North Carolina
Department of Conservation and Development
R. Bruce Etheridge, *Director*

Division of Mineral Resources
Jasper L. Stuckey, *State Geologist*

Bulletin Number 55

Geology and Ground Water

IN THE

Greensboro Area, North Carolina

By

M. J. Mundorff

Prepared in Cooperation with the Geological Survey, United States
Department of the Interior

Raleigh
1948

MEMBERS OF THE BOARD OF CONSERVATION AND DEVELOPMENT

LETTER OF TRANSMITTAL

Raleigh, North Carolina
February 4, 1948

To His Excellency, HON. R. GREGG CHERRY,
Governor of North Carolina.

SIR:

I have the honor to submit herewith, As Bulletin 55, a report entitled "Geology and Ground Water in the Greensboro Area, North Carolina," by M. J. Mundorff.

This report is one of a series being prepared as a part of the cooperative study of the ground water resources of the State by the North Carolina Department of Conservation and Development and the United States Geological Survey. In most parts of the State, ground water supplies are becoming more important, especially for public schools, some manufacturing plants, and smaller towns. It is believed that the present report and future ones will prove of assistance in the development and use of these resources.

Respectfully submitted,

R. BRUCE ETHERIDGE,
Director.

CONTENTS

CONTENTS—CONTINUED

CONTENTS—CONTINUED

ILLUSTRATIONS

ABSTRACT

The Greensboro area is in the north-central Piedmont of North Carolina and includes Alamance, Caswell, Forsyth, Guilford, Rockingham, and Stokes Counties.

The area includes 2,975 square miles and had a population of 438,404 in 1940.

The area lies entirely within the Piedmont province, which is characterized by flat to rolling upland surfaces, separated by stream valleys, with a few scattered monadnock hills.

Except for a belt of sandstones and shales along Dan River, the area is underlain by igneous and metamorphic rocks, consisting chiefly of gneiss, schist, slate, and granite.

Wells drilled in greenstone schist have a considerably higher average yield than wells in any other rock unit. The average yield of municipal and industrial wells in this rock is 55 gallons a minute. In granite, gneiss, and the Triassic sandstones and shales, the average yield of municipal and industrial wells is 33 to 35 gallons a minute.

Topographic location has an important bearing on the amount of water yielded by wells. The average yield of wells drilled in draws and valleys is more than 3½ times greater than the average yield of wells drilled on hills. It is probable that draws and valleys mark the location of sheared and fractured zones in which the rocks are saturated with water, whereas hills occupy areas of massive, unbroken rock which contain, and will yield, relatively little water.

Wells drilled where the weathered mantle is thick generally yield larger supplies than those drilled where it is thin.

The yield per foot of well generally decreases with depth and beyond 250 feet drops quite sharply, indicating that it is usually not advisable to drill beyond that depth if the well has not obtained water when it reaches that depth.

Included in the report are a number of tables showing the relation of yield to type of rock, to topographic location, and to depth of wells. The report includes a chapter on the ground-water resources of each of the six counties with tables of well data, chemical analyses, and well logs.

GEOLOGY AND GROUND WATER IN THE GREENSBORO AREA, NORTH CAROLINA

INTRODUCTION

LOCATION OF AREA AND SCOPE OF THE INVESTIGATION

This report, the third of a series on the ground-water resources of the State, gives the results of an investigation of the ground-water resources in a part of the north-central Piedmont of North Carolina. The area consists of Alamance, Caswell, Forsyth, Guilford, Rockingham, and Stokes Counties.

The investigations on which the reports are based are being made through a continuing cooperative agreement between the North Carolina Department of Conservation and Development and the Geological Survey, U. S. Department of the Interior. The program is under the direction of Dr. J. L. Stuckey, State Geologist of North Carolina, and Dr. A. N. Sayre, Geologist in charge, Division of Ground Water, U. S. Geological Survey.

The first report, published as Bulletin 47 of the North Carolina Department of Conservation and Development, is a progress report giving general information on ground-water resources of the entire State, with particular emphasis on the Coastal Plain.

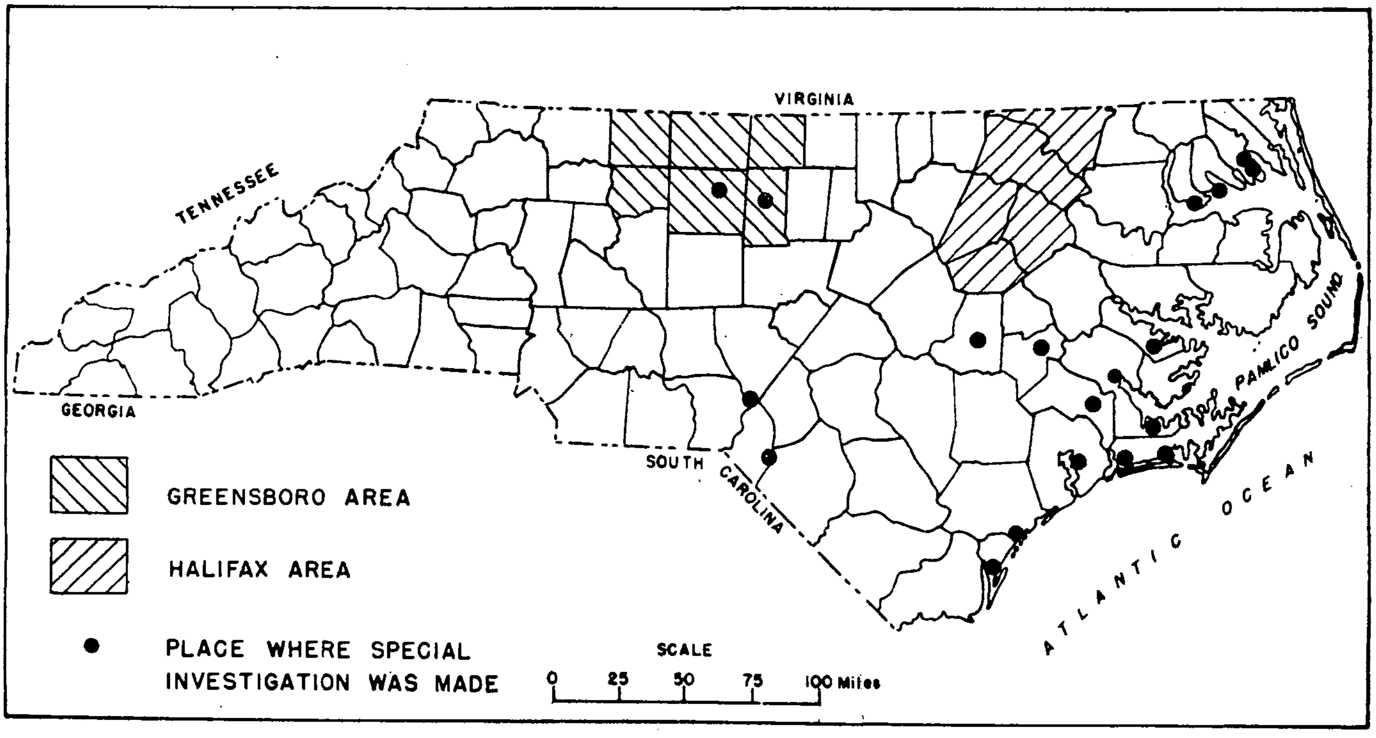


Fig. 1—Index map of North Carolina showing the location of the Greensboro area and other places where ground-water investigations have been made.

The second report, published as Bulletin 51, gives the results of an investigation of the ground-water resources of the Halifax area, including Edgecombe, Halifax, Nash, Northampton, and Wilson Counties.

Because of the many military establishments constructed in North Carolina during the war, most of which utilize ground water, a considerable amount of time has been devoted to special investigations and reports regarding ground-water supplies for military bases, war plants, and contiguous civilian housing areas. The index map (fig. 1) shows the areas in which investigations have been made.

The field work in the Greensboro area was done principally in the summers and autumns of 1942 and 1943 and consisted of obtaining data on about 1,300 wells, a number of springs, and the 23 municipal supplies, collecting samples of water, and noting the geologic and topographic setting of the wells. Information on the wells was obtained by interviewing well owners and operators and well drillers. A great deal of the information was given from memory and some of it, therefore, may be somewhat inaccurate.

During the course of the field work it was found that existing geologic maps were so generalized as to be wholly inadequate for use with the hydrologic data secured. Therefore, an additional 5 weeks were spent in the autumn of 1944 in mapping the geology on a reconnaissance scale. It should be emphasized that the geologic map (pl. 1) is based on these few weeks of field work plus notes made during the collection of hydrologic data in 1942 and 1943; and, in detail, the geology of the area is a great deal more complex than is shown by the map. Rocks of similar geologic and hydrologic characteristics have generally been mapped together. Also, some rocks of different kinds have been mapped together because they occur together in such a way that only mapping on a large scale, requiring a great deal of time, would permit their separation. The belt mapped as gneiss is a good example of this in that several types of gneiss and schist may alternate repeatedly in a short distance.

