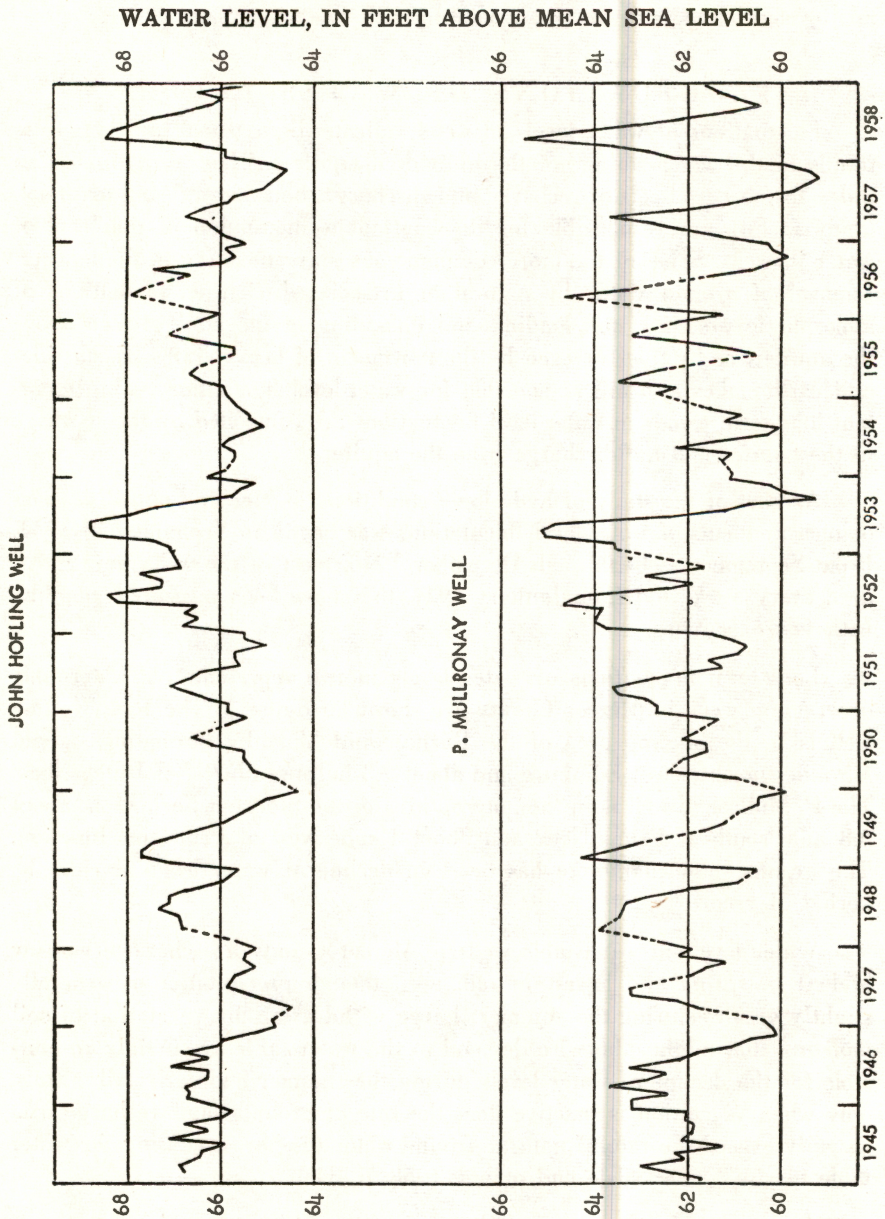


Figure 5.—Long-term fluctuations of water levels in representative water-table observation wells in Mercer County, N. J., 1945-58.

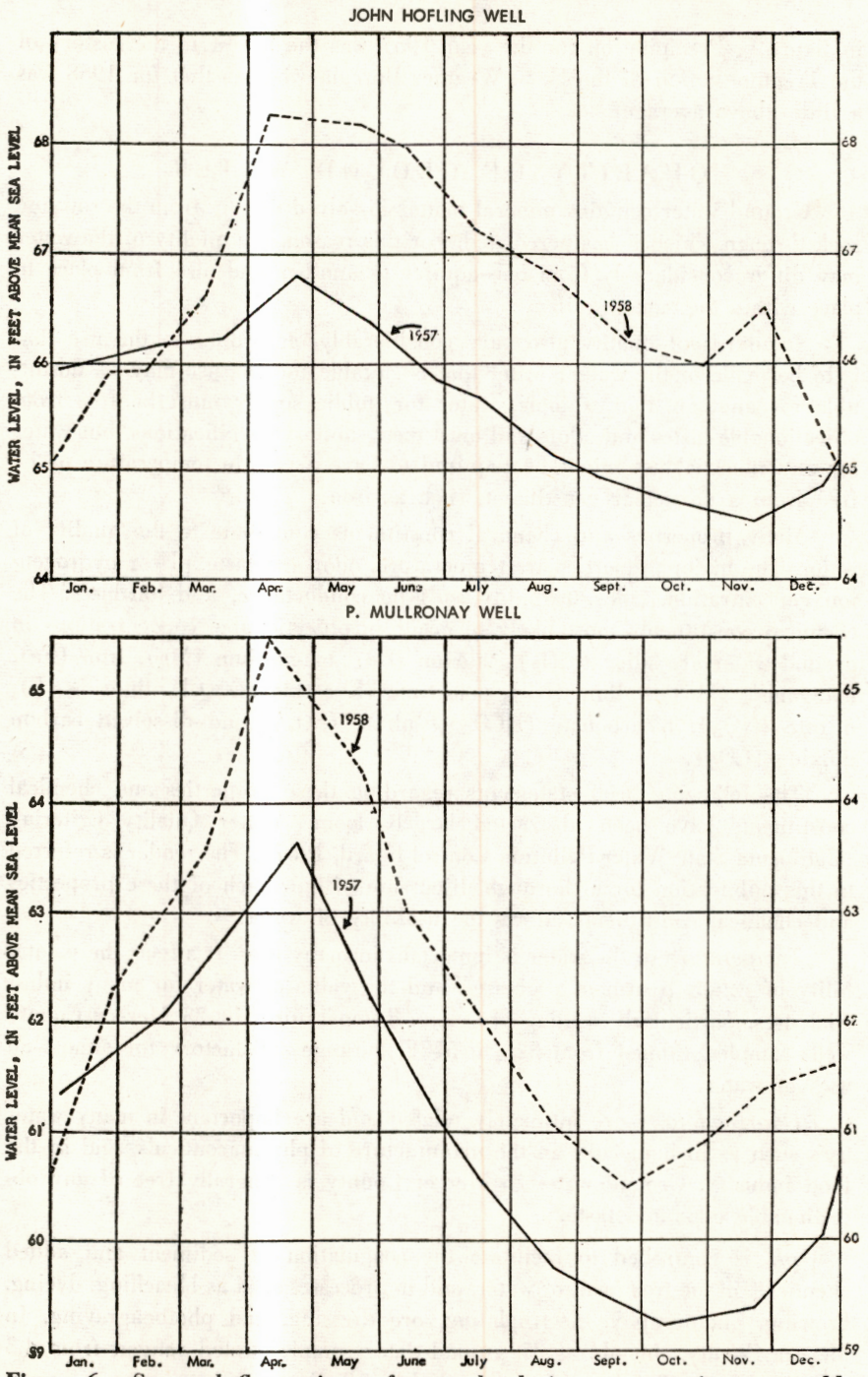


Figure 6.—Seasonal fluctuations of water levels in representative water-table observation wells in Mercer County, N. J., 1957-58.

in figure 6. Precipitation for the year 1957 was the lowest in the history of the Trenton station of the U. S. Weather Bureau, whereas that for 1958 was a little above average.

QUALITY OF GROUND WATER

Ground water contains mineral matter dissolved mainly from the soil and rock through which it has percolated. For this reason, the quality of the water may differ considerably from one aquifer to another and also from place to place within the same aquifer.

Standards of quality also vary considerably, according to the use that is to be made of the water; water that is suitable for one use may be unsuitable for another. For example, water for public supply must be free from objectionable tastes and odors and must meet sanitary specifications, but water for an industrial use might be required to have a certain temperature or be free from a particular constituent, such as iron.

Many properties and chemical constituents contribute to the quality of water. The major properties are temperature, odor and taste, pH or hydrogen-ion concentration, color, turbidity, specific conductance, and hardness. The chemical constituents most likely to occur in objectionable concentrations in ground water are silica (SiO_2), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), sodium (Na), potassium (K), chloride (Cl), fluoride (F), nitrate (NO_3), bicarbonate (HCO_3), sulfate (SO_4), and dissolved carbon dioxide (CO_2).

The following brief statements regarding these properties and chemical constituents have been abstracted largely from "Water Quality Criteria" (California State Water Pollution Control Board, 1957). The reader is referred to this publication for a thorough discussion of how each of these properties and chemical constituents affects the usability of water.

Temperature of the water is important in many uses. It affects the palatability of water, treatment processes, and the value of water for many industrial uses, particularly cooling processes. Temperatures in 23 Mercer County wells sampled ranged from 52° to 57°F, a range satisfactory for almost all uses of water.

Odor and taste are intimately related and are important in many water uses such as in home use, in the manufacture of pharmaceuticals, and in the food industry. Ground water in Mercer County is generally free of any objectionable odor and taste.

pH is controlled to facilitate the coagulation of sediment and added chemicals in the treatment of water, and in processes such as bleaching, dyeing, brewing, photography, electroplating, ore dressing, and photoengraving. In Mercer County, the pH of 37 ground-water samples tested ranged from 4.3 to 7.9, or from slightly acid to very slightly alkaline.

Color is an important factor when the water is to be used in the production of fine papers, white textiles, and pharmaceuticals. The color of 33 samples tested ranged from 2 to 12, a range satisfactory for almost all uses of water.

Turbidity of water is attributable to suspended and colloidal matter and it affects almost all uses of water. Most ground water is virtually free of turbidity.

Specific conductance gives an indication of the amount of dissolved mineral matter in the water. The specific conductance of 37 Mercer County samples ranged from 37 to 643 micromhos. The dissolved-solids content ranged from 27 to 482 ppm (parts per million).

Hardness of water is important in practically any use. Water of a hardness up to 60 ppm is generally considered soft, of 61 to 120 ppm, moderately hard, and above 120 ppm, hard (Lamar, 1942, p. 25 and 26). Many industrial uses can tolerate only a few parts per million of hardness. Hardness ranged from 7 to 197 ppm in 37 Mercer County samples.

Silica has a detrimental effect in high-pressure boiler operation, forming a hard "boiler scale" on heat-exchange equipment and steam-turbine blades. Analyses of 37 Mercer County samples indicate that silica ranges from 7.1 to 34 ppm.

Calcium and magnesium salts are mainly responsible for the hardness of water. Carbonate hardness occurs when the magnesium and calcium are associated with bicarbonate, and non-carbonate hardness when the salts are sulfates or chlorates. Calcium ranged from 1.2 to 56 ppm and magnesium from 0.2 to 21 ppm in 37 ground-water samples from Mercer County.

Iron and manganese cause stains on textiles and porcelain fixtures if their combined concentration exceeds about 0.3 ppm. Also, they support the growth of certain bacteria which can clog pumps, pipes, and fixtures by forming slime or sludge deposits. Iron ranged from 0.01 to 10 ppm in 36 samples tested and manganese from 0.02 to 0.27 ppm in 26 samples.

Sodium is detrimental to crops if present in irrigation water in high proportion to other positive ions. It may also render water unfit for use because of taste, reaction with compounds in industrial processes, and foaming of boiler-feed water. Analyses of 37 samples showed sodium to range from 2 to 28 ppm.

Potassium can cause foaming in boilers if present with sodium in concentrations over 50 ppm. Potassium ranged from 0.8 to 64 ppm in 37 samples tested.

Chloride salts in concentrations greater than 250 ppm impart a salty taste to the water. Water containing appreciable quantities of chloride is corrosive. Chloride ranged from 2.4 to 27 ppm in 37 samples tested.

Fluoride, if present in concentrations of 0.8 to 1.5 ppm, has been shown to aid in the prevention of tooth decay. In greater concentrations it may cause mottling of teeth in children. Analyses of 37 ground-water samples of Mercer County indicate a fluoride range from 0.0 to 0.4 ppm.

Nitrate may be indicative of organic pollution when present in concentrations greater than 5 ppm (Barksdale and others, 1958, p. 59). High-nitrate content, greater than 50 ppm, is a contributing factor to the infants' disease methemoglobinemia ("blue babies") (Bosch and others, 1950). Nitrate ranged from 0.1 to 123 ppm in 37 samples tested, but only 3 samples contained more than 50 ppm.

Bicarbonate, in a water containing calcium or magnesium, causes carbonate hardness. The alkalinity of most ground waters is due to bicarbonate ions. Bicarbonate ranged from 0 to 196 ppm in 37 ground-water samples collected in Mercer County.

Sulfate causes non-carbonate hardness when combined with calcium and magnesium. Sulfate ranged from 0 to 126 in 37 samples tested.

Carbon dioxide causes corrosion of cement building materials and of iron and steel. Determinations of dissolved carbon dioxide were not made of water samples collected in Mercer County.

Ground-water supplies generally are free of organic pollution because of the natural filtering action of the minute openings in the aquifer through which the water moves very slowly. However, wells that tap large fractures in consolidated rocks are subject to serious contamination if they are near a source of pollution, for the water moves relatively rapidly, and with little filtration, through open channels. Shallow wells in unconsolidated aquifers also are subject to contamination if located too close to a source of pollution.

Chloride and nitrate, when present together in concentrations each exceeding several parts per million, may indicate that the water is being contaminated by biologically reduced organic waste. Several of the ground-water samples tested (table 7) contained relatively high concentrations of chloride and nitrate, suggesting that such contamination is occurring in Mercer County. Hence, extreme care should be taken by all water users to protect their existing and future water resources by eliminating any source of pollution.

Most of the ground water in Mercer County is of excellent quality for domestic, industrial, and agricultural use. The quality varies somewhat from one aquifer to another and from place to place within the same aquifer, and it is sometimes necessary to remove objectionable quantities of iron, to adjust the pH, or to soften the water.

Ground water in the coastal plain part of Mercer County generally is low in dissolved solids (less than 100 ppm). However, its pH is low, and the water is corrosive locally. In the Piedmont part of the county, the water has a higher dissolved-solids content (greater than 100 ppm); its hardness is greater (about 50-200 ppm); and the pH ranges from 5.9 to 7.9.

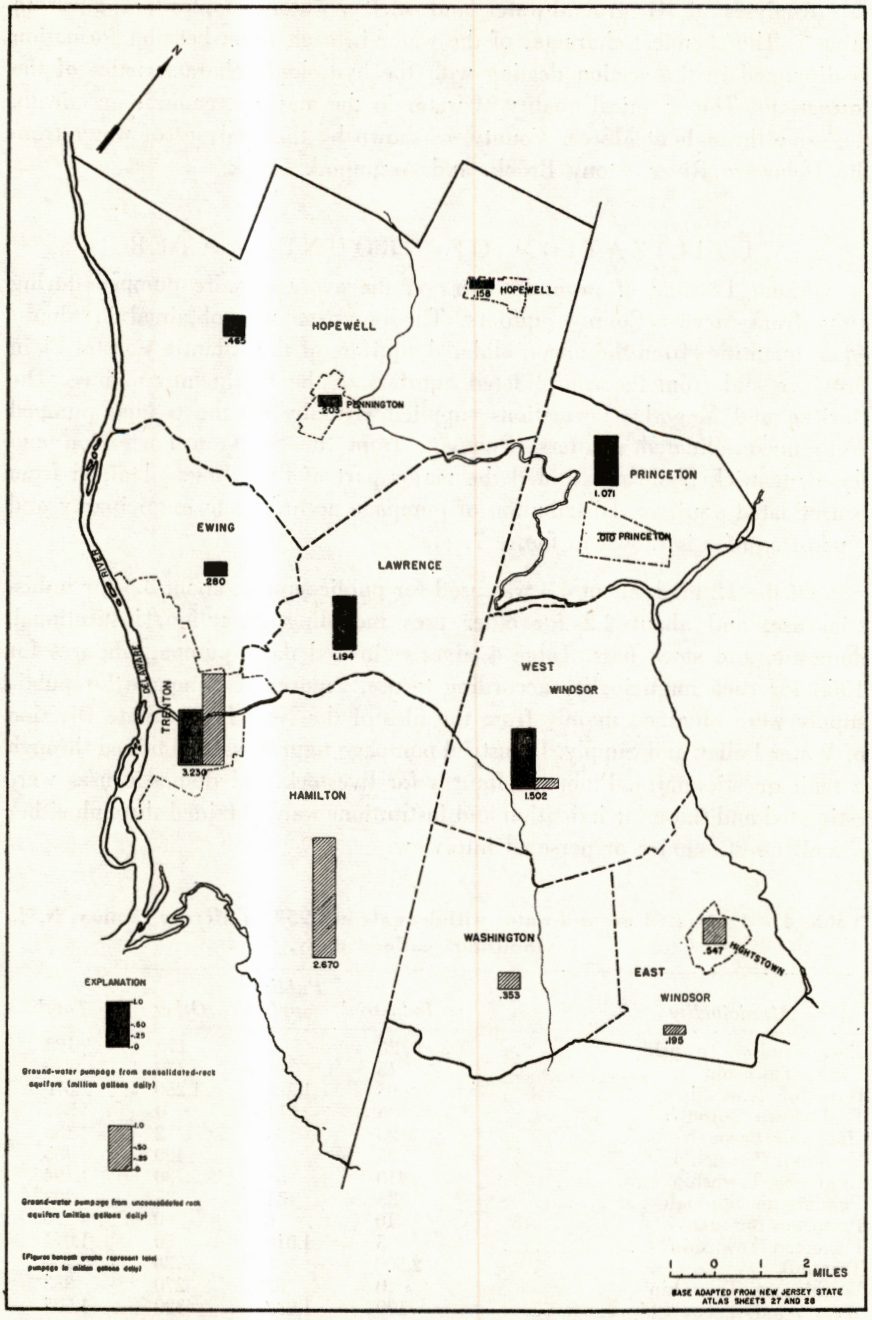


Figure 7.—Map showing average daily ground-water withdrawals in 1958 for each municipality according to type aquifer.