ACKNOWLEDGMENTS

Nearly all the chemical analyses were made by members of the Quality of Water Division, U. S. Geological Survey. The names of the analysts are given in the tables of analyses.

The writer wishes to acknowledge the courteous and generous assistance of the well owners, well drillers, school superintendents, superintendents of public water supplies, and many others. Without their aid the investigation could not have been successfully completed. Especial acknowledgment is due the well drillers, including the Carolina Drilling and Equipment Co., Danville Well Drilling Co., Heater Well Co., M. A. Holder, John Hopkins, W. B. Mayhew, J. A. Rich, F. L. Smith, J. Stafford, Sydnor Pump and Well Co., Virginia Machinery and Well Co., and Well Drillers Inc., who generously gave their time and effort in furnishing records of wells drilled by them.

GEOGRAPHY

INTRODUCTION

Area and population.—The Greensboro area is in the north-central part of the State, bordering the Virginia State line, and includes Alamance, Caswell, Forsyth, Guilford, Rockingham, and Stokes Counties, with a total area of 2,975 square miles. The location of the Greensboro area is shown in figure 1.

The area had a population of 438,404 in 1940, about 147 to the square mile, according to the U. S. Census Bureau report. There are 18 incorporated cities and towns with an aggregate population of 219,121, which is 50 percent of the total population of the area. Four cities, Burlington, Greensboro, High Point, and Reidsville, have a population of more than 10,000, and nine other cities and towns have a population of more than 1,000.

Agriculture and industry.—More than 79 percent of the area is included in farms, nearly half the total area of the farms, however, being woodland. The total value of the farm products in 1939, according to the 1940 census, was $20,599,677, tobacco accounting for slightly more than half the total. Other important products are livestock, dairy products, poultry and eggs, corn, wheat, hay, potatoes, and vegetables.

Manufacturing is the most important occupation in the area, with 67,607 wage earners being employed in 1939. The 1940 census report lists 526 manufacturing establishments in the Greensboro area. The total value added to that of the raw materials by the operations of these establishments in 1939, exclusive of the establishments in Forsyth and Rockingham Counties which are not reported, is more than $61,000,000. If these two counties were included, the total value added by manufacture probably would be well above $100,000,000. The textile industry, chiefly cotton, is the most important, employing about 65 percent of all factory workers. Tobacco manufacture, principally the manufacture of cigarettes, is next in importance, followed by furniture, food, chemicals, and lumber.

Mineral resources.—Crushed stone for use on roads and for general construction purposes is probably the most important mineral resource in the area. Rocks utilized include granite, gneiss, and greenstone. No building stone is being quarried within the area, although rock suitable for such use occurs at a number of places.

Shale of Triassic age is used in the manufacture of brick, tile, and similar products at Pine Hall. Brick plants at several other places within the area utilize residual clays formed by the weathering of the underlying bedrock.

Several mica mines in northwestern Rockingham County and northeastern Stokes County were being operated at the time the investigation was made. There are also a number of mica prospects at other places in Stokes, Rockingham, and Caswell Counties.

Minerals and rocks which have been mined in the past but are no longer being produced include limestone in Stokes and Forsyth Counties, iron ore in Stokes and Guilford Counties, and gold and copper in Guilford County.

CLIMATE

Precipitation.—There are six U. S. Weather Bureau stations in the Greensboro area from which a record of the precipitation is obtained. The oldest station is at Winston-Salem and was established in 1886. The youngest station, at the Greensboro Airport, was established in 1930. Two other stations, at Oak Ridge in Guilford County and Saxon in Stokes County, are no longer maintained. The normal monthly and annual precipitation at each station, as well as the average for the six stations now being maintained, is given in the following table.

NORMAL MONTHLY AND ANNUAL PRECIPITATION, IN INCHES, AT U. S. WEATHER BUREAU STATIONS IN THE GREENSBORO AREA, FOR THE PERIOD OF RECORD

STATION	Elevation (feet above sea level)	Length of record (years)	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Graham	656	43	3.70	3.80	4.20	4.00	3.60	4.20	5.40	5.00	3.20	2.90	2.40	4.20	46.60
Greensboro	843	51	3.57	3.70	4.36	3.57	4.04	4.86	5.12	5.24	3.25	3.05	2.46	3.83	47.05
Greensboro Airport	886	13	3.56	3.09	3.90	3.68	3.82	3.45	4.87	4.02	3.23	2.79	2.86	3.52	42.79
High Point	966	18	3.40	3.60	4.30	3.60	3.80	4.40	5.00	4.30	3.00	2.50	2.20	3.60	43.70
Reidsville	828	45	3.40	3.50	3.90	3.40	3.70	4.00	4.00	4.80	3.00	3.00	2.20	3.80	43.30
Winston-Salem	1,000	50	3.36	3.07	4.20	3.45	3.89	4.35	4.87	4.73	3.10	3.16	2.36	3.74	44.88
Average			3.50	3.50	4.14	3.62	3.81	4.21	4.98	4.08	3.12	2.90	2.41	3.78	44.72

STATIONS WHICH ARE NO LONGER MAINTAINED

Oak Ridge (Guilford Co.)	885	12a	3.36	5.02	4.01	3.37	5.00	4.57	5.83	4.28	3.89	3.05	2.87	3.27	48.52
Saxon (Stokes Co.)	900	23b	3.23	3.86	3.88	3.30	3.91	5.27	4.40	5.01	3.21	3.13	2.61	3.60	45.41

a–From 1890 to 1902
b–From 1891 to 1914

The average annual precipitation at the six stations is 44.72 inches. July is the wettest month, with an average normal rainfall at the six stations of 4.98 inches; and November is the driest month, with 2.41 inches of precipitation. June, July, and August are the three wettest months and September, October, and November the three driest. The precipitation is nearly uniform over the entire area. Peculiarly, the station at Greensboro has the greatest average annual precipitation, whereas the station at the Greensboro Airport has the least. The greatest annual precipitation averaged over the entire area was 55.52 inches in 1929. The least annual precipitation averaged for the entire area was 29.75 inches in 1941.

The average annual snowfall is nearly 10 inches.

Temperature.—Records of the temperature are obtained by the U. S. Weather Bureau at Greensboro, Greensboro Airport, High Point, Reidsville, and Winston-Salem. In addition, records of temperature are available for Oak Ridge from 1890 to 1902 and for Saxon, Stokes County, from 1891 to 1914.

The mean annual temperature during the period of record at the five stations now being maintained is 58.8° F. The coldest month is January, with a mean temperature of 40.6° F.; and the warmest month is July with a mean temperature of 77.8° F. High Point is the warmest station, with a mean annual temperature of 60.2° F., and Winston-Salem and Greensboro Airport are the coldest stations with a mean annual temperature of 57.9° F.

The average date of the last killing frost in the spring is about April 12, and the average date of the first killing frost in the autumn is about October 25, leaving an average growing season of about 196 days.

DRAINAGE

The entire area is drained by three major drainage systems, the Yadkin, the Dan, and the Cape Fear. Most of the drainage of Forsyth County and the southwestern corner of Stokes County is into Yadkin River, which forms the western boundary of Forsyth County. The remainder of Stokes County and most of Rockingham and Caswell Counties is drained by Dan River. Most of Guilford County, all of Alamance County, the southern part of Rockingham County, and the southwestern corner of Caswell County are drained by Haw River. The southwestern corner of Guilford County is drained by Deep River, which combines with Haw River to form the Cape Fear. All these streams empty into the Atlantic Ocean to the southeast and south, but the courses of the individual streams within the area are diverse. The drainage pattern is largely controlled by the geology of the area.

PHYSIOGRAPHY

The Greensboro area lies entirely within the upland section of the Piedmont physiographic province which is an uplifted, submaturely to maturely dissected peneplane on more or less resistant rocks.[1] In the Greensboro area the upland surface, which generally slopes to the east and southeast, is interrupted by a number of monadnock hills, some of which rise nearly 1,500 feet above the surrounding peneplane remnants.

Igneous, metamorphic, and sedimentary rocks occur in the Greensboro area. The metamorphic rocks include gneisses, schists, slates, and quartzite; the igneous rocks include granites and diorites; the sedimentary rocks include conglomerate, sandstone, and shale of Triassic age.

The quartzites, and many of the gneisses and schists, have been derived from sediments. The bedding in these rocks, as well as the schistosity, strikes generally northeast-southwest. The igneous rocks intruded into them are generally elongated in the same direction and, where metamorphosed, the structural elements also strike northeast-southwest. The cleavage and bedding in the slates and the bedding in the Triassic sedimentary rocks strike in the same direction. As these rocks differ considerably in resistance to erosion, structural control of the topography is considerable.

At some time during the interval between the last part of the Triassic period and the first part of the Cretaceous period, the area was eroded to a low-lying plain of little relief, save for a few monadnock hills. Widely spaced trunk streams, meandering across the area, moved sluggishly in wide floodplains. There is little doubt that this peneplane sloped to the east and southeast and that the streams discharged into the Atlantic Ocean. Subsequently, the peneplane was uplifted and probably tilted slightly so that the southeastward slope was increased. The present altitude of the upland surface in the western and northwestern part of the Greensboro area is about 1,200 feet, whereas the altitude along the southeastern edge is about 500 feet. After the area was uplifted the streams began to cut down rapidly, forming narrow, steep-walled valleys. The main streams probably followed more or less the channels of the former streams, in many places, however, cutting off the old meanders and in general straightening and shortening the courses. Between these main streams some of the smaller streams followed parallel courses.

[1] Fenneman, Nevin M., Physiographic divisions of the United States: Assoc. Am. Geographers Annals, vol. 18, no. 4, p. 290, 1928.

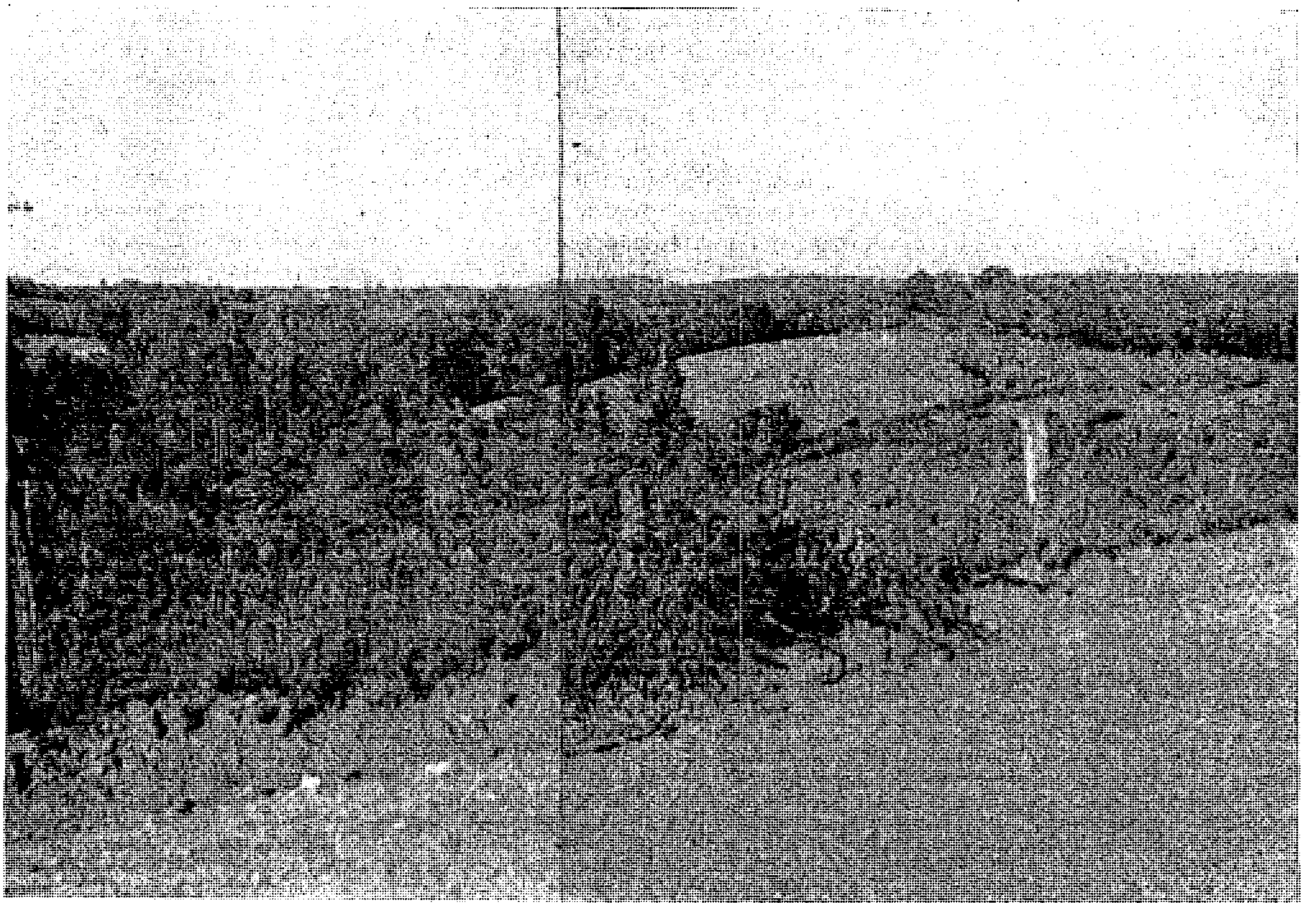


Plate 3—View illustrating the flatness of the upland surfaces, which are remnants of the uplifted and dissected peneplane.

Plate 4—View of the escarpment along the southeastern side of the Triassic basin at Madison. Dan River flows northeastward 30 miles in this basin before breaking through the escarpment and resuming its southeasterly course.

The rocks of the Greensboro area differ considerably in resistance to erosion; and because the beds and formations strike northeast ridges trending in that direction were developed on the more resistant rocks as dissection continued. The structural control of the rocks has considerably modified the drainage patterns of the Greensboro area. The most outstanding example of structural control is that of the Dan River in its course from near Walnut Cove to a few miles beyond the North Carolina-Virginia line, a distance of some 30 miles. The Dan River rises in Virginia and flows southward into the northwestern corner of Stokes County, thence southeast to the southeastern edge of the belt of Triassic sediments between Walnut Cove and Pine Hall. Here it turns almost at right angles and flows northeastward to Danville, Virginia, its channel being cut in the more easily eroded shales along the contact between the Triassic shales and metamorphic rocks to the southeast. The surface on these gneisses and schists is generally several hundred feet higher than the surface on the Triassic rocks in which the river flows. Dan River meanders considerably in its northeastward course, continually swinging in against the metamorphic rocks to the southeast but always being thrust back into its northeastward course in the Triassic shales by the greater resistance of the gneisses.

Many other streams in the area are controlled by the geologic structure, though not in such a spectacular fashion as the Dan.

Between the larger streams the peneplane has been preserved in flat areas of considerable extent. Drainage at many places is poor. The flatness and large size of some of these areas in contrast to the complex structure is striking evidence of the degree of peneplanation.

Closer to the larger streams the peneplane has been thoroughly dissected and the topography is in the mature stage. However, even in the most thoroughly dissected areas, remnants of the peneplane are preserved on the hills and ridges so that the skyline is remarkably flat. This uniformity is illustrated in plate 3. Local relief in the dissected areas commonly is 200 to 300 feet.