Analyses of 41 ground-water and surface-water samples are given in table 7. The chemical character of the water in each water-bearing formation is discussed in the section dealing with the hydrologic characteristics of the formations. The chemical quality of water in the major streams is practically the same throughout Mercer County, as shown by the analyses of water from the Delaware River, Stony Brook, and Assunpink Creek.

UTILIZATION OF GROUND WATER

About 12 mgd of ground water, on the average, were pumped during 1958 from Mercer County aquifers. The pumpage was obtained in almost equal quantities from the unconsolidated aquifers of the Atlantic Coastal Plain province and from the consolidated aquifers of the Piedmont province. The Raritan and Magothy Formations supplied virtually all the 6 mgd pumped from unconsolidated aquifers. Pumpage from the Stockton Formation and the Brunswick Shale constituted the major part of the 6 mgd obtained from consolidated aquifers. Distribution of pumpage according to municipality and type of aquifer is shown in figure 7.

Of the 12 mgd, about 4.4 was used for public supply, about 3.3 for industrial use, and about 4.2 for other uses including irrigation, institutional, domestic, and stock uses. Table 4 gives estimated daily pumpage figures for 1958 for each municipality according to use. Figures of pumpage for public supply were obtained mainly from the files of the New Jersey State Division of Water Policy and Supply. Industrial-pumpage figures were obtained through a mail questionnaire. Pumpage figures for livestock and domestic uses were estimated and those for irrigation and institutions were obtained through either a mail questionnaire or personal interview.

Table 4.—Estimated ground-water withdrawals in 1958 in Mercer County, N. J., in thousand gallons daily.

Municipality	*Industrial*	*Public supply*	*Other*	*Total*
East Windsor Township	25	0	170	195
Ewing Township	15	95	170	280
Hamilton Township	95	1,325	1,250	2,670
Hightstown Borough	36	511	0	547
Hopewell Borough	20	136	2	158
Hopewell Township	35	0	430	465
Lawrence Township	410	54	730	1,194
Pennington Borough	35	133	35	203
Princeton Borough	10	0	0	10
Princeton Township	5	1,016	50	1,071
Trenton	2,500	0	730	3,230
Washington Township	0	83	270	353
West Windsor Township	100	1,082	320	1,502
Total	3,286	4,435	4,157	11,878

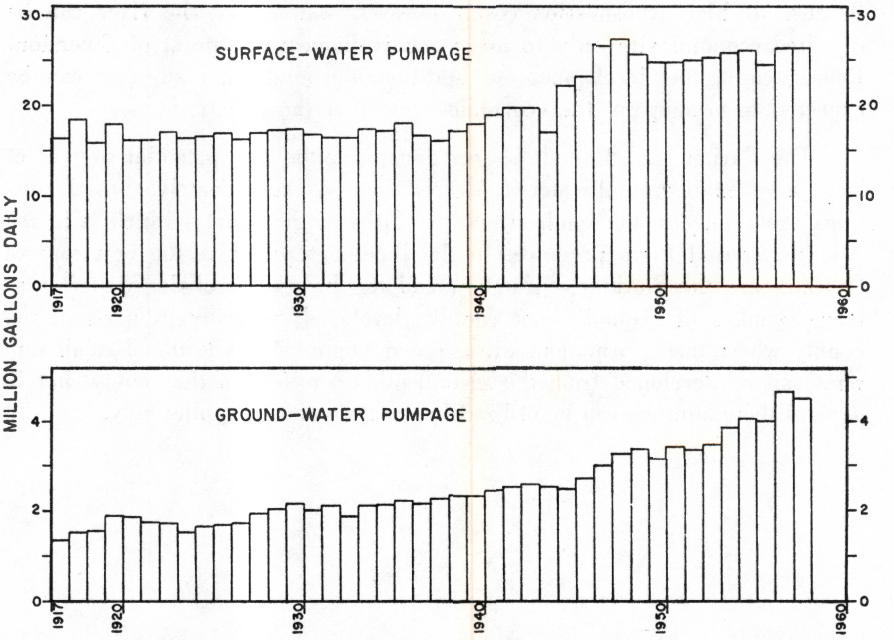


Figure 8.—Histograms of surface-water and ground-water pumpage for public supply in Mercer County, N. J., 1917-58.

Surface water is utilized to a much greater extent than ground water in Mercer County. During 1958, the Trenton Water Department pumped an average of almost 26.5 mgd of water from the Delaware River, whereas the total ground-water pumpage throughout the county was only about 12 mgd. The Trenton Water Department supplies nearly two-thirds of the county's population with water. Figure 8 shows the surface-water pumpage as compared with the ground-water pumpage for public supply in the period 1917 through 1958.

Many farmers in West Windsor, East Windsor, and Washington Townships use water from streams to irrigate their land. A few industries also make use of surface-water supplies.

Approximately one-fifth of the Mercer County residents are supplied with ground water by 13 water departments and companies. Figure 9 shows the areas served by these public suppliers of ground water as well as the area supplied with surface water by the Trenton Water Department.

Mercer County is endowed with an abundant surface-water supply owing to its contiguity with the Delaware River. Tippetts and others (1955, p. v-10) estimate that an ample water supply could be developed from the Delaware River to provide for the Trenton area at least until the year 2000.

Because of high transmission costs, however, water from the river can be supplied economically only to areas relatively near the point of diversion. Consequently, the development of additional ground-water supplies can be expected to accompany the economic growth of the county.

The Raritan and Magothy Formations offer the best potential sources of large supplies of ground water in Mercer County. Unfortunately, these formations occur only in the southeastern two-fifths of the county, which is in the Atlantic Coastal Plain province. In the Piedmont province, the best sources of water are the Stockton Formation and the Brunswick Shale. Moderate to large supplies of ground water can be developed generally in parts of the county where these formations are exposed (figure 3). Additional small supplies can be developed from the several other aquifers in the county, but in general these aquifers can be utilized for local domestic supplies only.

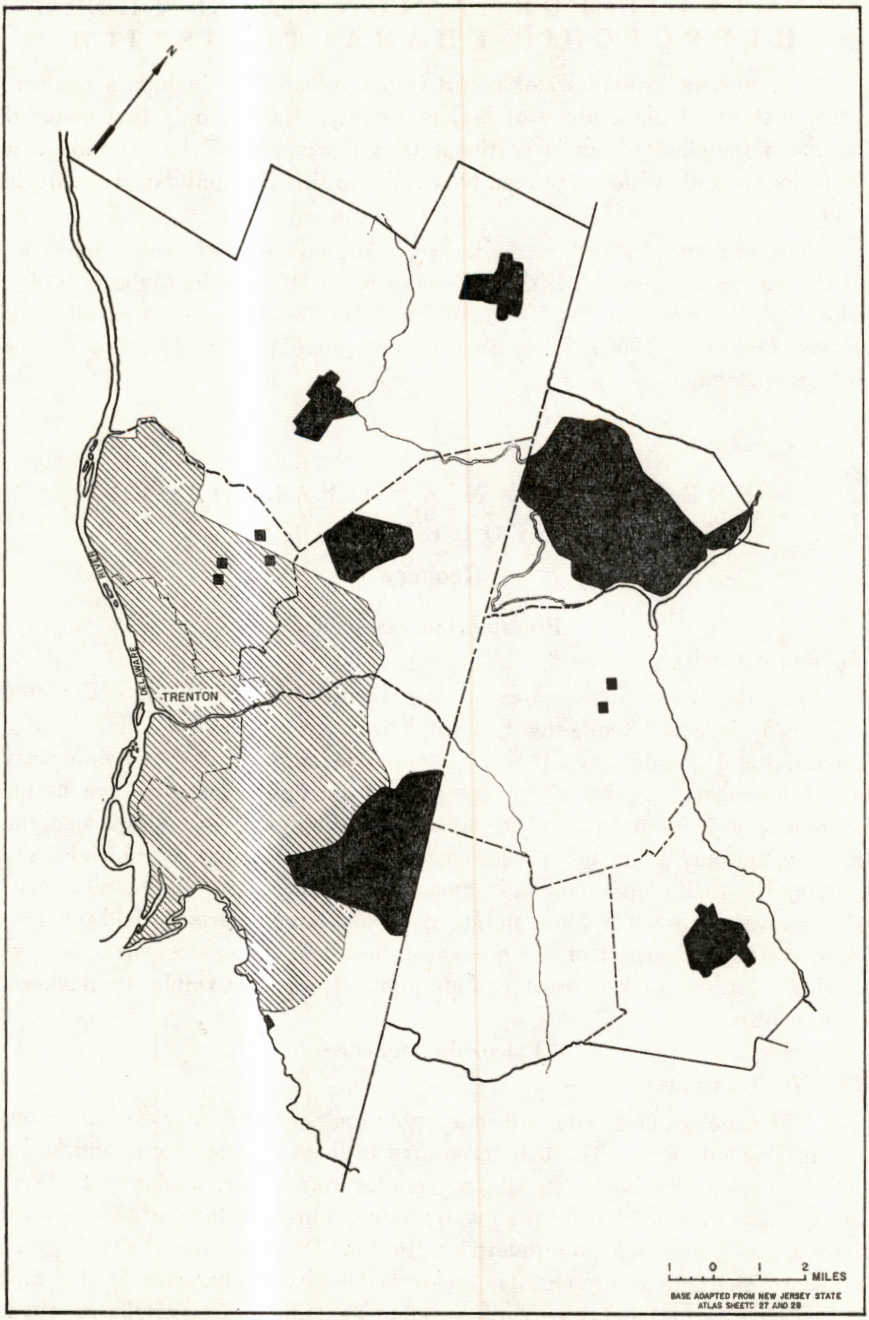


Figure 9.—Areas (in black) served by water departments and water companies utilizing ground water, and area (shaded) served by Trenton Water Department, utilizing surface water, 1958.

GEOLOGIC FORMATIONS AND THEIR HYDROLOGIC CHARACTERISTICS

The present ground water report is not intended to include a comprehensive study of the geology of Mercer County. Rather, only that material has been included which is pertinent to a discussion of the ground-water hydrology, and which is readily available in the published geologic literature.

The geologic descriptions of the rock formations are largely summaries of the discussions contained in the Trenton Folio (Bascom and others, 1909). The geologic maps in the Trenton Folio and the Geologic Map of New Jersey (Johnson, 1950) were used to determine the areal extent of the formational outcrops.

PRECAMBRIAN AND PALEOZOIC SEQUENCES

Geology

Precambrian Sequence

Baltimore Gneiss

The Baltimore Gneiss crops out in Trenton and northeast of Trenton (figure 3) in a belt that ranges in width from an eighth of a mile to half a mile and is 4¼ miles long. It is a complex metamorphic rock of sedimentary and igneous origin, part of the igneous portion being the same age as the sedimentary facies and part of it younger. The Baltimore Gneiss is a medium-grained thoroughly crystalline aggregate of quartz, feldspar, hornblende, and biotite. The rock is predominantly gneissic, but some exposures reveal a massive granitic character. Alternate layers of mica and quartz or feldspar produce the banded aspect of the gneissic facies. The Baltimore Gneiss is thoroughly fractured, and as many as four joint sets are discernible. Its thickness is unknown.

Paleozoic Sequence

Chickies Quartzite

The Chickies Quartzite, a metamorphic rock of sedimentary origin, crops out in Trenton (figure 3). Its outcrop area is about 2½ miles long and half a mile wide at its maximum. Its lithology grades from a blue conglomeratic layer at the base to a thick-bedded gray quartzite, which in turn grades upward into a pale-green schistose quartzite. In the Trenton area the pale-green schistose quartzite is present. The color and schistose character of this unit are attributed to the presence of sericite. The Chickies Quartzite is about 400 feet thick in the Trenton area, but isoclinal folding makes it appear much thicker. It is Cambrian in age.

Wissahickon Formation

The Wissahickon Formation crops out in two irregularly shaped bands (figure 3); one band is in Trenton and the other band is west of Princeton Junction. The outcrop area at Trenton is about 2 miles long and half a mile wide at its widest point. The outcrop area west of Princeton Junction is about 2¼ miles long. This band is almost a mile wide near its western end and less than a quarter of a mile wide near its eastern end.

The Wissahickon Formation is a medium- to coarse-grained foliated crystalline rock, ranging in texture from gneiss to schist. It is composed chiefly of quartz, feldspar, biotite, muscovite, chlorite, and, in some areas, garnet. "The formation is generally believed to have been originally a sedimentary deposit composed chiefly of beds or lenses of sandstone, shale, and arkose. Although these materials have been deformed and recrystallized by subsequent metamorphism, the original banding of the sediments has been largely retained" (Barksdale and others, 1958, p. 69).

The exact thickness of the Wissahickon Formation cannot be determined because of isoclinal folding and lithologic variation. However, estimates of the thickness range from 5,000 to 8,000 feet. The beds are thoroughly faulted and jointed, and it is these fractures, especially when enlarged by weathering, that provide most of the storage for ground water. The Wissahickon is of early Paleozoic (?) age.

Gabbro

Gabbro crops out in two areas in Mercer County; one is in Trenton and the other is just east of Trenton (figure 3). The Trenton outcrop area is about 1½ miles long, and the one to the east is 2 miles long; both have an average width of about a quarter of a mile. Many small gabbroic intrusives occur within the other crystalline rocks, particularly within the Wissahickon Formation and the Baltimore Gneiss. The gabbro is a medium-grained massive igneous rock consisting mainly of pyroxene and plagioclase minerals. It exhibits either a yellowish-gray or a greenish-gray color, according to the character and freshness of the ferromagnesian minerals present. The gabbro is of early Paleozoic (?) age.

Hydrology

The Precambrian and Paleozoic crystalline rocks have similar hydrologic properties and can be treated as a unit even though their orgins and many of their physical and chemical characteristics differ greatly. Relatively little water is obtained from them in Mercer County for several reasons. They have little capacity for storing and transmitting water and they crop out over a very small part of the county. It is only in the Trenton and Princeton Junction areas and

beneath the coastal plain part of the county that the crystalline rocks lie close enough to the surface to be utilized as a water supply. Another reason for the limited use of these rocks as a water supply is that they are covered in most places by younger rocks that are better sources of water. For these reasons, the crystalline rocks are considered relatively poor aquifers.

All these crystalline rocks have little primary porosity in their unweathered state and therefore are relatively impermeable to ground water. Fracturing and weathering, however, have developed secondary porosity and permeability in these rocks. Nearly all ground water in them occurs under water-table conditions in the weathered zone near the land surface. In this weathered zone, storage and movement of water occur in fractures that have resulted from faulting and jointing. These fractures have been enlarged by frost action, by plant roots, and by the dissolving action of circulating ground water. The water-bearing fractures decrease in size and number with increased depth so that the yields of most wells in the crystalline rocks are not appreciably increased by drilling below 200 or 300 feet.

The storage coefficients of the crystalline rocks are in the low range of water-table values, in the order of 0.02 (Greenman, 1955, p. 16). The coefficient of storage, as used by the U.S. Geological Survey, is the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface. It is dimensionless and is expressed as a decimal fraction. In water-table aquifers, the coefficient of storage is practically equal to the specific yield, which is the ratio of the volume of water that will drain by gravity from a saturated rock to the total volume of the rock. It is expressed either as a decimal fraction or as a percentage.

The specific capacities of wells that tap the crystalline rocks also are moderately low to very low. Specific capacity is the discharge of a well expressed as the rate of yield per unit of drawdown, generally gallons per minute per foot of drawdown (gpm per ft). Specific capacities of four large-diameter wells tapping these rocks in Mercer County range from 0.1 to 3.5 gpm per ft and average 1 gpm per ft. Accordingly, a typical well may be expected to exhibit appreciable drawdown at any pumping rate. Yields of 12 large-diameter wells tapping the crystalline rocks range from 5 to 266 gpm and average 46 gpm. Greenman (1955, p. 17) reports an average yield of 40 gpm for 59 wells tapping similar rocks in nearby Bucks County, Pa.

The crystalline rocks in Mercer County yield water of excellent quality. It is generally soft to moderately hard, low in dissolved solids, and, except for iron, is free of objectionable mineral matter for most uses. Analyses of three samples from the Wissahickon Formation are given in table 7.

MESOZOIC SEQUENCE

Triassic System

Stockton Formation

The Stockton Formation is the oldest sedimentary member of the Newark Group. It crops out in a 3-mile-wide belt across Mercer County along the southern margin of the Piedmont province (figure 3). The thickness of the Stockton in this area ranges from 2,300 to 3,100 feet.

Several lithologic units are contained in the Stockton Formation. They consist of light-yellow micaceous, feldspathic sandstone, light-colored arkosic conglomerate, red to brown fine-grained sandstone, and soft red shale. The different lithologies are interbedded in irregular order and are repeated many times, indicating rapidly changing and recurrent conditions of sedimentation. The arkosic conglomerate and the yellow sandstone prevail near the base of the formation, and the red-brown sandstone predominates near the top. Interbedded thin layers of red shale occur throughout the formation. Locally, thin layers of green, purple, and black shale are interlayed with the red shale.

The Stockton Formation dips predominantly to the northwest about 12° to 15°. The formation has been extensively faulted and jointed. Its other structural features include ripple marks, mud cracks, raindrop impressions, and crossbedding in the sandstones.

Because of faulting, the Stockton Formation crops out in a second belt in the Hopewell area (figure 3). There the Stockton has been uplifted to the surface by the Hopewell fault. This belt of outcrop is about 7½ miles long and about half a mile to three-quarters of a mile wide. Westward, toward the Delaware River, the fault changes direction and only the stratigraphically higher Lockatong Formation is at the surface.

The Stockton Formation is the most reliable source of ground water in the Piedmont province in Mercer County. Ground water occurs in joints and in intergranular openings of the sediments where the cementing material has been removed by weathering. Weathering is most prominent in regions of numerous cracks, and both the effects of weathering and the size and number of openings decrease with depth. The depth to which weathering occurs probably seldom exceeds 500 feet (Barksdale and others, 1958, p. 81). The permeability of the Stockton correspondingly decreases with depth to practically nothing in the unaltered rock, and drilling for water is not generally worthwhile at depths below the weathered part.

Ground water generally occurs under water-table conditions in the Stockton Formation. Artesian or semiartesian conditions exist, locally, at depth in the sandstone and conglomerate beds where they are interlayered with the

red shale—the shale acting as a confining layer. Vertical changes in permeability caused by gradations in texture and by differences in the amount of cementing material also account for local artesian pressures.

The Stockton is a reliable source of moderate to large supplies of ground water in Mercer County, especially where the formation is in hydraulic continuity with a nearby body of surface water or with overlying unconsolidated permeable sediments that are saturated. Wherever this hydraulic connection exists, the pumping of a well tapping the Stockton Formation produces a hydraulic gradient which causes water to move from the surface-water body or the overlying sediments into the Stockton. Thus, much more water is available to the well than that which is stored in the surrounding aquifer.

Yields of 84 large-diameter industrial and public-supply wells tapping the Stockton Formation range from 6 to 1,000 gpm and average 152 gpm. The following table shows the distribution of yields for the reported wells:

Yield (gpm)	*Number of wells*
0 – 50	32
51 – 100	18
101 – 200	14
201 – 500	14
> 500	6

The available data do not indicate any correlation between the yield and the depth or diameter of a well tapping the Stockton Formation. However, 14 of the wells listed above belong to the Princeton Water Co. and, of these, 11 have yields greater than 200 gpm. These wells are near bodies of surface water and their high yields are attributed to induced recharge from the surface-water bodies. If these 14 wells are not considered, the average yield becomes 92 gpm, and this figure is thought to be more representative of the aquifer. Specific capacities of 44 wells tapping the Stockton Formation in Mercer County range from less than 0.1 to 10 gpm per ft and average 2 gpm per ft.

A well tapping the Stockton generally draws water from several different water-bearing zones. The zones near the surface are commonly unconfined, or under water-table conditions. The deeper water-bearing zones may contain water that is confined to some degree. Therefore, pumping tests of wells that draw water from several zones would indicate the combined hydraulic characteristics of all the zones.

Pumping tests of wells tapping the Stockton Formation generally indicate low coefficients of storage and transmissibility. From a few preliminary tests, Barksdale and others (1958, p. 82) estimate the coefficient of storage to range from about 0.00001, a value characteristic of artesian conditions, to about 0.001, characteristic of semiartesian, or possibly water-table, conditions. The coefficients of transmissibility determined from these tests range from 1,000 to 35,000 gpd per ft (gallons per day per foot)—the more common values being

in the order of 5,000 gpd per ft. The coefficient of transmissibility as used by the Geological Survey is the rate of flow of water in gallons per day through a vertical strip of the aquifer 1 foot wide and having the full height of the aquifer under a unit hydraulic gradient. Although these values are derived largely from tests conducted outside of Mercer County, they are generally applicable to the area, as demonstrated by a pumping test at Penns Neck for which the coefficients of storage and transmissibility were respectively 0.0002 and 8,000 gpd per ft.

The chemical quality of ground water from the Stockton Formation varies considerably but is generally satisfactory for most uses. The water commonly contains moderate concentrations of dissolved solids and has a hardness that ranges from moderately hard to hard. Analyses of 13 water samples from wells tapping the Stockton Formation are given in table 7.

Lockatong Formation

The Lockatong Formation, the middle sedimentary member of the Newark Group, crops out in two narrow belts traversing Mercer County in a northeast-southwest direction (figure 3). In the southern belt it appears in normal stratigraphic position, dipping to the northwest and overlying the beds of the Stockton. This belt ranges in width from three-quarters of a mile to 2 miles. North of the Hopewell fault, the northern belt of Lockatong outcrop overlies the Stockton along the eastern two-thirds of its outcrop area but the western third is in direct contact with the upper part of the overlying Brunswick Shale. This belt has a maximum width of 1¾ miles.

The Lockatong Formation is made up of dark-gray to black highly fissile shale; hard, massive, black and bluish-purple argillite; dark-gray and green argillite; and dark-red shale. Thin layers of highly calcareous shale also occur, as do all gradations between these types. The Lockatong weathers to a dense clay soil, which impedes the infiltration of precipitation to the water table. The thickness of the Lockatong Formation in this area ranges from 1,800 to 3,600 feet. The beds dip predominantly 12° to 15° NW.

The upper and lower beds of the Lockatong are interfingered with beds of the Brunswick and Stockton, respectively, which suggests that parts of the Lockatong were deposited contemporaneously with parts of the other two formations. The Lockatong was deposited in an area of shallow quiet lakes and swamps surrounded by the fluvial environments in which parts of the Stockton Formation and the Brunswick Shale were deposited simultaneously.

The hydrology of the Lockatong is somewhat similar to that of the crystalline rocks: the ground water occurs under water-table conditions in fractures which have been enlarged by weathering. The Lockatong is generally inferior to the crystalline rocks as a source of water because its weathering products tend to fill the cracks, decreasing the capacity of the Lockatong for storing and

transmitting water. Yields of wells are rarely increased substantially by drilling below the weathered zone because cracks and solution openings decrease in size and number with depth.

Specific capacities of 24 wells tapping the Lockatong range from practically 0 to 3.8 gpm per ft and average 0.6 gpm per ft. The yields of 36 wells range from 3 to 88 gpm and average 19 gpm.

The water in the Lockatong is generally moderately to highly mineralized. (See table 7.) Hardness-forming ions are commonly the only constituents that occur in objectionable quantities, the range of hardness being from 89 to 172 ppm.

Brunswick Shale

The Brunswick Shale is the youngest sedimentary member of the Newark Group. It crops out above and northwest of the Lockatong Formation in a 4-mile-wide belt across the northern part of Mercer County. The Brunswick, like the Stockton and Lockatong, is exposed in a second belt north of the Hopewell fault, but only a small part of this belt is in Mercer County.

The Brunswick Shale consists chiefly of soft, argillaceous shale with hard, fine-grained sandstone and siltstone layers locally. The hard members are mostly near the base of the formation in the transition zone with the Lockatong Formation. The predominant color of the Brunswick is red, although purple, green, yellow, and black layers also are present. The thickness of the Brunswick Shale cannot be determined in Mercer County because the upper part of the formation has been cut out by the Hopewell fault. However, its thickness is estimated to be greater than 6,000 feet along the Delaware River. The formation dips to the northwest at about 12° to 15°, although locally there are variations in the regional dip.

The presence of abundant ripple marks, mud cracks, and raindrop impressions at many horizons in the formation indicate a shallow subaerial environment of deposition. Crossbedding and sharp variation of texture are common in the coarser sediments, adding further evidence of such environment. Imprints of leaves, tree stems, and numerous reptile tracks prove this origin conclusively.

Numerous well-developed fractures intersect the Brunswick Shale at high angles to the bedding, parallel to it, and at intermediate angles. The shale weathers quickly and crumbles into small rectangular fragments that weather to a red clayey soil of varying sandiness.

The Brunswick Shale is generally a reliable source of small to moderate supplies of ground water in Mercer County. Virtually all ground water in the Brunswick occurs in the fractures within the weathered zone of the formation, which probably is somewhat thicker than in the other consolidated rocks of the county because of the soft, well-fractured nature of the shale. It may extend to

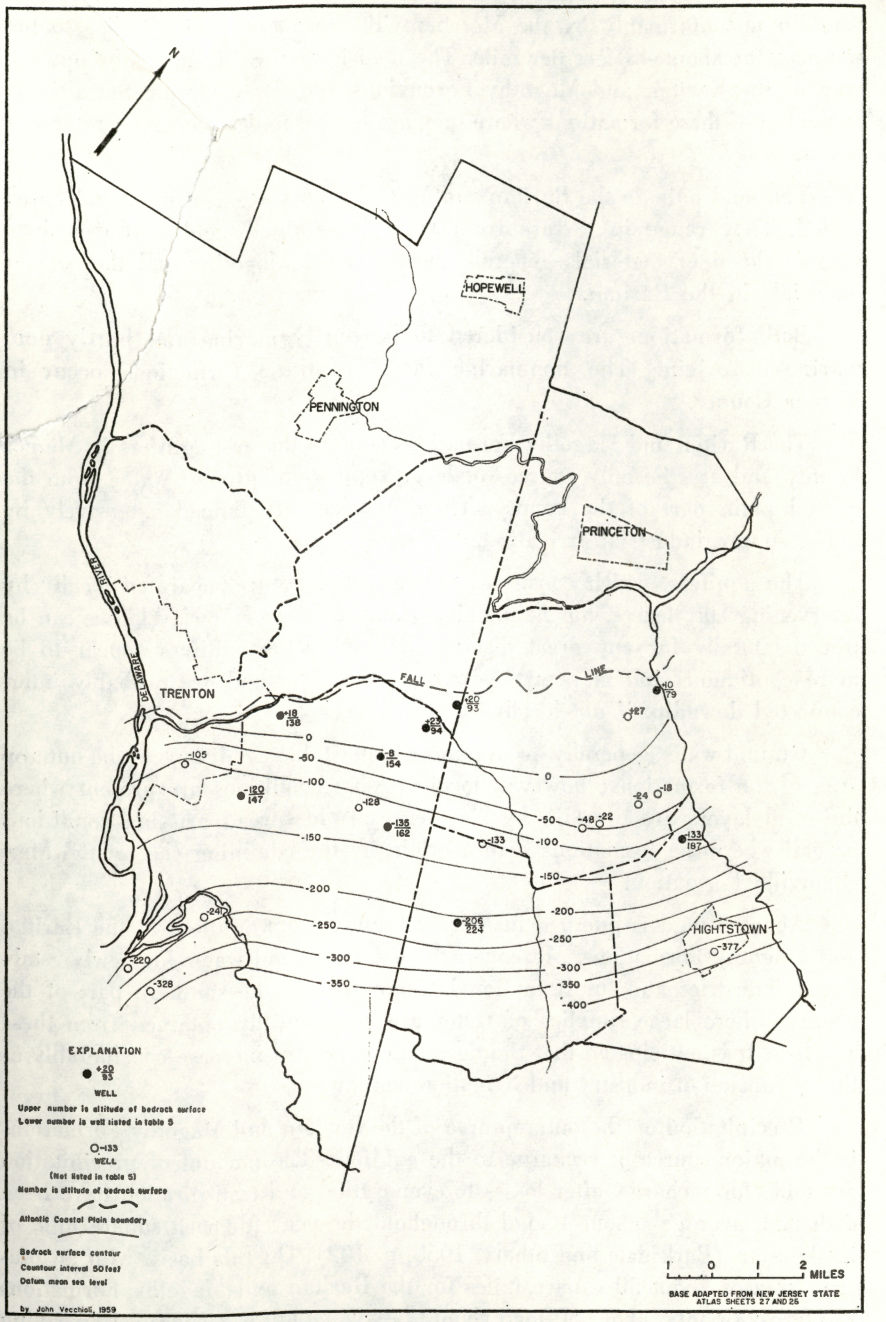


Figure 10.—Generalized structure-contour map of the bedrock surface beneath the Atlantic Coastal Plain of Mercer County, N. J.

The Magothy unconformably overlies the Raritan Formation. It in turn is overlain unconformably by the Merchantville Formation, and it dips to the southeast at about 45 feet per mile. The map in figure 11 shows the outcrop area of the Raritan and Magothy Formations and, by contours, the altitude at the top of these formations where they are buried under younger Cretaceous strata.

The sand units in the Raritan and Magothy Formations are generally well sorted. They range in texture from very fine-grained sand to fine-grained gravel; the finer materials generally occur in the Magothy, and the coarser materials in the Raritan.

Both formations are considered to be partly marine and partly nonmarine in origin. The nonmarine facies of these formations occur in Mercer County.

The Raritan and Magothy Formations contain the best aquifers in Mercer County and are the only sources of large supplies of ground water from the coastal plain part of the county. These aquifers are tapped extensively by public-supply, industrial, irrigation, and domestic wells.

The aquifers, which consist of the sand layers, are separated locally by intervening clay lenses, but neither individual aquifers nor clay lenses can be traced laterally for any great distance. However, the aquifers appear to be more continuous and more extensive than the clays and are probably interconnected downdip, if not locally.

Ground water generally occurs under water-table conditions in the outcrop area of the formations; however, local artesian conditions are present where the sand layers are overlain by clay lenses. Widespread artesian conditions prevail where the formations are overlain by the confining clay of the Merchantville Formation.

About 6 mgd is pumped in Mercer County from aquifers of the Raritan and Magothy Formations. Moreover, the use of ground water for newly established industries and for irrigation is increasing in the southern part of the county, where large supplies of water are economically obtained from these aquifers. It is anticipated that the daily pumpage will increase considerably as this expansion of industry and irrigation continues.

Precipitation on the outcrop area of the Raritan and Magothy Formations is the major source of recharge to the aquifers. The amount of precipitation available for recharge, after losses to evaporation and transpiration have been deducted, averages about 1 mgd throughout the year for each square mile of intake area (Barksdale and others, 1958, p. 102). On this basis, with an outcrop area of about 50 square miles for the Raritan and Magothy Formations in Mercer County, about 50 mgd should be available for recharge. In arriving at this figure, it is assumed that the overlying permeable Pleistocene deposits

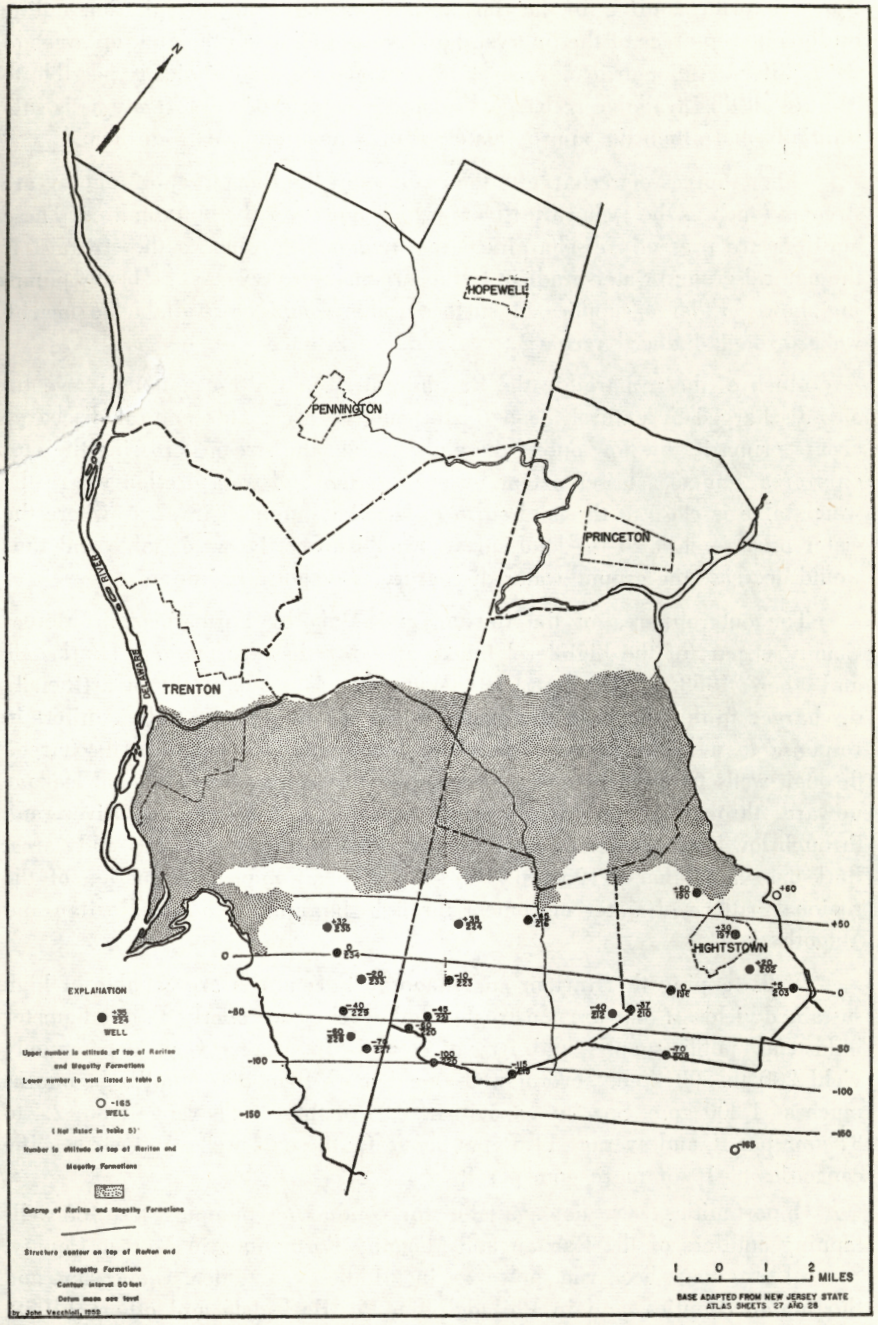


Figure 11.—Generalized structure-contour map of the top of the Raritan and Magothy Formations in Mercer County, N. J.

transmit to the aquifers of the Raritan and Magothy the precipitation falling on the outcrop areas of the intervening clays as well as on the outcrop areas of the aquifers. Although it may never be economically or technically possible to capture all this available recharge, the optimum yield of the formations is substantially more than the approximately 6 mgd now pumped from them.