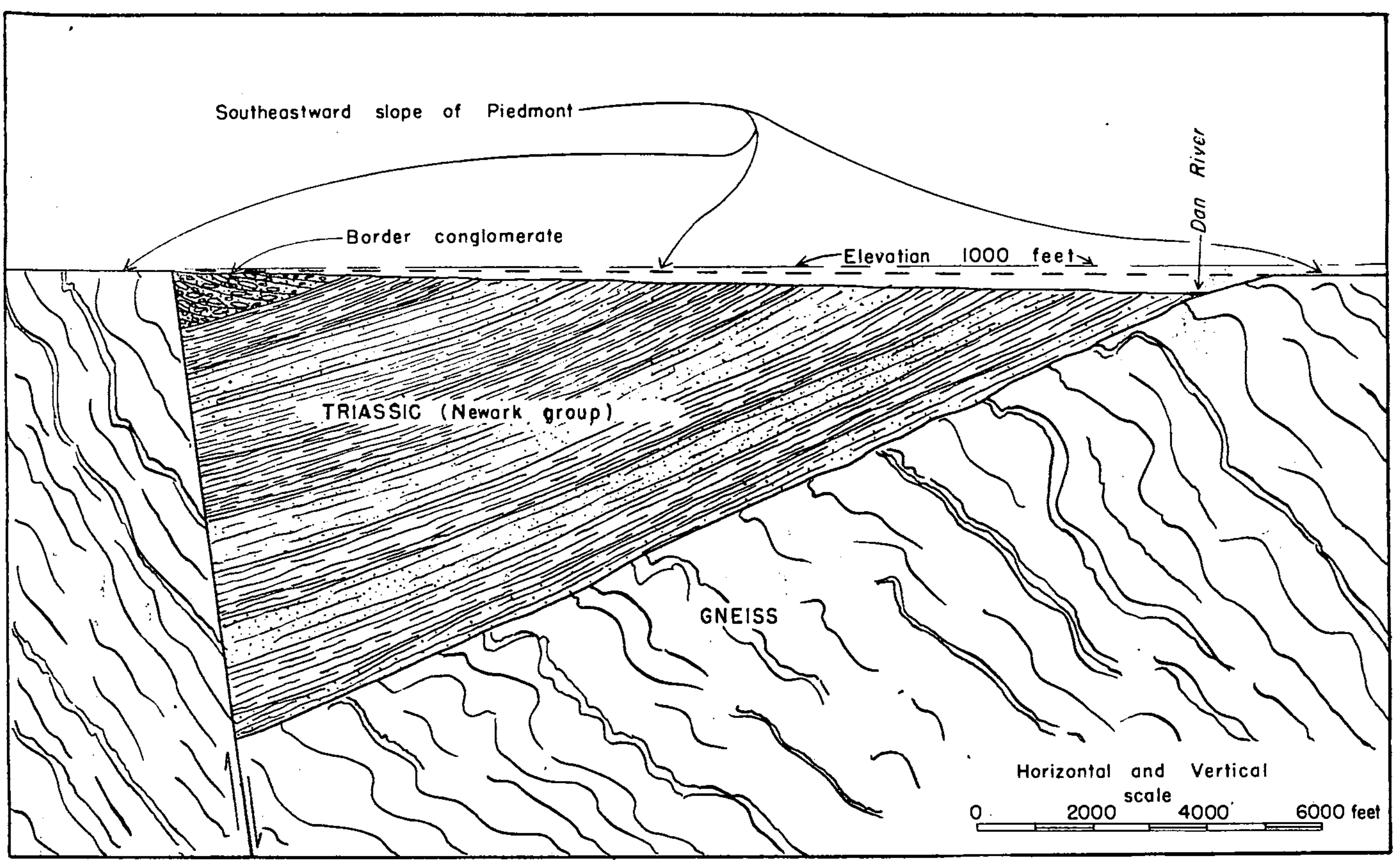


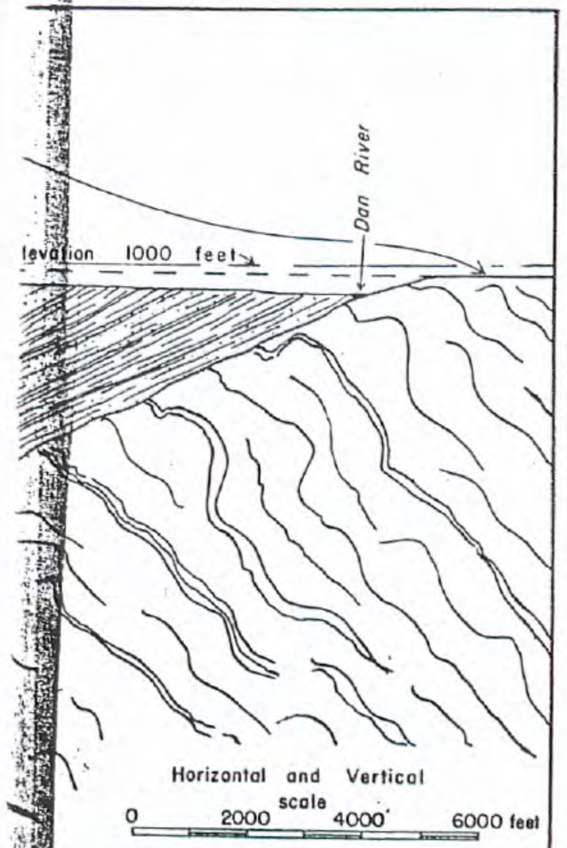
Fig. 2—Cross-section of the Triassic basin near Walnut Cove, showing the physiography and structure.

stance to erosion; and because the beds were developed on the more resistant s has considerably modified the drainage of structural control is that of the Dan e North Carolina-Virginia line, a distance thward into the northwestern corner of lt of Triassic sediments between Walnut vs northeastward to Danville, Virginia, contact between the Triassic shales and ses and schists is generally several hun- he river flows. Dan River meanders con- inst the metamorphic rocks to the south- the Triassic shales by the greater resist-

structure, though not in such a spectac-

in flat areas of considerable extent. Drain- these areas in contrast to the complex

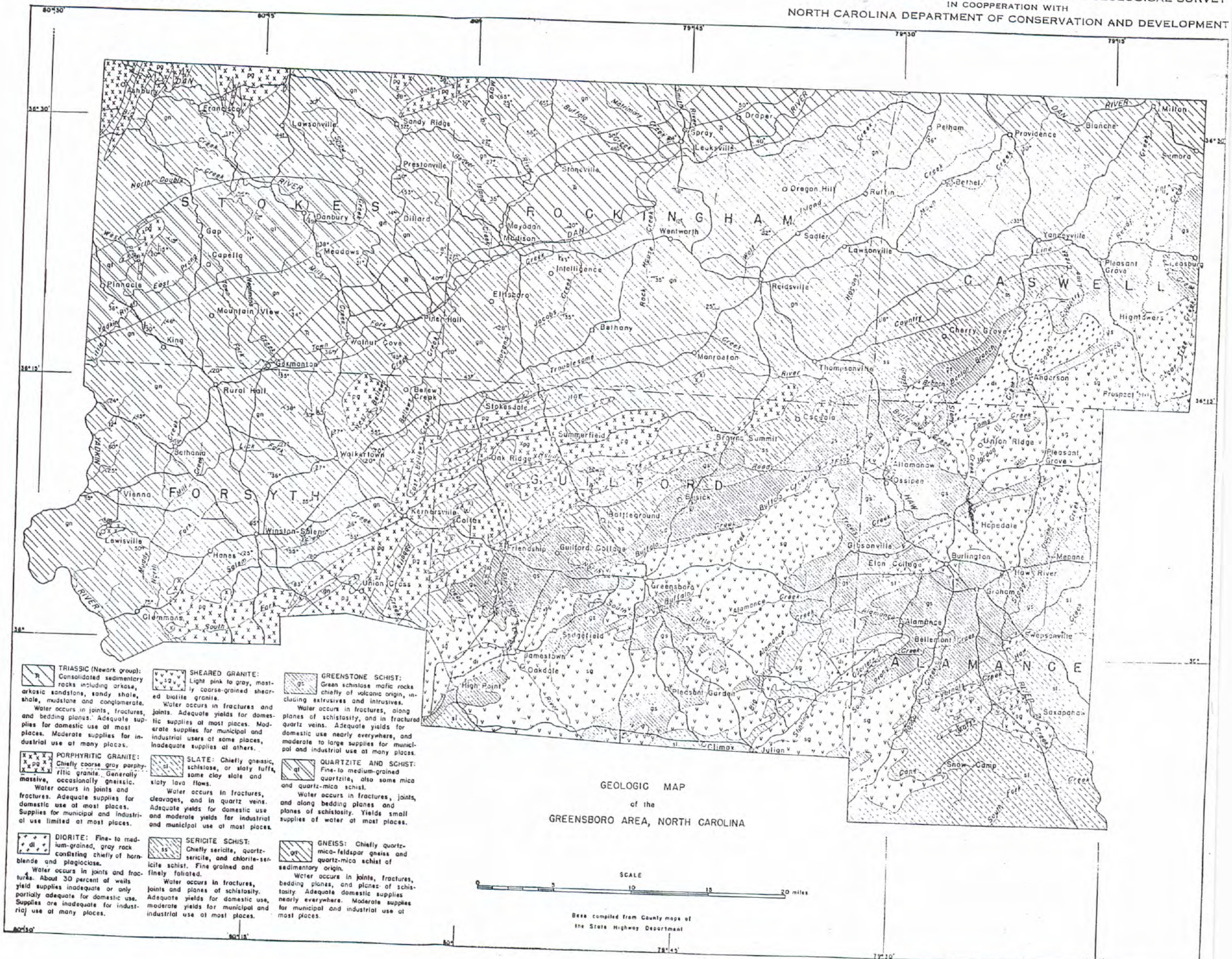
y dissected and the topography is in the eas remnants of the peneplane are pre- it. This uniformity is illustrated in plate



owing the physiography and structure.