Other sources of recharge to the aquifers of the Raritan and Magothy are streams (such as the Delaware River) which flow over the outcrop area. These aquifers are presently discharging large amounts of water to the streams. If the natural ground-water gradient to the streams were reversed by heavy pumping, however, large supplies of surface water would be available to nearby wells through induced recharge.

Much of the recharge to the Raritan and Magothy Formations is eventually discharged by natural means in the outcrop area. This natural discharge occurs primarily by flow out of the aquifers into the streams crossing the outcrop area, and to a lesser extent by evaporation and transpiration where the water table is close to the land surface. Heavier pumping in areas where the water table is close to the land surface would lower the water table and thus would decrease the ground-water discharge by evapotranspiration.

The outcrop area of the Raritan and Magothy Formations in Mercer County is part of the high-level intake area for these formations (Barksdale and others, 1958, p. 110, figure 18). Water that is not naturally or artificially discharged in this recharge area moves slowly downdip through the aquifers in response to a slight regional hydraulic gradient. This water is discharged through wells tapping the aquifers downdip, through interformational leakage upward, through a low-level discharge area along the Delaware River, and through low-level submarine discharge areas lying well outside the study area. Barksdale and others (1958, p. 108-128) give a complete discussion of the regional pattern of water movement through the aquifers of the Raritan and Magothy.

Wells tapping the Raritan and Magothy Formations are capable of high sustained yields, if they are constructed and developed properly. Large-diameter industrial, public-supply, and irrigation wells in Mercer County commonly yield 200 to 500 gpm. Several wells yield more than 500 gpm each, one as much as 1,200 gpm. Specific capacities of 24 of these wells range from 2.4 to 37 gpm per ft, and average 11.5 gpm per ft. Of these 24 wells, 10 have specific capacities of 10 or more gpm per ft.

Opportunities were not available for conducting pumping tests of wells tapping aquifers of the Raritan and Magothy Formations in Mercer County. Several tests have been run, however, in Middlesex, Camden, Gloucester, and Burlington counties, and in Philadelphia, Pa. Barksdale and others (1958, p. 96) report an average coefficient of transmissibility of about 45,000 gpd per ft, an average coefficient of storage of about 0.0003, and an average

coefficient of permeability of about 1,000 gpd per sq ft from aquifers of the Raritan. The coefficient of permeability as used by the Geological Survey is the rate of flow of water in gallons per day through a cross-sectional area of 1 square foot under a unit hydraulic gradient. Laboratory tests of samples collected from the Raritan and Magothy Formations in Middlesex County indicate average coefficients of permeability of about 1,300 gpd per sq ft for aquifers of the Raritan and about 400 gpd per sq ft for sands of the Magothy (Barksdale and others, 1958, p. 98). Porosities were about 40 and 45 percent for the Raritan and Magothy, respectively, and specific yields were 35 and 40 percent.

The scarcity of Raritan and Magothy outcrops in Mercer County and the heterogeneity of the formations make it difficult to collect representative samples. Therefore, no laboratory tests were conducted on materials from the Raritan and Magothy. However, the physical properties of the aquifers as determined from the pumping tests and laboratory tests in areas outside Mercer County can be applied, at least in a general way, to these aquifers in the county.

Water from the aquifers of the Raritan and Magothy is generally soft and low in dissolved solids. However, the water contains a high concentration of iron in many places, which necessitates treatment. Also, the pH of the water at several places must be raised prior to use. Chemical analyses of eight samples of water from the Raritan and Magothy Formations are given in table 7.

Merchantville Formation

The Merchantville Formation crops out in a narrow, irregularly shaped belt southeast of the Raritan and Magothy outcrop area (figure 3). The formation is a black glauconitic, micaceous clay that generally has a greasy appearance. It is commonly massive, particularly in the lower part, though the upper part is somewhat sandy and is distinctly laminated in places. The upper and basal beds are generally much more glauconitic than the middle beds. The glauconite is unevenly distributed, generally occurring in patches and lenses rather than as disseminated grains. The formation weathers to a coherent brown earth.

The Merchantville Formation lies disconformably above the Magothy Formation and is conformable with the overlying Woodbury Clay. Its thickness in the outcrop area is 50 to 60 feet. The formation dips to the southeast at a little more than 40 feet per mile and, in common with the other coastal plain formations, is overlain downdip by successively younger strata. Fossils found in the Merchantville indicate that it is of marine origin.

The Merchantville Formation and the overlying Woodbury Clay, as a unit, form an effective aquiclude between the aquifers of the underlying Raritan and Magothy Formations and the water-bearing Englishtown Formation above. An aquiclude is a formation which, although porous and capable of absorbing water slowly, will not transmit it fast enough to furnish an appreciable supply

to a well or spring. Thus, these relatively impermeable formations create artesian conditions in the underlying aquifers of the Raritan and Magothy. No water wells are known to tap the Merchantville Formation in Mercer County.

Woodbury Clay

The Woodbury Clay is exposed in an irregularly shaped belt southeast of the Merchantville outcrop area (figure 3). It is a tough black somewhat micaceous, nonglauconitic clay, slightly sandy in the upper part of the formation, where it is distinctly laminated. It weathers to a light-chocolate color, and when dry, breaks into blocks which exhibit curved or chonchoidal fracture surfaces. The thickness of the formation is about 50 feet at its outcrop area. The Woodbury is of marine origin.

The Woodbury Clay rests conformably upon the Merchantville Formation and is conformably overlain by the Englishtown Formation. It dips to the southeast beneath the younger coastal plain sediments at slightly more than 40 feet per mile.

The Woodbury Clay, together with the Merchantville Formation, serves as an aquiclude between the aquifers in the Raritan and Magothy Formations and the aquifers above. "The Woodbury clay is probably the best aquiclude in the coastal plain of New Jersey because it retains its tough dense character wherever encountered." (Barksdale and others, 1958, p. 136.) Vertical leakage may occur through the clays of the Woodbury and Merchantville Formations, however, because no clay is completely impermeable. Heavy pumping of the aquifers of the Raritan and Magothy could establish a sufficient hydraulic gradient to enable water to percolate through the clays of the Woodbury and Merchantville Formations and recharge the aquifers of the Raritan and Magothy. If such head differences were widespread, considerable quantities of water could leak through the clays into the underlying aquifers.

No water wells are known to tap the Woodbury Clay in Mercer County.

Englishtown Formation

The outcrop area of the Englishtown Formation lies along the southeastern edge of Mercer County (figure 3). The Englishtown is a fine- to medium-grained micaceous, lignitic, quartzose sand that contains thin lenses and laminae of clay. It is generally white, yellow, or brown in outcrop. For the most part, the formation consists of unconsolidated sand, but locally some beds are cemented by iron oxide to form rather massive beds of sandstone. The Englishtown Formation in Mercer County is about 50 feet thick and is of nonmarine origin.

The Englishtown lies conformably above the Woodbury Clay and conformably below the Marshalltown Formation. It dips about 40 feet per mile to the southeast beneath the younger strata.

Ground water occurs under water-table and local artesian conditions in the Englishtown Formation in Mercer County. To the east and southeast in

Monmouth and Ocean counties, the Englishtown becomes an artesian aquifer and is extensively developed for large supplies of ground water, particularly along the coast.

Except for a very small part of the outcrop area just south of Etra, the outcrop width of the Englishtown Formation extends beyond the county boundary. (See figures 1 and 3.) That part of the formation that is present is generally too thin to be a source of large supplies of ground water. It does, however, yield small amounts of water to shallow domestic and farm wells. Yields of 8 wells tapping the Englishtown in Mercer County range from 7 to 30 gpm and average 14 gpm. Specific capacities of 6 wells range from 0.3 to 1.0 gpm per ft and average 0.6 gpm per ft.

A coefficient of permeability of 100 gpd per sq ft was determined by laboratory methods for a sample of sand from the Englishtown taken at Etra. Mechanical analyses of this sample showed it to consist predominantly of medium sand-size particles. Using the formula

$$T = P \times m$$

where T = coefficient of transmissibility in gpd per ft,

P = coefficient of permeability in gpd per sq ft,

and m = thickness of aquifer in feet,

the maximum coefficient of transmissibility that the formation could have in Mercer County is 5,000 gpd per ft, based on the above coefficient of permeability. This figure would apply only to the small area south of Etra where the total saturated thickness of the Englishtown is present.

Water from the Englishtown Formation is generally satisfactory for ordinary uses without treatment except for the removal of iron. Analyses of samples taken from 3 wells in Mercer County and adjacent parts of Monmouth County show iron concentrations of 10 and 11 ppm. The water is commonly low in dissolved solids, soft, and slightly acid. A chemical analysis of a typical Englishtown water sample is given in table 7.

Marshalltown Formation

The Marshalltown Formation crops out in a small area just south of Etra (figure 3). Its lithology ranges from black sandy, micaceous clay to argillaceous glauconitic sand. The Marshalltown is 30 to 35 feet thick at the outcrop area, but this total thickness is not present in Mercer County because of its very small extent in the county. It overlies the Englishtown Formation conformably and dips southeast at a rate slightly greater than 35 feet per mile. The Marshalltown is the youngest Cretaceous formation in Mercer County, and fossils found in it indicate that it is of marine origin.

The Marshalltown Formation has practically no hydrologic significance in Mercer County because of its very small areal extent. Elsewhere, it serves as a confining layer above the Englishtown Formation. No water wells are known to tap the Marshalltown Formation in Mercer County.

CENOZOIC SEQUENCE

Quaternary System

Pleistocene Series

Geology

The Pensauken and Cape May Formations and the stratified drift of Wisconsin age, from oldest to youngest, constitute the Pleistocene Series in Mercer County. These deposits form a discontinuous veneer over the Atlantic Coastal Plain of the county and occur as small isolated patches in the Piedmont part. (See figure 4.) In Mercer County, all these deposits are of subaerial origin.

Pensauken Formation.—The Pensauken Formation is unconsolidated and consists of sand and gravel together with small amounts of silt and clay. Sand predominates over material of larger size but gravel is common, especially at the base. The sand and gravel beds are colored red, yellow, or brown; the clay is white, yellow, or brown.

A great variety of materials is found in the Pensauken in Mercer County. Most of the sand particles and smaller pebbles are composed of quartz, but pebbles of shale, sandstone, quartzite, and crystalline rocks are widely distributed. The Pensauken also contains chert, water-worn ironstone pebbles, and varying amounts of glauconite. Most of the materials are highly decomposed.

In Mercer County, the Pensauken Formation occurs as discontinuous patches (figure 4) disconformably overlying rocks of Cretaceous age or older. The thickness of the patches ranges from about 90 feet to practically nothing. The great variability in thickness is due to unequal deposition and subsequent erosion.

Cape May Formation.—The Cape May Formation is typically a medium- to coarse-grained quartzose sand and gravel with local clay lenses. The sand and gravel beds are various shades of yellow, brown, or gray; and the clays reportedly are yellow, black, brown, and gray.

The Cape May Formation crops out in irregular areas along stream channels in the southern two-thirds of the county (figure 4). Its thickness within this area ranges from 0 to about 30 feet. It lies unconformably on various formations which range in age from Precambrian to Pleistocene.

Stratified drift.—Deposits of stratified drift of Wisconsin age occur in the Trenton area and along the Delaware River above Trenton. They appear to be continuous with the deposits of the interglacial Cape May Formation to the south and east. Therefore, no boundary is drawn between the two on the Pleistocene geologic map (figure 4). The stratified drift includes beds of gravel, sand, and clay and attains a maximum thickness of approximately 30 feet.

Hydrology

The Pleistocene formations are generally thin and therefore are not major aquifers in Mercer County. They yield small supplies of water to shallow wells for domestic and farm use throughout much of their outcrop areas. Moderate supplies for irrigation have been developed in the vicinity of Dutch Neck, where the Pensauken attains a thickness of about 90 feet. Ground water occurs under water-table conditions in the Pleistocene deposits.

Results of a pumping test on a well drawing from the Cape May Formation at Clarksville indicate that these materials are very permeable. An average coefficient of permeability of about 3,000 gpd per sq ft, an average coefficient of transmissibility of 60,000 gpd per ft, and an average coefficient of storage of 0.10 were computed. Specific capacities of 11 wells tapping Pleistocene deposits range from 0.4 to 7.6 gpm per ft and average 2.2 gpm per ft. Yields range from 6 to 340 gpm and average 85 gpm for 19 wells.

Although these deposits do not generally constitute abundant sources of ground water, they have other important hydrologic functions because of their permeability. These beds effectively increase the storage capacities of underlying aquifers by absorbing precipitation and then transmitting the water to them.

The chemical quality of water from the Pleistocene deposits varies from place to place. In general, the water from these formations is only slightly to moderately mineralized; it is soft; the dissolved iron content is low; and the water is slightly acid. (See table 7.)

Recent Series

Recently deposited alluvium is present in many of the stream valleys. It consists of nearly horizontal, stratified gravel, sand, silt, and clay in deposits that are generally only a few feet thick.

Deposits of eolian sand occur at various points in the vicinity of Trenton, particularly on the bluffs bordering the Delaware River. These deposits are rarely more than 2 to 4 feet thick.

The only hydrologic significance of the alluvium and the eolian sand is that they can generally transmit precipitation and surface water to underlying aquifers.

SUMMARY

Virtually all ground water in Mercer County is derived from precipitation within the county. Its occurrence, quality, and availability, however, are controlled largely by the character of the geologic formations. The geology of the county is varied, the aquifers consisting of Precambrian and Paleozoic crystalline rocks, Triassic consolidated sediments and associated igneous rocks, and Cretaceous and Quaternary unconsolidated sands and gravels.

The principal sources of ground water are the sands of the Raritan and Magothy Formations, the Stockton Formation, and the Brunswick Shale. These aquifers supplied almost all the 12 mgd of ground water pumped in 1958 within Mercer County. All the other geologic formations in the county, except the Merchantville Formation, the Woodbury Clay, the Marshalltown Formation, the alluvium, and the eolian sand, generally yield at least small supplies of ground water to wells.

Ground water in all the aquifers throughout the county is generally of suitable quality for most uses. Objectionable concentrations of iron or hardness-forming constituents are present locally, however, and water containing them must be treated for some uses. Water from the aquifers of the Raritan and Magothy has a low pH locally and requires treatment. Relatively high chloride and nitrate concentrations have been noted in several areas, suggesting that the water is being contaminated by biologically reduced organic waste.

It is difficult to give quantitative estimates of the potential ground-water supply available at any selected locality in Mercer County because of the lack of detailed geologic and hydrologic data. Qualitative statements can be made, however, concerning availability of additional supplies. The aquifers of the Raritan and Magothy Formations offer the most dependable sources of additional large supplies of ground water in the county. Additional moderate to large supplies can be developed in the parts of the county where the Stockton Formation and the Brunswick Shale crop out. Problem areas exist in all the aquifers, however, so that locally it may not be possible to develop large ground-water supplies. Additional small supplies can be developed from the several other aquifers, but, in general, these aquifers can be utilized only for local domestic supplies.

The continued collection of basic geologic and hydrologic data is necessary, even though there are no water shortages in Mercer County, except in a few small areas. Growth of population, industrial expansion, and the increase in irrigation will cause an increase in the daily withdrawals of ground water throughout most parts of the county. Only through the continued study and interpretation of data can the water resources of the area be accurately evaluated and managed to prevent the deterioration of this extremely valuable natural resource.

REFERENCES

Barksdale, H. C., Greenman, D. W., Lang, S. M., Hilton, G. S., and Outlaw, D. E., 1958, Ground-water resources in the Tri-State Region adjacent to the lower Delaware River: New Jersey Dept. Conserv. and Econ. Devel. Spec. Rept. 13, 190 p.

Barksdale, H. C., Johnson, M. E., Schaefer, E. J., Baker, R. C., and DeBuchananne, G. D., 1943, The ground-water supplies of Middlesex County, New Jersey: New Jersey Water Policy Comm. Spec. Rept. 8, 160 p.

Bascom, Florence, Darton, N. H., Kümmel, H. B., Clark, W. B., Miller, B. L., and Salisbury, R. D., 1909, Trenton folio, N.J.-Pa.: U. S. Geol. Survey Geol. Atlas, Folio 167, 24 p.

Bosch, H. M., Rosenfield, A. B., Huston, Roberta, Shipman, H. R., and Woodward, F. L., 1950, Methemoglobinemia and Minnesota well supplies: Am. Water Works Assoc. Jour., v. 42, no. 2, p. 161-170.

California State Water Pollution Control Board, 1957, Water Quality Criteria: Pub. no. 3, p. 163-409.

Candeub and Fleissig, 1957, Trenton central district plan—Trenton and Mercer County economic study: Greater Trenton Council and City of Trenton, N. J., 32 p.

Fenneman, N. M., 1938, Physiography of eastern United States: New York, McGraw-Hill Book Co., Inc., 714 p.