STATE BULLETIN 55, PLATE 1

UNITED STATES DEPARTMENT OF THE INTERIOR. GEOLOGICAL SURVEY
IN COOPPERATION WITH
NORTH CAROLINA DEPARTMENT OF CONSERVATION AND DEVELOPMENT



Rising above the general upland surface formed by the peneplane remnants are a number of monadnocks. A small monadnock range in central and western Stokes County is the highest of these. This range includes Sauratown Mountain, Moores Knob, Hanging Rock, Cooks Wall, and several lower peaks. This group is capped by beds of highly resistant quartzite. Pilot Mountain, to the southwest in Surry County, belongs to this group. The altitude of Moores Knob is 2,572 feet and that of Pilot Mountain is 2,415 feet. A number of other peaks rise well above 2,000 feet, 1,000 feet or more above the general upland surface.

Although the entire area is included in the Piedmont upland section, the Triassic rocks have been eroded more easily than the other rocks so that a partial lowland has developed on them. Along the southeastern edge of the Triassic belt this lowland is separated from the upland by a very prominent scarp, the surface of the Triassic being 200 to 300 feet lower than the surface of the crystalline rocks to the southeast. Northwestward the Triassic gradually rises 300 to 400 feet and the surface on the Triassic merges into the surface on the crystalline gneisses and schists without any pronounced break in the topography.

The relation of the physiography and topography to the geology of the Triassic basin is shown in the generalized cross-section of figure 2.

GEOLOGY

INTRODUCTION

Most of the time in the field was spent in obtaining hydrologic data, but some attention was also given to the geology. Before completion of the field work it became apparent that existing geologic maps were entirely inadequate for use in arriving at any conclusions regarding the quantity and quality of water available from the different rock units. Therefore, 5 additional weeks were spent in making a reconnaissance of the geology of the area; and the reconnaissance data, together with the notes made during the collection of the data on the wells, were used in making a geologic map of the area. Considering the large size of the area and the short time spent in mapping, it is readily apparent that the geology was necessarily greatly generalized and that the map can be considered only a reconnaissance map. The rock units chosen are rather broad and often include several kinds of rock. For example, the Triassic includes sandstone, arkose, conglomerate, shale, and mudstone. The Triassic could easily have been divided into three or four formations if time had permitted and the mapping had been done on large-scale base maps. Similarly, the gneiss and schist unit includes several types of gneisses and schists which probably could be separated into individual formations. The units chosen for the mapping were the broadest possible that would include rocks of similar ages, petrology, and water-bearing properties.

Because of the complexity of the geology, the time available did not permit the complete separation of even these broad units, so that some areas shown as one rock unit on the map may actually include some small areas of rocks belonging to another unit. Furthermore, the small scale of the map does not permit the showing of very small areas.

AREAL DISTRIBUTION AND CHARACTER OF THE ROCKS

Gneiss.—This unit includes several types of interbedded gneisses and schists, most of which appear to be of sedimentary origin. Most of these rocks are identical with rocks in other sections of the State which were mapped by Arthur Keith as Carolina gneiss[1], although small areas of hornblende schist and gneiss are included with this unit in the Greensboro area that are similar to Keith's Roan gneiss. The unit forms a broad belt trending northeast-southwest. It underlies nearly one-half of the Greensboro area, occupying most of Forsyth, Rockingham, and Caswell Counties and occurring in large areas in Stokes and Guilford Counties.

The most abundant rock is quartz-mica-feldspar gneiss with the proportion of quartz differing greatly from place to place. The feldspar usually is predominantly plagioclase although nearly always some potash feldspar is also present. At a few places the potash feldspar, either orthoclase or microcline, or both, predominates. At some places the proportion of quartz increases greatly so that the rock is actually a quartzite gneiss. The rock has a medium to coarse texture and is usually light gray in color. However, at many places a larger proportion of biotite gives the rock a darker color. In some areas the gneiss is very fine-textured and finely

[1] Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Cranberry folio, (no. 90), 1903: also Asheville folio (no. 116), 1904; Mount Mitchell folio (no. 124), 1905; Nantahala folio (no. 143), 1906; Pisgah folio (no. 147), 1907; and Gaffney-Kings Mountain folio (no. 222), 1931.

SUMMARY OF ROCK UNITS AND THEIR WATER-BEARING PROPERTIES

The following table lists the rock units shown on the map, plate 1, and gives a brief geologic and hydrologic description of them.

ROCK UNITS IN THE GREENSBORO AREA

Unit	*Description*	*Water-bearing Properties*
Triassic (Newark group)	Consolidated sedimentary rocks consisting of arkose, arkosic sandstone, sandy shale, shale, mudstone, and conglomerate. Mostly red, brown, and yellow in color. Lenticular in many places.	Water occurs in fractures, joints, and along bedding planes. Entirely adequate supplies for domestic use nearly everywhere. Moderate to moderately large supplies for municipal and industrial use at many places, but yields decrease with continuous pumping. Average yield of 50 wells is 17 gallons a minute. Water at many places is moderately hard to hard.
Porphyritic granite	Commonly gray, very coarse porphyritic granite, generally massive, but gneissic at places owing to only partial assimilation of intruded gneisses and schists. At a few places medium-textured, equigranular.	Water occurs in joints and fractures. Adequate supplies for domestic use obtained at most places. Limited quantities for industrial and municipal supplies at most places, larger supplies at a few places. Average yield of 47 wells is 8 gallons a minute.
Diorite	Usually fine- to medium-grained, gray to dark greenish gray; consists chiefly of plagioclase and hornblende. Massive at many places but schistose or gneissic at a few places.	Water occurs in joints and fractures. About 30 percent of wells yield supplies inadequate or only partially adequate for domestic use. Supplies are inadequate for municipal and industrial use at many places. Average yield of 26 wells is 6 gallons a minute. Water generally moderately hard to hard, low in iron.
Sheared granite	Light pink to gray, mostly coarse-grained biotite granite. Greatly sheared, at places schistose or gneissic. Cut by innumerable green mafic schistose or slaty dikes which resemble the greenstone schist.	Water occurs in fractures and joints. Adequate yields for domestic supplies at most places. Moderate to moderately large supplies for municipal and industrial users at some places, but inadequate supplies at a number of places. Average yield of 116 wells is 14 gallons a minute. Water moderately hard at many places, soft at other places; usually low in iron content.
Slate	Chiefly gneissic, schistose, or slaty tuffs consisting of mineral grains and fragments in a fine-grained matrix of volcanic ash and some land waste. Usually tough, hard, light-colored. Include some clay slates.	Water occurs in joints, fractures, slaty cleavages, and in quartz veins. Adequate yields for domestic use nearly everywhere. Moderate yields for municipal and industrial use at most places. Average yield of 40 wells is 16 gallons a minute. Water generally soft to moderately hard but at a few places is hard or very hard.
Sericite schist	Chiefly sericite, quartz-sericite, and chlorite-sericite schist. Usually fine-grained and finely foliated. Schistosity strikes northeast, dip is vertical. Very deeply weathered.	Water occurs in joints, fractures, and planes of schistosity. Yields are adequate for domestic supplies at most places and moderate supplies can be obtained for municipal and industrial use at most places. Average yield of 14 wells is 10.5 gallons a minute. Water usually soft, in some places contains objectionable amounts of iron.
Greenstone schist	Green, slightly to highly schistose mafic rocks chiefly of volcanic origin. Consist of lava flows, tuffs, breccias, and some intrusives. Usually greatly sheared and fractured. Quartz veins at many places.	Water occurs in joints, fractures, along planes of schistosity, and in fractured quartz veins. Yields adequate domestic supplies nearly everywhere and moderate to moderately large supplies for municipalities and industries. Average yield of 135 wells is 28 gallons a minute, the highest of all units. Water generally moderately soft and in some places contains objectionable iron.
Quartzite and schist	Fine- to medium-grained quartzite, gneissic appearance at places because of muscovite contained; also mica schist, quartz-mica schist, quartz-chlorite-mica schist, moderately coarse and greatly crenulated.	Water occurs in fractures, joints, along bedding planes, and planes of schistosity. Yields small supplies of water at most places. Average yield of 27 wells is 5 gallons a minute. Water usually soft and low in iron.
Gneiss	Quartz-mica-feldspar gneiss, quartz-mica schist, hornblende plagioclase gneiss, hornblende schist, and marble. Mostly of sedimentary origin. Bedding usually distinct, striking northeast. Dip generally moderate.	Water occurs in joints, fractures, bedding planes, and planes of schistosity. Yields adequate domestic supplies practically everywhere. Moderate to moderately large supplies for municipal and industrial use at most places. Average yield of 350 wells in area is 11.5 gallons a minute. Water ranges from soft to extremely hard. Iron content usually low.

laminated. This phase usually is light-colored and consists chiefly of muscovite and plagioclase. Where muscovite is prominent, the rock has some of the characteristics of a schist. Where it contains considerable amounts of potash feldspar, the gneiss has a pinkish cast. Banding is generally prominent caused either by differences in color due to the different proportions of the minerals, or by variation in texture.

A second important rock type included in this unit is quartz-mica schist. Biotite and muscovite usually occur in nearly equal amounts. Quartz generally is subordinate to the mica, although at a few places it is the chief mineral. Plagioclase is a characteristic accessory and by increase in amount of this mineral the schist grades into feldspar gneiss. In places garnet is an important accessory, the grains usually ranging in size from about 1 to 5 millimeters. The schist is usually rather coarse with irregular, wavy schistosity. The color is commonly bronze to brown, the darker colored varieties having a higher proportion of biotite. Other, lighter-colored phases consist chiefly of muscovite and quartz.

Other types of gneisses and schists mapped with this unit include hornblende-plagioclase gneiss, hornblende schist, quartzite and, at a few places, marble.

Most of the gneisses are distinctly banded, and the different types alternate in layers that at many places appear to be beds of sedimentary origin. Dips and strikes of the bedding planes were recorded at many

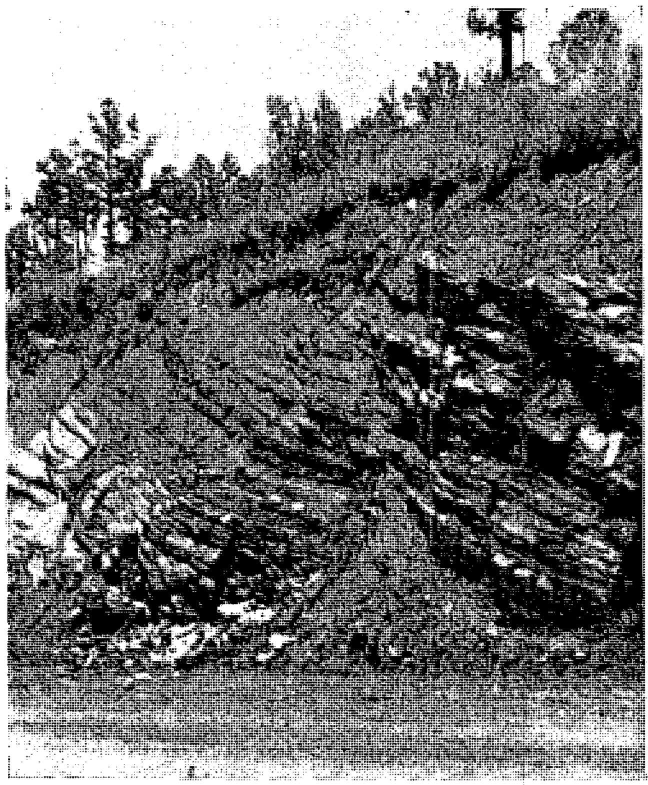


Plate 5—Interbedded gneiss and schist in northwestern Forsyth County, three quarters of a mile east of Yadkin River on State Highway 67. Strike about N. 50° E., dip 24° SE.

places and have been plotted on the map. Only dips and strikes were recorded that appeared to be representative of a considerable area, usually where the same dip and strike persisted for at least several hundred feet. The small folds, both synclinal and anticlinal, many of which were observed, were not recorded. Some of the larger folds are shown by the plotting of the dip and strike arrows. Several relationships are illustrated by the dip and strike arrows. First, the strike is quite uniformly to the northeast. Second, the dip is rarely, if ever, vertical and dips of less than 45 degrees are commoner than dips of more than 45 degrees. Third, the dip southeast of the quartzite and schist unit, is uniformly to the southeast with relatively few exceptions. In a small area in northwestern Rockingham County, the dip appears to be uniformly to the northwest. Northwest of the quartzite and schist unit, in northwestern Stokes County, the dip apparently is reversed and is generally to the northwest. The structure of the gneiss and schist unit apparently is that of an anticlinorium whose axis extends from southwestern Stokes County to northeastern Rockingham County. The general dips of the limbs of this structure are interrupted by many minor folds.

The southeastern limb of the anticlinorium is generally about 20 miles wide. Assuming an average dip of 30 degrees, a conservative figure, the total thickness of the strata would be 10 miles, a figure which appears to be much too large. It seems probable that normal strike faults have caused a repetition of the strata. One such fault, along the northwestern side of the Triassic, has a throw of more than 7,000 feet. Similar faults are also suggested by the parallelism of some of the streams and by the apparent repetition of strata, features which are particularly noticeable in Forsyth County, northwest of Bethania.

Most of the gneisses and schists of this unit appear to have been derived from sedimentary rocks, mostly sandy clays or arkoses, with some beds of clean sand and some of clay. In many places the bedding is distinct and the large proportion of quartz rules out any possibility of an igneous origin, either intrusive or extrusive. The hornblende-feldspar gneisses and the hornblende schists may originally have been igneous rock. Some may have been ferromagnesian intrusives and probably others were lava flows. The rocks of this unit appear to be identical with the Carolina gneiss in other sections of North Carolina, which according to Keith[1] is mainly of sedimentary origin. The age of these rocks is indefinite. They apparently are older than Cambrian because in western North Carolina they are overlain by rocks of Cambrian age[2].

Quartzite and schist.—The rocks of this unit crop out in a belt extending northeast across southwestern and central Stokes County, forming Sauratown Mountain, Moores Knob, Hanging Rock, Cooks Wall, and other large and small mountains of that area. The rocks are chiefly quartzite and quartz-muscovite or quartz-chlorite-muscovite schist. The quartzite is usually fine- to medium-grained, light-colored, and usually contains some silvery-white muscovite. At some places it also has a small amount of green chlorite, and at places brownish-green or green biotite. The mica and chlorite are usually fine-grained and at most places enough of the micaceous minerals are contained in the rock to give it a gneiss appearance. With larger amounts of mica the gneissic appearance is quite prominent. At some places magnetite and plagioclase are present as accessory minerals.

The schist is most commonly a moderately coarse muscovite schist with considerable quartz. At some places the quartz predominates. In many places the schist contains brown to greenish colored biotite, and at some places green chlorite. Where biotite and chlorite are absent the schist is silvery gray, but where these minerals are present the schist usually has a greenish tinge. At some places the schist is slightly graphitic and at many places it contains considerable garnet. The schist is greatly crenulated and corrugated, especially at the base of the mountains.

Other types of rocks found include quartz-mica-feldspar gneiss. It seems that every gradation between a pure quartzite and a feldspar (mostly plagioclase) gneiss can be found. It is not known whether these rocks grade from one to another in the same bed or whether different beds are represented. An interesting rock found at a few places in the Sauratown Mountain group is flexible sandstone, a fine-grained sandstone consisting of fine interlocking quartz grains and mica flakes.

The mountains are capped by massive white to light-gray quartzite beds, with a few relatively thin layers of greenish-colored mica, quartz schist, and quartz-mica schist, forming a nearly vertical wall at many places several hundred feet high. The slopes below the caps at most places are covered with debris, but the underlying rock apparently is alternating quartzite and schist layers, the schist becoming predominant near the base.

The dips in the quartzites are usually lower than in the gneisses of the first unit, usually being 15 to 20 degrees. In general the strike is northeast, but considerable variation was noted.

The great crenulation and corrugation of the schist at the base of the mountains suggests that most of the stress which produced the deformation of the rocks was absorbed by the schists beneath the more competent quartzites. The quartzite, as it were, rode up on the more plastic schist.

In the short time available only a generalized idea of the structure could be obtained. However, the structures of a few of the mountains were observed. Sauratown Mountain proper, between Gap and Pinnacle, is a hogback ridge. The south end of the ridge trends nearly due north, the quartzite dipping to the

---

[1] Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Gaffney-Kings Mountain folio (no. 222), p. 3, 1931.
[2] Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Asheville folio (no. 116), p. 4, 1904.

west, and the northeast end of the ridge trends about N. 25° E., the quartzite dipping to the northwest. The trend of this, the main part of Sauratown Mountain, is not parallel to the strike of the quartzite because the quartzite cliff becomes lower to the northeast along the ridge. The mountains between Gap and Danbury appear to be formed by the upturned edges of the quartzite which has been folded into an eastward-plunging syncline. Moores Knob and Ruben Mountain form the northwestern limb and Huckleberry Mountain, Cook's Wall, and Cole Gap Mountain form the southeastern limb. The quartzite forming Hanging Rock dips to the north and appears to be the southern limb of another eastward-plunging syncline or the same syncline faulted up.