Greenman, D. W., 1955, Ground-water resources of Bucks County, Pennsylvania: Pennsylvania Topog. and Geol. Survey, Fourth Ser. Bull. W11, 66 p.

Johnson, M. E., 1950, Revision of Lewis, J. V., and Kümmel, H. B., 1912, Geologic map of New Jersey: New Jersey Dept. Conserv. and Econ. Devel. Atlas Sheet 40.

Kümmel, H. B., 1913, Annual administrative report of the State Geologist for the year 1912: N. J. Geol. Survey Bull. 8, p. 12-14.

Lamar, W. L., 1942, Industrial quality of public water supplies in Georgia, 1940: U. S. Geol. Survey Water-Supply Paper 912, 83 p.

Meinzer, O. E., 1923a, The occurrence of ground water in the United States: U. S. Geol. Survey Water-Supply Paper 489, 321 p.

————, 1923b, Outline of ground-water hydrology: U. S. Geol. Survey Water-Supply Paper 494, 71 p.

New Jersey Department of Agriculture, 1957, New Jersey agriculture statistics, 1945-1956: Circ. 404, 83 p.

Rutgers Planning Service, 1957, A regional planning pilot study of the Millstone watershed: New Brunswick, N. J., Rutgers Univ., 83 p.

Tilton, G. R., Wetherill, G. W., Davis, G. L., and Hopson, C. A., 1958, Ages of minerals from the Baltimore gneiss near Baltimore, Maryland: Geol. Soc. America Bull., v. 69, no. 11, p. 1469-1474.

Tippetts, E. F., Abbett, R. W., McCarthy, G. T., and Stratton, J. H., 1955, Study of water demand by service areas and transmission requirements, chap. V *in* Survey of New Jersey water resources development: New Jersey Legislative Comm. on Water Supply, p. 1-13.

BASIC DATA

SELECTED WELL RECORDS

Data for 241 selected wells in Mercer County are given in table 5, and the locations of these wells are shown on figure 12; the well numbers in the table correspond to the well numbers on the map. The wells were selected to give sufficient areal distribution to show conditions in all the aquifers. They include all active public-supply wells (as of 1958) and some industrial, agricultural, and domestic wells. Almost all the data given in the table were obtained from drillers' records supplied by personnel of the State Geologist's office. The locations of the wells were field checked.

Table 5 is self-explanatory except for the column headed "New Jersey grid number." The series of numbers in this column show locations of the wells according to a system based upon the New Jersey topographic atlas sheets. Mercer County is included in parts of atlas sheets 27 and 28 (figure 13). The numbering system was described by Kümmel (1913, p. 13 and 14) as follows: "Each atlas sheet is divided into rectangles measuring 6-minutes of latitude and 6-minutes of longitude. Beginning in the upper left-hand corner, these are numbered across the sheet from 1 to 5, inclusive, number 5 being an incomplete rectangle comprising 2-minutes of longitude at the right. Those on the second row are numbered 11 to 15, those on the third 21 to 25, those on the fourth 31 to 35 and on the fifth 41 to 45. The rectangles numbered 41 to 44, inclusive, differ from the others in comprising 6-minutes of longitude and 4-minutes of latitude. Number 45 embraces 2-minutes of longitude and 4-minutes of latitude. Each of these rectangles is divided into smaller rectangles measuring 2-minutes of latitude and 2-minutes of longitude by lines already engraved upon the sheet. The 2-minute rectangles in each of the 6-minute rectangles are numbered from 1 to 9 beginning in the upper left-hand corner and numbering to the right, number 4 being on the left under number 1. The subdivisions of the incomplete 6-minute rectangles on the right of the sheet, i.e., those numbered 5, 15, 25, 35, are numbered 1, 4, 7, of those at the bottom, i.e., numbers 41, 42, 43, 44, the subdivisions are numbered 1, 2, 3, 4, 5, 6. The subdivisions of the incomplete rectangle in the lower right-hand corner, number 45, are numbered 1, 4. It is evident that by writing first the number of the atlas sheet; second, the number of the 6-minute rectangle; and third, the number of any 2-minute rectangle, we can form a combination of numbers peculiar to any 2-minute rectangle within the State. In order to locate points more accurately each of the 2-minute rectangles is divided into nine equal parts, numbered from 1 to 9, beginning in the upper left-hand corner, and each of these is again divided into nine, numbered similarly. The smallest rectangles represent areas about 330 yards from east to west and 440 yards from north to south. By adding the appropriate numbers of these two smaller divisions to the three already written, it is possible to get a combination which represents the exact location of any area 330x440 yards."

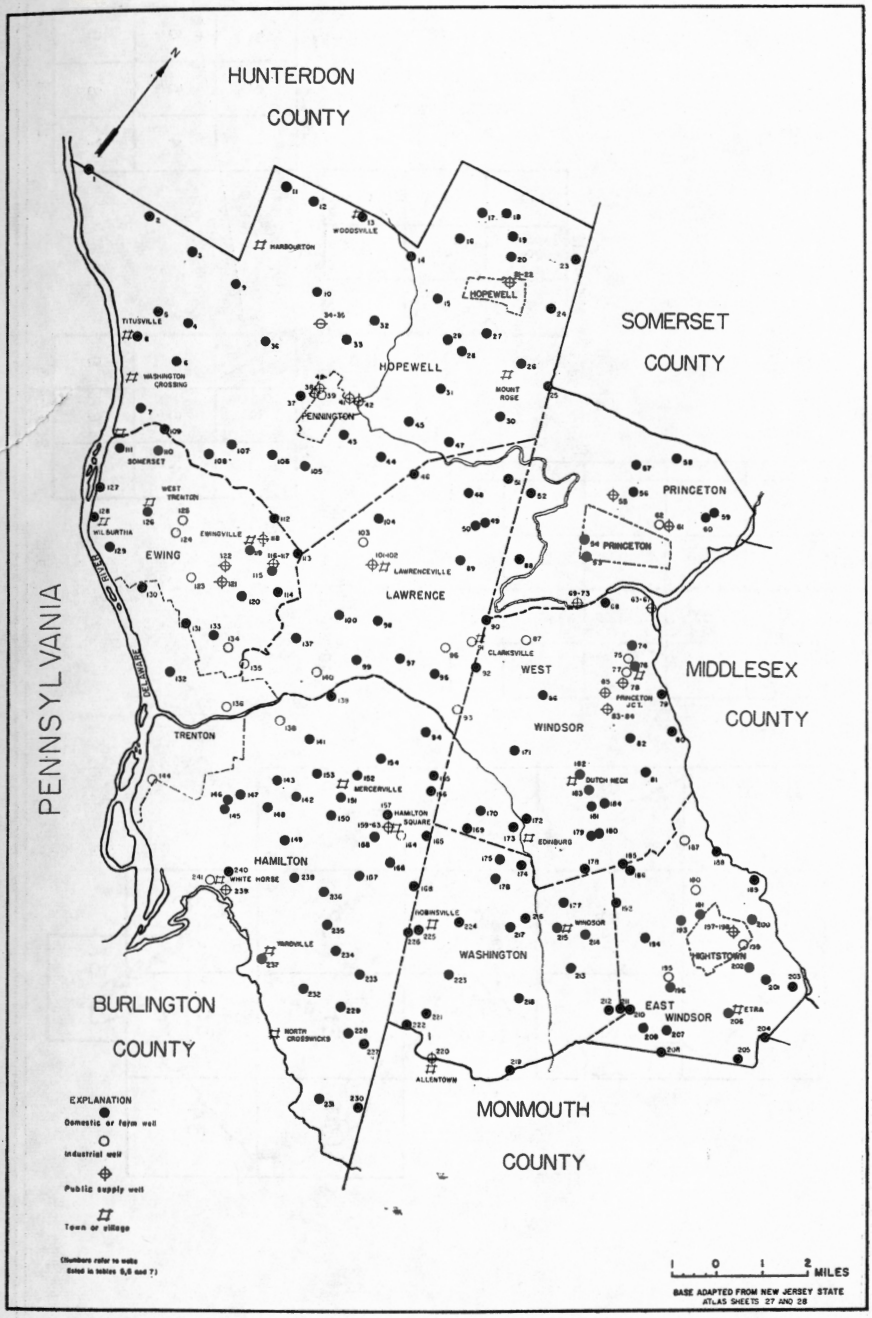


Figure 12.—Map showing locations of selected wells in Mercer County, N. J.

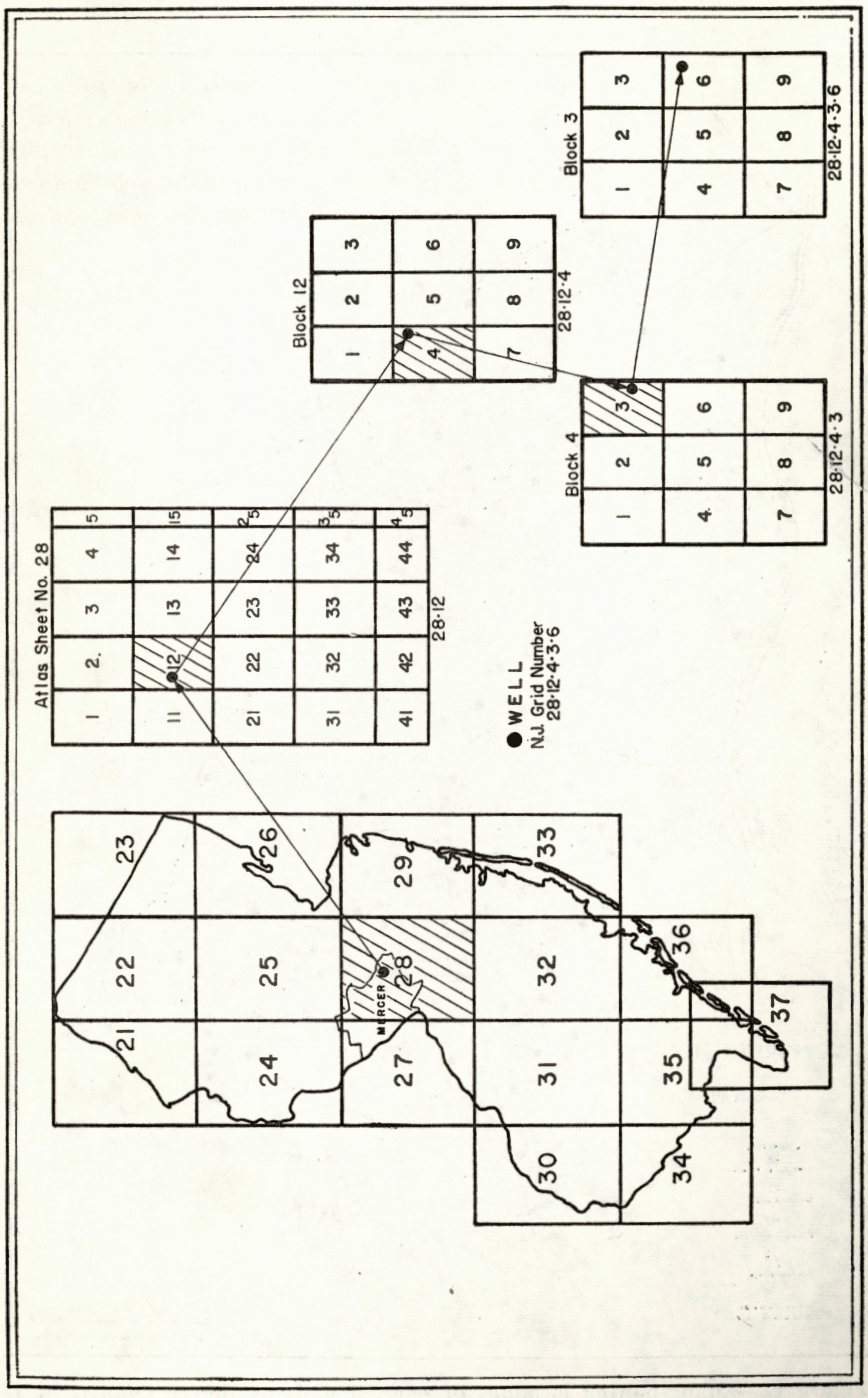


Figure 13.—Diagram illustrating the New Jersey grid numbering system.

SELECTED WELL LOGS

Logs of 11 selected deep wells in the Atlantic Coastal Plain of Mercer County are given in table 6. Prepared from drillers' records, they were selected to show the depth and thickness of water-bearing sand layers throughout this part of the county. The well logs are numbered according to the well numbers in table 5, which contains construction and yield data for the wells, and on figure 12, which shows the location of the wells.

Wells in the Piedmont part of the county obtain practically all their water from fractures and solution cavities in the consolidated rocks. Drillers' logs describing the materials penetrated in the drilling of these wells generally do not indicate in detail the degree of fracturing and weathering of the materials, which varies considerably within short distances. Because it is difficult to select representative well logs that would indicate the depth and thickness of water-bearing zones in the Piedmont province, such logs are not included in this report.

CHEMICAL ANALYSES

Chemical analyses of 37 ground-water samples and 4 surface-water samples are compiled in table 7. The well numbers in the table correspond to the well numbers on the well-location map (figure 12) and the well-data sheets (table 5). Sources of samples not shown on the well-location map and not described in the well-data sheets are given in footnotes to the table.

Table 5.—Records of Selected Wells in Mercer County, N. J.

(Static water level, yield, and drawdown reported for date of well completion. Use of water: AC, air conditioning; D, domestic; I, industrial; Irr, irrigation; PS,, public supply; U, unused. Other data available: C, chemical analysis in Table 7; L, log, Table 6.)

Well	Owner or tenant	New Jersey Grid Number	Driller	Date completed	Altitude of land surface above mean sea level (feet)
1	B. Given	27.13.3.7.4.	C. Snyder	10/11/51	110
2	W. Suydam	27.14.1.7.4	G. Orr	5/21/57	80
3	Mrs. Graham	27.14.1.9.4	E. C. Stover	6/12/54	400
4	R. B. Power	27.14.5.4.3	F. Ziegenfuss & Son	4/ 7/53	260
5	J. Hinkle	27.14.4.6.5	M. Seitz	5/17/57	180
6	C. Majeski	27.14.5.8.4	R. Tilton	1/18/53	180
7	J. E. Postley	27.14.8.5.1	Wm. Stothoff Co.	12/31/53	160
8	A. J. Bennett	27.14.4.9.5	G. Orr	4/25/56	100
9	G .Bear	27.14.2.8.4	F. Ziegenfuss & Son	8/ 1/52	280
10	B. Hansen	27.14.3.4.3	Dinunzi Co.	2/15/54	300
11	F. Arch	27.4.8.7.5	G. Orr	7/ 2/52	360
12	J. C. Sheridan, Jr.	27.4.8.8.6	M. Seitz	7/ 8/54	370
13	J. S. Clawson	27.4.9.4.8	L. Bainbridge	5/25/54	240
14	W. T. Elliot	27.4.9.6.9	W. Travis	8/ 1/51	240
15	J. L. Backes	27.5.7.8.2	C. Snyder	11/24/50	240
16	H. Espenharst	27.5.7.1.6	F. Ziegenfuss & Son	9/ 2/53	280
17	V. Dagostino	27.5.4.7.6	G. Orr	10/14/57	420
18	M. Ruberto	27.5.4.8.2	T. Larason	9/ 4/53	440
19	N. Stellitano	27.5.4.9.5	C. Snyder	5/24/52	340
20	H. Edsko	27.5.7.3.3	D. Van Eaton	9/10/53	420
21	Hopewell Water Dept.	28.1.7.1.4	Wm. Stothoff Co.	1914	220
22	do.	28.1.7.1.4	do.	1915	220
23	A. C. Collins	28.1.4.8.3	D. Van Eaton	5/17/53	390
24	R. H. Vansant	28.1.7.3.4	T. Larason	8/12/52	160
25	F. Sutphen	28.1.8.7.3	C. Snyder	10/24/53	280
26	G. Carom	28.1.7.9.2	T. Larason	10/17/51	240
27	R. L. Hunt	28.1.7.7.3	T. Hunter	5/ 2/57	300
28	J. Kianka	28.11.1.1.2	F. Ziegenfuss & Son	2/ 2/53	190
29	Colonial Construction of Princeton, Inc.	27.15.1.3.3	do.	5/29/58	220
30	Western Electric Co., Inc.	28.11.2.1.7	T. Larason	1948	190
31	H. K. Pedersen	28.11.1.4.3	I. & P. Elec. Co.	12/ 2/57	140
32	Gulf Oil Co.	27.15.1.1.7	C. Snyder	6/26/58	205
33	D. B. Wicoff	27.14.3.6.9	R. Tilton	9/ ?/53	200
34	Pennington Water Dept.	27.14.3.5.9	———	1919	260
35	do.	27.14.3.5.9	———	1923	260
36	H. Smith	27.14.6.1.2	G. Orr	3/30/56	200
37	Tobiason & Son	27.14.6.3.9	F. Ziegenfuss & Son	5/29/56	200
38	Pennington Water Dept.	27.15.4.1.4	Ridpath & Potter	1927	200
39	Cointreau, Ltd.	27.15.4.1.1	Wm. Stothoff Co.	———	200
40	Pennington Water Dept.	27.15.4.1.4	Wm. Stothoff Co.	11/13/57	200
41	do.	27.15.4.2.1	L. Bainbridge	1947	180
42	do.	27.15.4.2.2	T. Larason	5/27/54	140
43	Howe Nurseries	27.15.4.5.2	F. Ziegenfuss & Son	8/ 6/57	180
44	B. Mraz	28.11.4.1.8	T. Larason	6/19/54	180