The quartzites and schists of this unit originated as sedimentary sands and clays, presumably deposited in marine water. The rocks appear to be similar to those mapped as Cambrian in the Gaffney-Kings Mountain area[1]. These rocks in that area and in the Greensboro area are shown on the geologic map of the

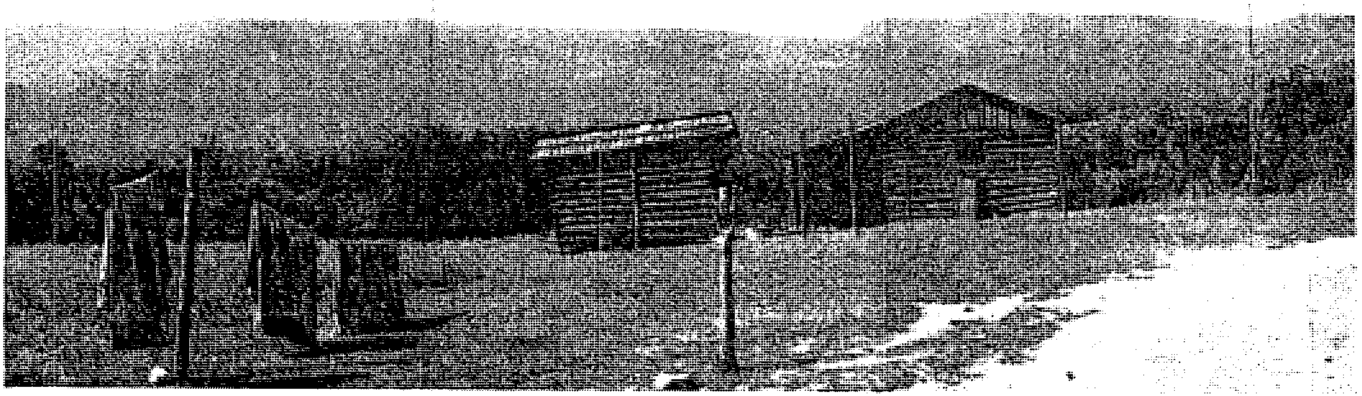


Plate 6—Sauratown Mountain from the south. These mountains are capped by massively bedded quartzite which is very resistant to erosion. The dips are low, generally 10° to 15°.

United States[2] as Wissakickon schist and are regarded as Pre-Cambrian. No information was obtained regarding their age in the Greensboro area. It is believed that they are younger than the gneiss unit.

Greenstone schist.—The greenstone schist crops out in a very irregular belt extending across the southeastern half of Guilford County, the northwestern half of Alamance County, and the south-central part of Caswell County. The greenstone schist does not crop out continuously across this belt but occurs in elongated areas and irregular patches separated by areas of granite.

The greenstone schist includes an assemblage of rocks that were mapped together because it is difficult, if not impossible, to separate them in the field; because they are thought to be of the same age and to have similar origins; and because they have certain marked resemblances. All are some shade of green, are slightly to highly schistose, and are mafic rocks of igneous origin. The typical greenstone schist is a very fine-grained light to medium olive-green hornblende-plagioclase schist, generally containing some chlorite. The hornblende is green, decidedly pleochroic, and has an extinction angle of 18° to 20°. The plagioclase in many samples was also green, apparently from partial alteration to epidote. The plagioclase generally has a low extinction angle and is probably oligoclase and sodic andesine. The chlorite is green and fibrous and appears to have formed by alteration of the hornblende. This rock probably was originally an andesitic lava. In some exposures the greenstone schist is coarser, is less schistose, and has a darker color. In these rocks the feldspar is relatively unaltered and little chlorite has developed, possibly because the more massive structure has hindered the circulation of the hydrothermal solutions. The hornblende is green, but because of the absence of chlorite and because the feldspar is not altered to epidote the rock has a dark greenish-black appearance. The grain is usually sufficiently coarse that close examination discloses the interlocking

[1] Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Gaffney-Kings Mountain folio (no. 222), 1931.
[2] U. S. Geol. Survey, Geologic map of the United States, 1932.

grains of white plagioclase and greenish-black hornblende. This rock quite possibly is an altered diorite. At a few places the greenstone schist is apparently a very much altered ferromagnesian tuff or breccia. In the bed of Haw River, near Swepsonville, some of the greenstone is fine-grained and slightly gneissic. On the south side of the river a very coarse greenish-colored rock is exposed that consists chiefly of hornblende and plagioclase. In some layers the plagioclase appears to have been completely altered to epidote. This rock overlies the rock exposed in the river and apparently is flat-lying. Both rocks may have been lava flows, but the relatively coarse grain of the higher one suggests that it was a sill.

At a number of other places the greenstone has a gneissic appearance, particularly in the coarser phases.

The schistosity strikes northeast, parallel to the general regional strike, and is nearly everywhere vertical. Where the rocks are gneissic, the banding is usually greatly contorted. The present attitude of the original flows, beds and other individual members is obscure, and no attempt was made to decipher the structure.

The greenstone schists probably all originated as ferromagnesian igneous rocks, most of them probably as lava flows. Their age is uncertain.

Sericite schist.—This unit extends northeastward from a point near Guilford College through the southeastern corner of Rockingham County and halfway across Caswell County, to a point a few miles south of Yanceyville. It forms a belt from 1 to 4 miles wide northwest of and for almost the entire distance in contact with the greenstone schist.

The sericite schist is generally so deeply weathered that only rarely can fresh, unaltered material be obtained, and even then one cannot be certain that the fresh rock is the same as the rock from which the weathered material was derived. The schist is usually fine-grained, with fine, smooth planes of schistosity. Generally the only recognizable minerals are sericite, quartz, chlorite, and limonite. The sericite occurs in small silvery-white scales. Some specimens of the schist consist almost entirely of sericite and have a silvery-white color; others contain much iron oxide that has evidently been derived from a mineral such as biotite, chlorite, or hornblende. At other places the rock is a quartz-sericite schist or a quartz-biotite schist. In the latter rock quartz generally predominates. Near Cherry Grove, in Caswell County, unweathered rock from a dug well was a fine-grained, finely foliated green quartz-sericite-chlorite schist. The weathered material at the surface was the usual deeply weathered red clayey soil with sericite flakes. It is possible that this specimen represents most of the rock in the unit.

The sericite schist lies along the northwestern edge of the greenstone schist and appears to be in contact with it for nearly the entire distance. At several places near the contact, exposures were noted in which greenstone schist and sericite schist alternated as though interbedded. It may be that the sericite schist was formed as a sedimentary product of land waste deposited at intervals of quiescence between the periods of volcanism that produced the greenstone schists. The main body of chlorite-sericite schist would thus have been deposited during a long period of quiescence; most of the greenstone schist being formed when volcanism was active. According to this hypothesis the rocks near the contact were formed during a transition period, when short intervals of volcanic activity alternated with short periods of quiescence.

The two rock units were evidently formed in the same period, but it is not known whether the period began with the deposition of the sediments from which the sericite schist was derived and ended with the volcanism that produced the rocks from which the greenstone schists were derived, or vice versa.

Slates.—Included in this unit are rocks of sedimentary and igneous origin that have been metamorphosed into slates, and phyllites or low rank schist.

The largest area of slate covers approximately the southeastern third of Alamance County. A narrow, very irregular belt of slate extends from Climax in Guilford County, northeastward nearly to Burlington; and a small area crops out just south of High Point.

Probably the commonest rocks of this unit are gneissic, schistose and slaty tuffs. These usually are tough, hard grayish-white to bluish-gray rocks consisting of mineral fragments or grains in a fine-grained matrix of volcanic ash. At places the tuff contains both feldspar and quartz fragments and grains. At other places the tuff consist largely of quartz grains and pebbles with just enough ash to fill the space between the grains. At some places the rock is dense and fine-grained and was derived entirely from volcanic ash.

This phase resembles chert. All these rocks are tough and hard when unweathered but in some places upon weathering they disintegrate into their component minerals. Thus a weathered tuff containing quartz grains and pebbles resembles a friable silty sandstone.

Most of the tuff has a slaty or schistose cleavage; in many exposures the cleavage is prominent, but at some places it may be obscure or entirely absent. At many exposures of the coarser phases the tuff has a gneissic appearance caused by crude banding of the coarse feldspar or quartz grains and fragments. Clay slate, a very fine-grained buff-colored rock with smooth cleavage planes, occurs in Guilford County south of Big Alamance Creek and at a few other places.

The cleavage planes of the slates usually are vertical and strike northeast. At only a few places can the bedding be observed. These rocks were formed mostly by the commingling of volcanic ash and other ejecta with some land waste. Some of the beds are believed to have been deposited in water but many may have been deposited directly on the land. The clay slates probably were formed by the deposition of clay and silt in bodies of water.