Total depth of well below land surface (feet)	Diameter (inches)	Depth to which well is cased (feet)	Screen setting (feet)	Aquifer	Static water level below land surface (feet)	Yield (gpm)	Drawdown (feet)	Specific capacity (gpm/ft.)	Use of water	Other data available	Well
[illegible]	6	52	None	Lockatong Formation	45	5	45	0.11	D		1
90	6	21	do.	Brunswick Shale	15	10	50	.20	D		2
257	6	19	do.	Diabase	50	5	135	.03	D		3
160	6	24	do.	Brunswick Shale	58	5	72	.07	D	C	4
103	6	22	do.	do.	25	20	25	.80	D		5
138	6	22	do.	do.	40	15	20	.75	D		6
397	8	32	do.	do.	25	8	235	.03	D		7
130	6	24	do.	do.	80	15	20	.75	D		8
95	6	22	do.	do.	4	9	26	.34	D		9
100	6	29	do.	Diabase	8	10	35	.28	D		10
60	6	22	do.	Lockatong Formation	3	8	32	.25	D		11
95	6	25	do.	do.	8	6	77	.08	D		12
50	6	22	do.	do.	7	20	38	.52	D		13
150	6	22	do.	Stockton Formation	6	4	94	.04	D		14
117	6	55	do.	Diabase	18	10	32	.31	D		15
55	6	23	do.	Lockatong Formation	10	5	20	.25	D		16
95	6	30	do.	do.	11	20	64	.31	D		17
121	6	16	do.	do.	12	10	58	.17	D		18
82	6	19	do.	do.	15	7	40	.17	D		19
148	6	21	do.	do.	26	4	89	.04	D		20
251	8	31	do.	Stockton Formation	16	30	185	.19	PS	C	21
243	8	40	do.	do.	16	15	169	.88	PS		22
208	6	21	do.	do.	18	50	42	1.19	D		23
139	6	21	do.	Brunswick Shale	17	7	53	.13	D		24
59	6	37	do.	Diabase	8	8	22	.36	D		25
130	6	15	do.	Brunswick Shale	23	8	47	.17	D		26
63	6	21	do.	Diabase	30	2	—	—	D		27
100	6	23	do.	Brunswick Shale	8	6	60	.10	D		28
100	6	24	do.	do.	16	20	24	.83	D		29
185	6	12	do.	do.	14	20	36	.55	D	C	30
200	6	24	do.	do.	70	5	80	.06	D		31
150	6	35	do.	do.	18	14	72	.19	D		32
94	6	22	do.	do.	30	8	30	.26	D		33
159	6	—	do.	do.	—	50	—	—	PS		34
170	6	—	do.	do.	—	30	—	—	PS		35
105	6	32	do.	do.	10	12	45	.26	D		36
155	6	31	do.	do.	55	15	45	.33	D		37
657	8	53	do.	do.	38	48	112	.42	PS	C	38
300	8	—	do.	do.	60	68	100	.68	I		39
272	10	43	do.	do.	83	201	62	3.24	PS		40
512	8- 6	50	do.	do.	45	40	155	.25	PS		41
178	12-10	43	do.	do.	19	38	141	.27	PS	C	42
205	6	22	do.	do.	30	22	120	.18	Irr		43
125	6	22	do.	do.	29	10	41	.24	D		44

Table 5.—Records of Selected Wells in Mercer County, N. J. (Continued)
(Static water level, yield, and drawdown reported for date of well completion.
Use of water: AC, air conditioning; D, domestic; I, industrial; Irr, irrigation; PS,, public supply; U, unused. Other data available: C, chemical analysis in Table 7; L, log, Table 6.)

Well	Owner or tenant	New Jersey Grid Number	Driller	Date completed	Altitude of land surface above mean sea level (feet)
45	T. Kuller	28.11.1.7.5	T. Larason	6/22/53	160
46	A. C. Blackwell	28.11.4.2.6	E. C. Stover	11/13/53	200
47	T. Engle	28.11.1.9.1	M. Seitz	11/ 9/56	120
48	H. Goldstine	28.11.5.1.3	Wm. Stothoff Co.	10/23/50	180
49	A. N. Hazeltine	28.11.5.3.4	do.	2/15/49	200
50	G. A. Van Cleve	28.11.5.2.9	R. Tilton	12/12/52	200
51	Educational Testing Service	28.11.2.5.8	Wm. Stothoff Co.	3/ 9/57	160
52	W. W. Augustine	28.11.2.9.3	L. Bainbridge	3/15/54	160
53	S. Kidd	28.12.1.7.4	F. Ziegenfuss & Son	10/12/53	60
54	T. R. Ritts	28.11.3.9.2	Wm. Stothoff Co.	5/13/53	200
55	Princeton Water Co.	28.11.3.3.5	Artesian Well Drilling Co.	7/ ?/58	180
56	A. Foulet	28.11.3.3.3	Wm. Stothoff Co.	10/30/57	200
57	L. Anderson	28.1.9.9.4	F. Ziegenfuss & Son	10/30/52	320
58	Ed. D. Cook	28.2.7.4.4	C. Snyder	3/29/52	260
59	Esther Todd	28.2.7.9.3	T. Larason	8/11/52	160
60	G. Hall	28.2.7.9.5	F. Ziegenfuss & Son	12/31/57	160
61	Princeton Water Co.	28.12.1.2.4.	Artesian Well Drilling Co.	12/ ?/57	140
62	Princeton Shopping Center	28.12.1.2.5	Wm. Stothoff Co.	8/ 9/52	140
63	Princeton Water Co.	28.12.1.9.6	Artesian Well Drilling Co.	1927	60
64	do.	28.12.2.7.4	do.	1929	60
65	do.	28.12.1.9.6	do.	1930	60
66	do.	28.12.1.9.6	do.	2/ 7/45	60
67	do.	28.12.2.7.4	do.	1/25/56	60
68	Delaware & Raritan Canal	28.12.4.2.2	F. Ziegenfuss & Son	12/16/53	80
69	Princeton Water Co.	28.12.4.1.9	Thomas Harper	1905	50
70	do.	28.12.4.1.5	do.	1913	50
71	do.	28.12.4.1.6	P. H. & J. Conlan	1915	50
72	do.	28.12.4.1.6	do.	1923	50
73	do.	28.12.4.1.9	Artesian Well Drilling Co.	8/ 8/29	50
74	Stanfield Corp.	28.12.5.1.8	D. Van Eaton	1/ 6/56	80
75	McLean Engineering Co.	28.12.5.4.2	Wm. Stothoff Co.	9/ 1/53	60
76	M. L. Wadlin	28.12.5.4.3	Herman Owen	12/14/57	60
77	Roger Williams, Inc.	28.12.5.4.3	Wm. Stothoff Co.	2/10/56	70
78	Princeton Jct. Water Co.	28.12.5.4.9	do.	4/14/55	110
79	F. Stewart	28.12.5.6.4	L. Bainbridge	8/11/52	70
80	E. Hahn	28.12.6.4.8	L. Bainbridge	3/ 3/56	90
81	Lloyd Smith	28.12.9.1.2	Andy White	9/ 4/51	100
82	Citizens Rifle & Revolver Club	28.12.5.9.8	L. Bainbridge	9/ 6/55	100
83	Princeton Colonial Park	28.12.5.7.6	Wm. Stothoff Co.	5/13/58	90
84	do.	28.12.5.7.6	do.	11/11/58	90
85	Princeton Jct. Water Co.	28.12.5.7.2	T. Larason ?	1938	110
86	P. A. Zerman	28.12.7.2.6	L. Bainbridge	10/ 4/57	80
87	Paradise Pool, Inc.	28.12.4.7.4	D. Van Eaton	6/11/54	60
88	F. Dunn	28.11.6.1.9	F. Ziegenfuss & Son	5/19/56	170

Total depth of well below land surface (feet)	Diameter (inches)	Depth to which well is cased (feet)	Screen setting (feet)	Aquifer	Static water level below land surface (feet)	Yield (gpm)	Drawdown (feet)	Specific capacity (gpm/ft.)	Use of water	Other data available	Well
135	6	22	None	Brunswick Shale	23	7	57	0.12	D		45
76	6	16	do.	Lockatong Formation	21	8	24	.33	D		46
173	6	24	do.	Brunswick Shale	20	18	55	.32	D		47
103	6	22	do.	Lockatong Formation	10	25	35	.71	D		48
105	6	28	do.	do.	3	30	12	2.50	D		49
95	6	18	do.	do.	10	10	30	.33	D		50
248	8	30	do.	do.	13	45	148	.30	AC		51
116	6	33	do.	do.	8	15	107	.14	D		52
70	6	35	do.	Stockton Formation	12	20	33	.60	D		53
179	8	31	do.	do.	30	140	30	4.66	D		54
403	12	36	do.	Brunswick Shale	13	197	187	1.05	PS		55
240	8	181	do.	do.	37	30	113	.26	D		56
56	6	22	do.	Diabase	14	10	31	.32	D		57
65	6	28	do.	do.	8	10	42	.23	D		58
175	6	18	do.	Brunswick Shale	20	8	60	.13	D	C	59
328	6	22	do.	Lockatong Formation	50	8	110	.07	D		60
572	12	25	do.	do.	70	88	118	.72	PS		61
393	10	38	do.	Brunswick Shale	1	460	49	9.38	AC		62
503	16-10	35	do.	Stockton Formation	2	150	71	2.11	PS	C	63
301	14-10	29	do.	do.	—	350	90	3.88	PS		64
302	14-10	10	do.	do.	—	450	—	—	PS		65
300	12	69	do.	do.	5	250	143	1.74	PS		66
335	18-12	63	do.	do.	12	700	88	7.95	PS		67
84	6	30	do.	do.	4	30	41	.73	D		68
490	8	35	do.	do.	24	600	—	—	PS		69
353	10	25	do.	do.	—	250	—	—	PS		70
305	10- 8	25	do.	do.	—	550	—	—	PS		71
294	10	25	do.	do.	—	700	—	—	PS		72
301	14-10	40	do.	do.	25	905	—	—	PS	C	73
80	6	42	do.	do.	12	6	53	.11	D		74
393	8	89	do.	do.	9	150	71	2.11	AC	C	75
200	6	96	do.	Wissahickon Formation	22	12	108	.11	D		76
155	6	44	do.	Stockton Formation	10	30	18	1.66	I		77
312	8- 6	74	do.	Wissahickon Formation	2	20	167	.11	PS	C	78
112	6	60	do.	Stockton Formation	10	3	80	.04	D		79
95	6	92	92- 95	Raritan and Magothy Formations	45	10	20	.50	D		80
55	4	52	52- 55	Pleistocene Deposits	40	6	10	.60	D		81
26	4	23	23- 26	do.	6	9	14	.64	D		82
283	8	34	None	Wissahickon Formation	3	60	167	.36	PS	C	83
339	8	47	do.	do.	8	266	76	3.50	PS		84
306	8- 6	54	do.	do.	58	6	—	—	PS	C	85
91	6	47	do.	do.	18	10	42	.23	D		86
320	6	37	do.	Stockton Formation	2	34	153	.22	D		87
143	6	23	do.	do.	53	12	22	.54	D		88

Table 5.—Records of Selected Wells in Mercer County, N. J. (Continued)
(Static water level, yield, and drawdown reported for date of well completion.
Use of water: AC, air conditioning; D, domestic; I, industrial; Irr, irrigation; PS,, public supply; U, unused. Other data available: C, chemical analysis in Table 7; L, log, Table 6.)

Well	Owner or tenant	New Jersey Grid Number	Driller	Date completed	Altitude of land surface above mean sea level (feet)
89	H. G. Houghton	28.11.5.6.7	T. Larason	12/ 1/52	140
90	C. H. Steelman	28.11.6.8.8	do.	12/11/48	60
91	Ceramic Mold & Design	28.11.9.2.2	M. Seitz	9/ 2/53	80
92	N. J. Telephone Co.	28.11.9.3.7	L. Bainbridge	4/24/57	100
93	Marco Products, Inc.	28.11.9.9.2	do.	12/24/57	80
94	Bernard S. Clark	28.21.3.3.4	do.	11/ 8/57	80
95	W. Schenck & Son	28.12.9.5.7	Wm. Stothoff Co.	1/24/55	60
96	Rhea Lightning Rod Co.	28.11.9.4.2	M. Seitz	3/ 1/54	70
97	H. F. Kaplan	28.11.8.9.3	F. Ziegenfuss & Son	9/ 5/49	55
98	T. Bailey	28.11.8.5.4	R. Tilton	6/24/54	80
99	S. & F. Theater, Inc.	28.11.8.8.7	W. Travis	7/25/49	60
100	R. Inglis	28.11.7.9.3	do.	7/ 7/53	100
101	Lawrenceville Water Co.	28.11.7.3.6	L. Bainbridge	9/ ?/31	120
102	do.	28.11.7.3.6	do.	1951	120
103	Buxton Dairy	28.11.7.2.3	Wm. Stothoff Co.	1948	190
104	S. Wilczynski	28.11.4.8.3	M. Seitz	10/13/54	180
105	City Service Oil Co.	27.15.4.8.5	F. Ziegenfuss & Son	8/13/57	195
106	S. Reside	27.15.4.7.7	M. Seitz	8/ 3/51	225
107	M. T. Bard	27.14.9.2.3	T. Larason	8/30/50	220
108	K. Underwood	27.14.9.2.8	do.	8/27/52	180
109	G. U. Smith	27.14.8.6.2	D. Van Eaton	6/15/56	190
110	A. J. Pulone	27.14.8.6.9	W. Travis	6/ 5/52	200
111	R. Dowdell	27.14.8.8.2	R. Tilton	1952	120
112	J. F. Martin	27.15.7.5.3	W. Travis	6/19/57	140
113	J. Abbott	28.11.7.4.4	M. Seitz	2/20/57	140
114	Fountain Lawn Development	28.11.7.7.8	R. Tilton	2/12/54	120
115	S. Kraiviec	27.15.7.9.6	M. Seitz	2/23/57	110
116	Hillwood Manor Water Co.	27.15.7.9.6	L. Bainbridge	2/ ?/52	120
117	do.	27.15.7.9.6	R. Tilton	5/ 6/54	120
118	Hampton Hills Water Co.	27.15.7.6.7	Philip Travis	9/10/55	170
119	C. Jacobelli	27.15.7.8.3	W. Travis	11/15/53	160
120	H. D. Kelly	27.25.1.3.5	R. Tilton	11/18/53	110
121	Crestmont Park Water Co.	27.25.1.2.6	———	1916	120
122	Ewing Water Supply Co.	27.25.1.2.8	R. Ziegenfuss	6/16/54	120
123	Food Fair, Inc.	27.25.1.1.8	Wm. Stothoff Co.	8/27/51	120
124	General Motors	27.24.3.3.1	L. Bainbridge	1941	125
125	U. S. Navy	27.14.9.9.7	Wm. Stothoff Co.	1943	160
126	C. S. Pietruch	27.24.3.1.3	R. Tilton	8/14/51	160
127	G. Mami	27.24.2.2.6	W. Travis	6/ 2/53	60
128	F. Russo	27.24.2.6.1	F. Ziegenfuss & Son	9/19/57	45
129	L. Wood	27.24.3.4.8	W. Travis	1/ 5/57	50
130	N. J. State Hospital	27.24.3.9.1	Wm. Stothoff Co.	1943	130
131	T. Callahan	27.25.1.8.2	W. Travis	5/21/57	100
132	D. Paddock	27.25.4.3.7	do.	1/30/54	60

Total depth of well below land surface (feet)	Diameter (inches)	Depth to which well is cased (feet)	Screen setting (feet)	Aquifer	Static water level below land surface (feet)	Yield (gpm)	Drawdown (feet)	Specific capacity (gpm/ft.)	Use of water	Other data available	Well
101	6	37	None	Lockatong Formation	28	5	42	0.11	D		89
90	6	21	do.	Stockton Formation	10	20	15	1.33	D	C	90
100	6	55	do	do.	5	14	40	.35	I		91
202	8	—	do.	do.	44	30	35	.85	D		92
60	6	57	57- 60	Raritan and Magothy Formations	8	15	4	3.75	I		93
62	6	59	59- 62	Pleistocene Deposits	15	10	25	.40	D		94
82	10	62	62- 82	do.	3	240	77	3.11	Irr		95
70	6	30	None	Stockton Formation	6	25	8	3.12	I		96
116	6	33	do.	do.	1	35	39	.89	D		97
61	6	34	do.	do.	20	12	4	3.00	D		98
150	6	34	do.	do.	4	72	54	1.33	D		99
72	6	33	do.	do.	11	12	29	.41	D		100
110	8	25	do.	do.	6	60	6	10.00	U		101
286	12- 8	30	do.	do.	8	125	42	2.97	PS	C	102
250	8	27	do.	Lockatong Formation	2	19	137	.13	I	C	103
70	6	24	do.	do.	10	30	8	3.75	D		104
140	6	26	do.	Brunswick Shale	10	20	10	2.00	D		105
100	6	23	do.	do.	22	15	38	.39	D		106
145	6	22	do.	do.	28	10	22	.45	D		107
133	6	22	do.	Lockatong Formation	25	12	45	.26	D		108
220	6	20	do.	do.	8	4	142	.03	D	C	109
81	6	22	do.	do.	12	15	28	.53	D		110
84	6	23	do.	do.	20	5	40	.12	D		111
80	6	24	do.	do.	5	30	15	2.00	D		112
103	6	27	do.	Stockton Formation	16	20	24	.83	D		113
65	6	39	do.	do.	18	14	—	—	D		114
75	6	30	do.	do.	7	10	63	.15	D		115
165	6	45	do.	do.	10	50	40	1.25	PS	C	116
165	8	48	do.	do.	15	100	45	2.22	PS		117
250	8	35	do.	Lockatong Formation	19	—	—	—	PS	C	118
90	6	57	do.	Stockton Formation	27	15	13	1.15	D		119
73	6	34	do.	do.	10	10	15	.66	D		120
180	8- 6	—	do.	do.	—	—	—	—	PS	C	121
200	10- 8	63	do.	do.	20	110	135	.81	PS	C	122
203	8	36	do.	do.	12	150	135	1.11	AC		123
278	10	40	do.	do.	21	280	—	—	I		124
603	8	79	do.	do.	10	120	127	.94	U		125
25	6	21	do.	do.	18	15	—	—	D		126
130	6	22	do.	Lockatong Formation	27	8	53	.15	D		127
75	6	32	do.	Stockton Formation	25	20	5	4.00	D		128
145	6	22	do.	do.	30	15	50	.30	D		129
372	8	—	do.	do.	47	284	—	—	D	C	130
97	6	22	do.	do.	30	30	5	6.00	D		131
60	6	25	do.	Chickies Quartzite	9	20	6	3.33	D		132

Table 5.—Records of Selected Wells in Mercer County, N. J. (Continued)
(Static water level, yield, and drawdown reported for date of well completion.
Use of water: AC, air conditioning; D, domestic; I, industrial; Irr, irrigation; PS,, public supply; U, unused. Other data available: C, chemical analysis in Table 7; L, log, Table 6.)

Well	Owner or tenant	New Jersey Grid Number	Driller	Date completed	Altitude of land surface above mean sea level (feet)
133	D. A. Mann	27.25.1.6.8	W. Travis	8/29/57	50
134	Martindell Plastic Co.	28.21.1.4.7	do.	10/ 5/57	75
135	Kool Vent Mfg. Co.	28.21.1.5.7	L. Bainbridge	8/ 4/53	95
136	Hamilton Rubber Mfg. Co.	28.21.4.2.2	Wm. Stothoff Co.	1946	50
137	F. Quill	28.21.1.3.4	W. Travis	6/12/57	110
138	National Sponge Cushion Co.	28.21.2.7.5	L. Bainbridge	9/24/57	55
139	J. Vogel	28.21.2.5.2	D. Van Eaton	3/27/54	70
140	Colonial Bowling	28.21.2.1.8	Wm. Stothoff Co.	6/14/49	60
141	Eleanor Lapp	28.21.2.8.6	W. Travis	5/21/53	60
142	Wilbur Agins	28.21.5.6.3	L. Bainbridge	4/ 4/56	60
143	Stanley Solski	28.21.5.2.9	do.	4/18/56	60
144	J. A. Roebling's Sons Corp.	28.21.7.2.1	Layne-New York Co., Inc.	1940	30
145	John Giddens	28.21.5.8.7	F. Ziegenfuss & Son	5/21/54	50
146	Thomas Giddens	28.21.5.7.6	do.	5/27/54	50
147	A. DeMario	28.21.5.5.7	L. Bainbridge	3/30/56	60
148	E. Plavchak	28.21.5.6.8	do.	5/20/58	75
149	V. W. Sesini	28.21.6.7.2	do.	6/19/52	90
150	S. Varamjak	28.21.6.2.7	Greenhalgh & Kaye	3/18/53	85
151	D. J. Giovenelli	28.21.6.2.1	Wilbur Clair	9/18/55	80
152	H. J. Schuler	28.21.3.8.4	L. Bainbridge	5/12/54	85
153	R. Hutchinson	28.21.5.3.3	Greenhalgh & Kaye	11/27/53	80
154	Mercer Contracting Co.	28.21.3.5.5	L. Bainbridge	5/ 5/55	65
155	C. Callahan	28.22.1.4.2	do.	6/23/53	100
156	G. Springsteen	28.22.1.4.6	do.	8/27/53	90
157	Herbert N. Jenkins	28.21.3.9.9	do.	5/ 4/54	85
158	John E. Lockwood	28.22.4.1.4	do.	2/20/58	100
159	Hamilton Square Water Co.	28.22.4.1.1	do.	9/10/49	100
160	do.	28.21.6.3.1	do.	7/ ?/54	100
161	do.	28.22.4.1.1	do.	10/ ?/54	100
162	do.	28.21.6.3.1	Wm. Stothoff Co.	1/ ?/58	100
163	do.	28.21.6.3.1	A. C. Schultes	1958	100
164	Mercer Rubber Co.	28.22.4.1.3	L. Bainbridge	11/22/54	105
165	J. H. Kelly	28.22.1.8.5	do.	5/20/52	90
166	Barton F. Francis	28.22.4.2.7	Wm. Stothoff Co.	10/ 1/52	100
167	Lotto Kokesh	28.22.4.4.8	L. Bainbridge	10/11/57	85
168	E. Cubberly	28.22.4.3.8	F. Ziegenfuss & Son	9/ 3/53	100
169	E. L. Cubberly	28.22.1.6.8	Wm. Stothoff Co.	1955	90
170	Wm. Bolduc	28.22.1.6.2	L. Bainbridge	5/ 1/56	100
171	S. D. Grover	28.12.7.9.1	do.	11/ 5/57	80
172	Olga Sampson	28.22.2.2.7	Greenhalgh & Kaye	6/21/54	60
173	Mrs. Hannah Foster	28.22.2.1.9	L. Bainbridge	1/29/58	80

Total depth of well below land surface (feet)	Diameter (inches)	Depth to which well is cased (feet)	Screen setting (feet)	Aquifer	Static water level below land surface (feet)	Yield (gpm)	Drawdown (feet)	Specific capacity (gpm/ft.)	Use of water	Other data available	Well
75	6	20	None	Stockton Formation	13	30	1	30.00	D		133
200	8	45	do.	do.	35	100	10	10.00	I		134
205	8	71	do.	do.	28	40	27	1.48	I		135
200	12- 6	38	do.	Wissahickon Formation	30	50	—	—	I		136
93	6	43	do.	Stockton Formation	7	30	18	1.66	D		137
38	8	23	23- 38	Pleistocene Deposits	14	50	20	2.50	I		138
82	6	21	None	Gabbro	8	6	67	.09	D		139
304	8	30	do.	Baltimore Gneiss	11	5	179	.02	AC		140
45	6	40	40- 45	Raritan and Magothy Formations	9	20	21	.95	D		141
55	6	52	52- 55	do.	12	15	8	1.87	D		142
76	6	73	73- 76	do.	20	10	3	3.33	D		143
147	16-10	125	125-147	do.	—	425	—	—	I	C,L	144
72	4	67	67- 72	do.	31	20	29	.69	D		145
85	4	81	81- 85	do.	31	15	39	.38	D		146
112	6	109	109-112	do.	28	15	7.5	2.00	D		147
92	6	89	89- 92	do.	35	15	5	3.00	D		148
124	6	120	120-123	do.	40	30	5	6.00	D		149
79	4	76	76- 79	do.	45	10	5	2.00	D		150
60	3	55	55- 60	do.	33	10	10	1.00	D		151
70	6	67	67- 70	do.	34	20	5	4.00	D		152
90	4	86	86- 90	do.	30	10	25	.40	D		153
83	6	80	80- 83	do.	6	15	42	.35	D		154
65	6	60	60- 63	do.	23	12	29	.41	D		155
86	6	83	83- 86	do.	17	20	4	5.00	D		156
108	6	105	105-108	do.	31	15	5	3.00	D		157
153	6	150	150-153	do.	53	15	10	1.50	D		158
220	8	187	187-202	do.	51	500	31	16.12	PS	L	159
186	12	155	155-175	do.	60	190	50	3.80	PS		160
218	8	164	164-218	do.	53	500	67	7.46	PS	C	161
230	10	200	200-230	do.	37	460	123	3.73	PS		162
144	10	124	124-141	do.	26	700	19	36.84	PS		163
186	8	171	171-186	do.	54	50	12	4.16	I		164
125	6	120	120-123	do.	40	50	5	10.00	D		165
168	6	158	158-168	do.	56	55	24	2.29	D		166
78	6	67	67- 70	do.	16	15	14	1.07	D		167
28	4	21	21- 28	Pleistocene Deposits	11	12	14	.85	D		168
100	10	85	85-100	Raritan and Magothy Formations	40	700	20	35.00	Irr		169
61	6	58	58- 61	do.	11	15	39	.38	D		170
62	6	59	59- 62	do.	24	10	16	.62	D		171
70	4	66	66- 70	Pleistocene Deposits	6	10	9	1.11	D		172
82	6	79	79- 82	Raritan and Magothy Formations	30	15	5	3.00	D		173

Table 5.—Records of Selected Wells in Mercer County, N. J. (Continued)
(Static water level, yield, and drawdown reported for date of well completion. Use of water: AC, air conditioning; D, domestic; I, industrial; Irr, irrigation; PS,, public supply; U, unused. Other data available: C, chemical analysis in Table 7; L, log, Table 6.)

Well	Owner or tenant	New Jersey Grid Number	Driller	Date completed	Altitude of land surface above mean sea level (feet)
174	George W. Nobe	28.22.2.6.7	L. Bainbridge	7/25/54	95
175	E. L. Cubberly	28.22.2.5.7	do.	3/20/54	85
176	John C. Curry	28.22.2.8.5	do.	9/ 5/53	95
177	S. Sefcik	28.22.3.5.7	do.	10/21/57	95
178	Paul M. Hartalck	28.22.3.2.4	do.	3/22/56	95
179	Wm. Hand	28.12.9.7.8	do.	1930	101
180	do.	28.12.9.7.5	Calvin Linke	10/ ?/57	100
181	L. Grover, Jr.	28.12.8.9.3	F. Ziegenfuss & Son	5/18/55	100
182	Jesse Coleman	28.12.8.5.6	Greenhalgh & Kaye	5/21/57	100
183	G. Tindall, Jr.	28.12.8.6.8	Wm. Stothoff Co.	3/ 4/55	100
184	Mullen Brothers	28.12.9.4.7	F. Ziegenfuss & Son	4/19/55	80
185	G. Cranstoun	28.12.9.9.7	Wm. Stothoff Co.	7/31/54	100
186	Richard Cranstoun	28.12.9.9.8	John Keidel	2/26/54	100
187	Hightstown Rug Co.	28.13.7.4.2	Layne-New York Co., Inc.	1/19/54	100
188	Phillip Slapack	28.13.7.2.8	Greenhalgh & Kaye	7/ 9/56	100
189	D. Salvenimi	28.13.8.1.8	Allen McCurdy	1/ 9/52	100
190	McGraw-Hill Publishing Co.	28.13.7.8.3	Wm. Stothoff Co.	2/12/58	105
191	C. B. Gilbert	28.13.7.9.5	Rudolph Kaye	3/21/49	115
192	Frank Melicharek	28.22.3.3.9	do.	5/13/56	100
193	W. H. Kollmar	28.23.1.2.3	do.	6/29/53	115
194	Decker's Dairy	28.23.1.5.1	do.	2/28/55	120
195	Conover's Dairy	28.23.2.4.4	Wm. Stothoff Co.	1/20/49	145
196	B. Weiner	28.23.2.4.7	A. H. White	2/ 8/52	150
197	Hightstown Water Dept.	28.13.8.7.6	American Well Drilling Co.	1946	100
198	do.	28.13.8.7.6	Layne-New York Co., Inc.	1947	100
199	Decker's Dairy	28.13.8.8.4	L. Bainbridge	1947	105
200	B. Zaitz & Sons	28.13.8.5.7	Wm. Stothoff Co.	5/ 5/55	105
201	J. Capozello	28.13.8.9.9	Greenhalgh & Kaye	1949	105
202	N. J. Turnpike Authority	28.13.8.8.9	Wm. Stothoff Co.	7/10/51	120
203	C. B. Probasco	28.13.9.7.5	Greenhalgh & Kaye	7/ 1/54	120
204	Harry Sachowitz	28.23.3.5.2	do.	9/ 4/57	120
205	G & G Farms	28.23.3.8.1	do.	4/25/58	120
206	Angelo Trapamo	28.23.2.6.5	do.	6/22/53	120
207	S. Kristal	28.23.2.8.7	Tindall	1942	145
208	Daniel Tedesco	28.23.5.2.5	Ed. Robbins	———	130
209	Lewis Bellardo	28.23.5.1.1	L. Bainbridge	12/16/53	145
210	Ernest Hancock	28.23.1.9.8	Wm. Stothoff Co.	6/23/56	120
211	do.	28.23.1.9.8	do.	7/13/56	120
212	A. Geller	28.23.4.2.6	L. Bainbridge	8/15/53	120
213	Nick Fedasz	28.22.6.3.3	do.	11/27/53	100

Total depth of well below land surface (feet)	Diameter (inches)	Depth to which well is cased (feet)	Screen setting (feet)	Aquifer	Static water level below land surface (feet)	Yield (gpm)	Drawdown (feet)	Specific capacity (gpm/ft.)	Use of water	Other data available	Well
108	6	105	105-108	Raritan and Magothy Formations	32	15	3	5.00	D		174
101	6	98	98-101	do.	23	20	10	2.00	D		175
74	6	71	71- 74	do.	35	20	9	2.22	D		176
121	6	118	118-121	do.	34	12	26	.46	D		177
101	6	98	98-101	do.	23	15	12	1.25	D		178
95	6	90	90- 95	do.	—	24	—	—	D	C	179
28	48	28	None	Pleistocene Deposits	21	15	—	—	D	C	180
91	10	72	72- 91	do.	15	340	45	7.55	Irr		181
72	4	66	66- 72	do.	20	15	5	3.00	D		182
70	10	20	20- 70	do.	16	190	46	4.13	Irr		183
61	6	41	41- 61	do.	3	80	37	2.16	Irr		184
137	10	105	105-135	Raritan and Magothy Formations	24	480	76	6.31	Irr		185
97	4	——	——	do.	50	8	15	.53	D		186
215	8	205	205-215	do.	33	500	56	8.92	I	L	187
62	4	58	58- 62	do.	15	10	11	.90	D		188
97	4	94	94- 97	do.	12	15	51	.29	D		189
173	12	153	153-173	do.	39	363	101	3.59	I		190
70	4	65	65- 68	do.	40	10	10	1.00	D		191
108	6	105	105-108	do.	25	15	9	1.66	D		192
165	6	162	162-165	do.	40	15	50	.30	D		193
310	6	290	290-310	do.	60	40	30	1.33	D		194
251	6	241	241-251	do.	74	146	60	2.43	I		195
198	6	193	193-198	do.	84	15	36	.41	D		196
205	20	181	181-205	do.	18	1200	44	27.20	PS	C	197
205	20	181	181-205	do.	30	726	33	22.00	PS	C	198
240	8	160	160-175	do.	40	150	—	—	I		199
100	10	80	80-100	do.	13	520	25	20.80	Irr		200
267	6	252	252-267	do.	50	500	—	—	Irr		201
181	6	171	171-181	do.	41	60	89	.67	D		202
232	4	228	228-232	do.	63	12	47	.25	D	L	203
51	4	47	47- 51	Englishtown Formation	11	12	15	.80	D	C	204
55	4	51	51- 55	do.	7	10	19	.52	D		205
31	4	28	28- 31	do.	4	7	17	.41	D		206
65	6	60	60- 65	do.	20	15	—	—	Irr		207
315	10	285	285-315	Raritan and Magothy Formations	15	500	—	—	Irr	L	208
92	6	89	89- 92	Englishtown Formation	35	10	31	.32	D		209
280	12	243	250-280	Raritan and Magothy Formations	65	372	89	4.11	Irr	L	210
38	6	28	28- 38	Pleistocene Deposits	7.5	15	27.5	.54	D	C	211
248	6	245	245-248	Raritan and Magothy Formations	58	20	22	.91	D		212
230	6	200	None	do.	32	23	20	.86	D		213

Table 5.—Records of Selected Wells in Mercer County, N. J. (Continued)
(Static water level, yield, and drawdown reported for date of well completion.
Use of water: AC, air conditioning; D, domestic; I, industrial; Irr, irrigation; PS,, public supply; U, unused. Other data available: C, chemical analysis in Table 7; L, log, Table 6.)

Well	Owner or tenant	New Jersey Grid Number	Driller	Date completed	Altitude of land surface above mean sea level (feet)
214	Albert Astbury	28.22.3.9.1	Wm. Stothoff Co.	5/18/57	100
215	F. N. Drake	28.22.3.8.3	do.	2/26/49	95
216	Harry Schwartz	28.22.3.7.8	Allen McCurdy	11/12/51	105
217	Pater Motors	28.22.6.1.1	Wm. Stothoff Co.	3/29/49	110
218	Washington Twp. Bd of Ed.	28.22.6.5.9	L. Bainbridge	11/12/57	150
219	George Wilson	28.23.7.1.5	Wm. Stothoff Co.	4/28/58	120
220	Allentown Water Dept.	28.22.9.4.9	do.	8/ ?/52	80
221	Alex Madar	28.22.8.3.8	L. Bainbridge	1/25/54	110
222	Richard Potts	28.22.8.6.2	Andy White	8/17/51	105
223	Fred F. Agans	28.22.5.9.1	L. Bainbridge	2/ 8/54	115
224	Suburban Propane Natural Gas	28.22.5.2.8	do.	3/18/53	90
225	Robbinsville Trailer Sales	28.22.5.4.8	Rudolph Kaye	7/30/48	105
226	Earle Dilatush	28.22.5.7.1	L. Bainbridge	10/30/57	105
227	Hunt & Brown	28.22.8.8.5	Greenhalgh & Kaye	8/ 4/53	70
228	Peter Sadley	28.22.8.7.6	do.	11/10/53	80
229	N. J. Turnpike Authority	28.22.7.9.3	Wm. Stothoff Co.	1955	80
230	Charles Ewart	28.32.2.3.9	A. H. White	2/ 6/52	100
231	N. R. Burke	28.32.2.5.5	———	———	95
232	Louis Mason	28.22.7.8.1	Wilbur Clair	3/ ?/54	60
233	L. S. Chryanowski	28.22.7.3.9	L. Bainbridge	7/16/57	60
234	Frank Buckley	28.22.7.2.8	do.	10/21/53	60
235	A. DeFelice	28.22.7.1.8	do.	1/ 6/53	70
236	Terry F. Ward	28.21.6.9.9	Greenhalgh & Kaye	8/29/57	90
237	Crosswicks Sand & Gravel Co.	28.21.9.9.5	L. Bainbridge	9/ 1/55	50
238	B. Emil	28.21.6.8.9	do.	5/ 3/57	70
239	Bordentown Water Dept.[1]	28.21.8.6.6	Bordentown Water Dept.	———	5-30
240	A. Agabiti	28.21.8.3.8	L. Bainbridge	5/24/58	95
241	Hamilton Township	28.21.8.6.4	do.	5/ 1/49	35

Total depth of well below land surface (feet)	Diameter (inches)	Depth to which well is cased (feet)	Screen setting (feet)	Aquifer	Static water level below land surface (feet)	Yield (gpm)	Drawdown (feet)	Specific capacity (gpm/ft.)	Use of water	Other data available	Well
171	6	163	163-171	Raritan and Magothy Formations	31	35	9	3.88	D		214
169	6	159	159-169	do.	25	30	30	1.00	D		215
147	4	143	143-147	do.	38	12	27	.44	D		216
230	6	220	220-230	do.	35	60	65	.92	D		217
67	6	57	57- 67	Englishtown Formation	34	30	29	1.03	D		218
464	10	437	434-464	Raritan and Magothy Formations	77	580	54	10.74	Irr	L	219
273	10	263	263-273	do.	32	260	103	2.52	PS	C,L	220
243	6	240	240-243	do.	68	15	87	.17	D		221
200	6	—	———	do.	65	30	25	1.20	D		222
200	6	197	197-200	do	68	15	77	.19	D		223
186	6	183	183-186	do.	55	25	30	.83	D	L	224
160	6	150	150-160	do.	40	30	30	1.00	D		225
106	6	103	103-106	do.	9	15	15	1.00	D		226
194	6	190	190-194	do.	40	20	14	1.42	D		227
193	6	188	188-193	do.	48	30	35	.85	D		228
200	8	170	170-200	do.	55	200	60	3.33	AC	L	229
35	6	30	30- 35	Englishtown Formation	10	10	15	.66	D		230
30	48	30	None	do.	20	20	—	—	D		231
132	3	127	127-132	Raritan and Magothy Formations	35	20	2	10.00	D		232
141	6	138	138-141	do.	25	15	25	.60	D		233
123	6	120	120-123	do.	17	20	41	.48	D		234
180	6	177	177-180	do.	35	3	55	.05	D	L	235
76	4	67	67- 70	do.	32	7	13	.53	D		236
80	8	70	70- 80	do.	19	30	40	.75	D		237
142	8	128	128-134	do.	50	10	40	.25	D		238
60- 80	2- 6	60- 80	None	do.	Flowing	—	—	—	PS	C	239
48	6	45	45- 48	do.	17	10	25	.40	D		240
126	8	114	117-124	do.	28	144	27	5.33	I		241

1. Data are for 42 flowing wells.

Table 6.—Logs of selected deep wells in Atlantic Coastal Plain province of Mercer County, N. J.

Well 144. John A. Roebling's Sons Corp.
Altitude, 30 feet

	Thickness (feet)	*Depth (feet)*
QUATERNARY:		
Undifferentiated:		
Cinder fill	8	8
Clay, sandy, brown	2	10
Sand, coarse, gravel, and boulders	6	16
Hardpan, gravel, and boulders	20	36
Clay, yellow	3	39
CRETACEOUS:		
Raritan Formation:		
Clay, white	6	45
Sand, coarse, white and yellow	11	56
Clay, white	16	72
Clay, sandy, white	11	83
Clay, white and red	5	88
Clay, white	12	100
Clay, sandy, brownish-white	4	104
Clay, sandy, white	10	114
Sand, coarse, white, and gravel	3	117
Clay, white	11	128
Sand, coarse, white, and gravel	17	145
Sand, medium to coarse, yellow	18	163
Clay, red and white	7	170

Well 159. Hamilton Square Water Co.
Altitude, 100 feet

QUATERNARY:		
Pensauken Formation:		
Clay and gravel, yellow	40	40
CRETACEOUS:		
Raritan Formation:		
Clay, white	10	50
Clay, red	30	80
Clay, blue	20	100
Sand, white	27	127
Clay, white	27	154
Clay, blue	16	170
Clay, white, and sand	10	180
Sand, white	32	212
Clay, yellow	1	213
Clay, blue, hard	7	220

Table 6.—Logs of selected deep wells in Atlantic Coastal Plain province of Mercer County, N. J. (Continued)

Well 187. Hightstown Rug Co.
Altitude, 100 feet

	Thickness (feet)	*Depth (feet)*
QUATERNARY:		
Topsoil	1	1
Pensauken Formation:		
Sand, coarse, brown	11	12
CRETACEOUS:		
Raritan and Magothy Formations:		
Clay, gray, and sand	9	21
Sand, coarse; contains gravel and wood	19	40
Clay and fine sand	25	65
Sand, white	10	75
Sand, brown, and gravel	25	100
Clay, white	31	131
Clay, blue	10	141
Clay, blue, sand and wood	52	193
Clay, tough	11	204
Sand and gravel	22	226
Clay, tough, gray	7	233
EARLY PALEOZOIC(?):		
Wissahickon Formation:		
Rock	2	235

Well 203. C. B. Probasco
Altitude, 120 feet

QUATERNARY:		
Pensauken Formation:		
Clay, yellow, and gravel	27	27
CRETACEOUS:		
Merchantville Formation and Woodbury Clay:		
Clay, gray	88	115
Raritan and Magothy Formations:		
Clay, gray and black	55	170
Sand, fine, gray, lignitic, and black clay	55	225
Sand, clean, gray	7	232

Well 208. Daniel Tedesco
Altitude, 130 feet

Topsoil	3	3
CRETACEOUS:		
Englishtown Formation:		
Sand, yellow	59	62
Merchantville Formation and Woodbury Clay:		
Clay, black	138	200
Raritan and Magothy Formations:		
Clay, black	45	245
Sand, fine, white, with pebbles	70	315

Table 6.—Logs of selected deep wells in Atlantic Coastal Plain province of Mercer County, N. J. (Continued)

Well 210. Ernest Hancock
Altitude, 120 feet

	Thickness (feet)	*Depth (feet)*
QUATERNARY:		
Pensauken Formation:		
Clay and sand	22	22
Sand, yellow	17	39
CRETACEOUS:		
Merchantville Formation and Woodbury Clay:		
Clay, grayish-blue	44	83
Clay, dark-red	20	103
Clay, green	20	123
Clay, dark-gray	34	157
Raritan and Magothy Formations:		
Sand, fine	6	163
Clay, dark-gray	22	185
Sand, fine	10	195
Clay, gray	22	217
Sand, fine	13	230
Clay, dark-gray	13	243
Sand, fine	12	255
Clay	3	258
Sand and clay	4	262
Sand, fine	18	280

Well 219. George Wilson
Altitude, 120 feet

QUATERNARY:		
Undifferentiated:		
Earth and sand	10	10
CRETACEOUS:		
Englishtown Formation:		
Sand, yellow	50	60
Merchantville Formation and Woodbury Clay:		
Clay, dark	175	235
Raritan and Magothy Formations:		
Sand, fine	2	237
Clay, dark	43	280
Sand, fine, white	50	330
Clay, dark	1	331
Clay, white	34	365
Clay, red	15	380
Clay, white	2	382
Sand, white	10	392
Clay, dark	8	400
Clay, light	32	432
Sand, fine to medium	32	464

Table 6—Logs of selected deep wells in Atlantic Coastal Plain province of Mercer County, N. J. (Continued)

Well 220. Allentown Water Dept.
Correlations by Frank J. Markewicz, Principal Geologist,
New Jersey Bureau of Geology and Topography
Altitude, 80 feet

	Thickness (feet)	*Depth (feet)*
Undescribed	20	20
CRETACEOUS:		
Merchantville Formation and Woodbury Clay:		
Clay, dark-gray	160	180
Raritan and Magothy Formations:		
Clay, dark-gray	10	190
Clay, dark-gray, and sand	30	220
Clay, dark-gray	10	230
Clay, dark-gray, and sand	10	240
Clay, dark-gray	20	260
Sand, dark-gray	15	275
Clay, dark-gray	5	280
Clay, red	25	305

Well 224. Suburban Propane Natural Gas
Altitude, 90 feet

QUATERNARY:		
Topsoil	3	3
Pensauken Formation:		
Clay, yellow	9	12
Gravel	2	14
Clay, yellow	9	23
Clay, yellow, and sand	9	32
CRETACEOUS:		
Merchantville Formation:		
Clay, brown	1	33
Marl, green	27	60
Clay, brown	5	65
Raritan and Magothy Formations:		
Sand, yellow	5	70
Clay, blue, and fine sand	45	115
Clay, blue-black	15	130
Clay, white	12	142
Clay, white and brown	18	160
Clay, white and blue, some fine sand	10	170
Clay, gray, and fine sand	4	174
Sand, fine, gray	12	186
Clay, hard, blue	79	265
Sand, very fine	31	296
EARLY PALEOZOIC(?):		
Wissahickon Formation:		
Rock, white		at 296

Table 6.—Logs of selected deep wells in Atlantic Coastal Plain province of Mercer County, N. J. (Continued)

Well 229. New Jersey Turnpike Authority
Log and correlations by Frank J. Markewicz, Principal Geologist, New Jersey Bureau of Geology and Topography
Altitude, 80 feet

	Thickness (feet)	*Depth (feet)*
Topsoil	10	10
CRETACEOUS:		
Merchantville Formation and Woodbury Clay:		
Clay, medium-gray, micaceous, slightly glauconitic	50	60
Clay, tough, dark-gray, micaceous, slightly fossiliferous	10	70
Clay, tough, olive-gray, micaceous, glauconitic	50	120
Clay, medium-gray, micaceous, glauconitic, lignitic	20	140
Raritan and Magothy Formations:		
Sand, fine to medium, gray, micaceous, glauconitic, lignitic	60	200

Well 235. Anthony De Felice
Altitude, 70 feet

QUATERNARY:		
Undifferentiated:		
Soil	3	3
Clay, yellow	17	20
CRETACEOUS:		
Merchantville Formation:		
Clay, brown	10	30
Marl, brown	8	38
Raritan and Magothy Formations:		
Clay, brown	17	55
Clay, blue	25	80
Clay, black, blue, and red	11	91
Clay, white	23	114
Clay, white and red	11	125
Clay, blue	11	136
Clay, brown and blue	22	158
Clay, blue, and fine sand	7	165
Sand, fine	12	177
Sand, coarse	5	182
Clay, white		at 182

Table 7.—Chemical analyses of water from the principal water-bearing formations and major streams in Mercer County, N. J.
(Results, except for pH and specific conductance, in parts per million. Analyzed by the U. S. Geological Survey.)

Well	Date Collected	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH
PLEISTOCENE DEPOSITS																		
180	10/ 8/58	7.1	0.10	—	38	21	11	64	44	126	22	0.0	123	482	182	146	643	6.5
(a)	9/26/49	7.7	.12	...	2.8	5.9	2.4	3.1	3	2.5	5.0	.0	33	64	31	—	98	5.2
(a)	4/14/58	9.4	.01	0.18	3.2	6.8	9.2	3.3	3	2.9	27	.0	19	121	36	34	155	5.2
211	10/ 8/58	17	.50	.09	14	5.6	8.8	5.0	16	5.0	20	.0	45	165	58	45	202	6.2
ENGLISHTOWN FORMATION																		
204	4/14/58	10	10	0.27	4.0	1.5	2.3	1.7	4	13	4.0	0.3	0.4	42	16	13	66	5.6
RARITAN AND MAGOTHY FORMATIONS																		
144	4/15/58	14	0.03	0.08	19	12	16	3.4	14	47	23	0.0	54	231	97	86	305	6.7
239	9/26/49	7.7	.06	—	1.6	.8	2.7	.9	0	11	2.5	.0	.1	27	7	—	53	4.5
239	4/14/58	8.6	.61	.04	1.2	.2	2.3	.9	0	10	2.8	.0	.2	43	8	8	50	4.3
161	4/14/58	7.9	.07	.10	2.0	.5	2.3	.9	3	.8	3.2	.0	7.4	42	7	5	37	5.5
179	8/20/58	8.4	1.1	.07	5.2	6.8	8.5	3.3	4	.0	21	.0	35	97	41	38	152	5.4
197	9/26/49	9.3	4.1	—	2.2	1.2	2.3	1.0	8	6.2	2.4	.1	.1	27	10	—	38	5.6
198	4/14/58	10	3.5	.08	2.4	.7	2.0	.9	6	6.1	2.6	.1	.4	42	9	4	41	6.9
220	4/14/58	15	6.9	.21	12	3.6	2.3	2.6	54	6.6	3.2	.1	.2	80	45	1	110	6.9
BRUNSWICK SHALE																		
4	4/24/58	23	0.81	0.03	40	20	9.2	1.1	170	29	10	0.1	20	240	182	43	380	7.2
38	9/22/49	24	.20	—	35	17	15	1.4	168	24	11	.2	4.1	209	157	—	357	7.6
42	5/ 1/58	26	.13	.05	38	16	9.2	1.2	162	39	7.6	.1	3.8	215	161	28	344	7.8
30	8/ 7/58	21	.04	.04	56	14	12	1.8	196	38	8.8	.0	11	267	197	37	421	7.4
59	5/ 1/58	20	.04	.07	31	12	20	2.8	164	25	6.0	.1	9.3	215	127	0	332	7.3

LOCKATONG FORMATION																		
109	4/24/58	34	0.04	0.03	44	15	16	1.4	174	45	13	0.1	6.5	292	172	29	396	7.9
103	4/17/58	34	.14	.02	22	10	15	1.5	82	34	12	.2	12	190	96	29	268	7.1
118	3/ 4/59	32	.05	.02	21	8.8	8.3	1.4	78	22	5.6	.0	19	159	89	25	226	7.0
STOCKTON FORMATION																		
21	10/ 6/49	18	0.05	—	31	15	10	0.8	136	39	6.6	0.1	3.4	190	139	—	321	7.6
21	4/15/58	19	1.1	0.06	35	16	9	1.0	134	38	9.6	.0	6.7	244	154	44	331	7.8
130	9/27/49	27	.03	—	27	6.8	12	1.7	88	20	11	.0	12	158	95	—	247	6.7
130	4/25/58	28	.03	.03	27	5.2	11	1.5	78	26	10	.0	12	190	89	25	242	6.7
102	4/15/58	26	.07	.04	22	10	11	1.0	95	15	10	.1	17	185	96	18	247	7.3
(b)	9/27/49	28	.04	—	14	7.2	9.6	1.0	62	12	6.6	.1	11	117	65	—	175	6.4
90	4/15/58	24	.15	.03	25	12	16	2.7	12	48	26	.2	68	250	112	102	342	5.9
73	9/27/49	26	.04	—	27	11	9.4	1.2	104	31	7.4	.1	.5	160	113	—	256	6.5
63	11/13/49	18	—	—	21	8.7	5.6	1.9	47	35	9.1	.0	9.0	139	88	—	222	6.4
75	4/25/58	21	1.1	.15	8.1	1.9	19	4.0	57	9.8	16	.2	.4	128	28	0	159	6.9
116	3/ 2/59	19	.12	.07	31	11	13	3.2	161	11	4.8	.0	2.3	179	123	0	286	7.9
121	3/ 3/59	33	.09	.04	14	4.9	11	1.3	44	7.1	11	.0	27	132	55	19	178	6.8
122	3/ 4/59	29	.07	.11	22	5.8	10	1.4	63	14	12	.0	26	156	79	28	213	6.7
WISSAHICKON FORMATION																		
85	9/27/49	24	1.3	—	18	4.4	13	3.3	98	7.7	4.4	0.4	0.1	121	63	—	188	7.1
78	4/15/58	33	2.1	0.12	15	3.9	28	2.4	118	10	7.0	.1	.5	152	54	0	220	7.5
83	3/ 3/59	16	.15	.09	2.4	2.2	3.9	2.1	14	7.1	3.0	.0	4.1	54	15	4	59	6.5
SURFACE-WATER SAMPLES																		
(c)	10/ 8/58	14	0.28	0.02	16	7.5	8.7	3.3	43	41	8.4	0.1	3.8	132	71	36	193	6.9
(d)	9/28/49	1.0	—	—	21	7.2	8.4	—	—	33	8.0	.0	—	126	82	—	197	7.9
(d)	9/15-30/58	4.1	—	—	16	6.1	4.8	2.9	48	28	5.5	.1	4.7	96	65	26	167	6.9
(e)	10/ 8/58	14	.67	.10	10	5.4	5.0	3.5	7	33	1415	.3	5.0	110	47	42	144	6.1

Sources of samples not shown on well-location map and not described in well-data tables are: (a) Crosswicks Water Co. spring; (b) Lawrenceville Water Co. 150-ft. well; (c) Stony Brook at Rosedale; (d) Delaware River at Trenton; (e) Assunpink Creek at Edinburg.