The age of the slates has usually been considered to be pre-Cambrian. There is little or no direct evidence either supporting or disproving this correlation. Probably the arguments most commonly advanced for a pre-Cambrian age are the degree of metamorphism and the absence of any fossils. The argument based on degree of metamorphism appears to be very weak because at many places in the United States rocks much younger than pre-Cambrian have undergone as much or more metamorphism than these slates. Detailed studies of the slates have been made in only a few places. The most important of these, made by Laney[1], Pogue[2], and Stuckey[3], all state that no evidence was found regarding the age but place the slates in the pre-Cambrian because that has been the accepted age.

Sheared granite.—This unit is very distinctive and can generally be readily distinguished in the field. It is a sheared, in many places schistose or gneissic, biotite granite cut by innumerable greenish-colored mafic dikes which have been metamorphosed to a slate or schist. The dikes have a close resemblance to the greenstone schists, and in general appear in much greater numbers near the southeastern margin of the granite belt, near the contacts with the greenstone schists.

The granite crops out in an irregular and interrupted belt across southeastern Guilford County, most of Alamance County, and the southeastern corner of Caswell County. In this belt it is very closely associated with the greenstone schist and, in southeastern Alamance County, with the tuffaceous slates.

The granite is most commonly a light-pink coarse-grained rock consisting chiefly of orthoclase, plagioclase, biotite, and quartz. At a few places the granite is light gray and medium-grained, the feldspar being chiefly plagioclase. Nearly everywhere the granite has been greatly sheared, with the development of a schistose or gneissic structure. The biotite occurs in large smears which wrap around the surfaces of the feldspar and quartz crystals.

Microscopic examination of a thin-section cut from a specimen obtained 5 miles east of High Point indicated that the granite has undergone a considerable amount of metamorphism. Orthoclase occurred in a few large-zoned crystals, with some microcline which showed strain shadow. The feldspar is chiefly albite which showed both albite and pericline twinning. The crystals are large and many of them are curved as much as 5°. Some form an S-curve. Quartz occurs only in very small grains, as though granulated or mylotinized, and occurs in stringers threading between the feldspar crystals. Nearly all the quartz grains show prominent strain shadows. There is considerable green, very pleochroic hornblende which occurs in large curved crystals. There are also a few scattered augite crystals. Biotite is quite plentiful and threads in between the other minerals, curving around their margins. The small amount of chlorite is similar to the biotite in its occurrence.

Probably more than 90 percent of the dikes, which cut the granite in such great numbers, are of one general type. They are generally several inches to several feet wide, a few being up to about 25 feet in width. Some of them can be traced for hundreds of feet. The dikes occur nearly everywhere in the granite in great numbers. Rarely does an outcrop of 200 or 300 feet of granite fail to expose at least one dike, and at many places 10 or 12 dikes cut the granite in an outcrop of that size. The dikes appear to be more num-

[1] Laney, F. B., The Gold Hill mining district of North Carolina: North Carolina Geol. and Econ. Survey Bull. 21, p. 74, 1910.
[2] Pogue, J. E., Jr., Cid mining district of Davidson County: North Carolina Geol. and Economic Survey Bull. 22, p. 95, 1910.
[3] Stuckey, J. L., The pyrophyllite deposits of North Carolina: North Carolina Dept. Cons. and Devel. Bull. 37, p. 25, 1928.

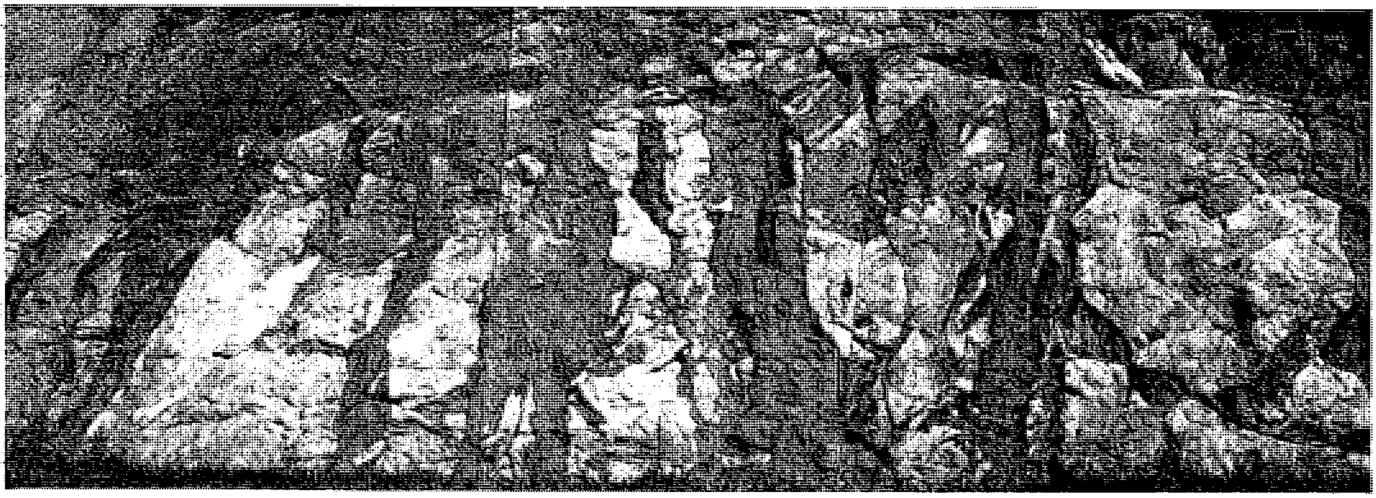


Plate 7—Sheared granite with inclusions of gneiss, both cut by mafic dikes. Metamorphism has produced a gneissic structure in the granite and has altered the dikes to schist.

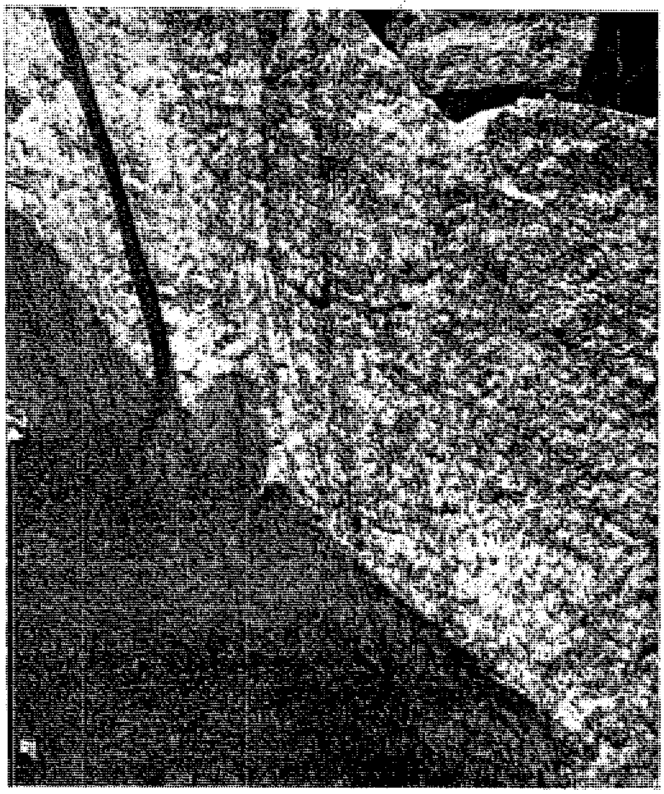


Plate 8—Close-up of sheared granite.

erous and more closely spaced along the margins of the granite, where it is in contact with the greenstone schist. In fact, in some exposures near the margin of the granite the dikes occupy more area than the granite into which they are intruded.

The typical dike is a very fine-grained greenish-colored schist. Brownish-colored dikes are noted at a few places and, except for the color, they are similar to the green dikes. Microscopic study shows that the rock consists chiefly of chlorite, biotite, plagioclase, and augite. Present in minor amounts are muscovite, apatite, and garnet. The chlorite occurs as a matrix of felted shards from which the biotite and augite developed. Both the biotite and augite occur in idimorphic crystals ranging in size from the smallest that can be discerned with the microscope to crystals several hundred times that size. The plagioclase contains many inclusions of muscovite and chlorite and some biotite.

A few felsic dikes cut the granite at places. These are fine-grained, light-colored, and appear to consist chiefly of feldspar and quartz.

Diorite.—Diorite crops out in a number of places in Alamance, Caswell, and Guilford Counties. The four areas of diorite shown on the map include one just north of High Point, one about 8 miles northeast of Julian, a small area at Swepsonville, and a much larger area in south-central Caswell County. Besides the areas shown on the map, many other outcrops of diorite were mapped with other rocks, mostly because their small size did not permit their separation on the map scale used. Many outcrops of diorite were included in the areas mapped as greenstone schist, and conversely, some greenstone schist may be included with the diorite, particularly in the area near High Point and the one in Caswell County. The greenstone schist and diorite appear to be closely associated areally, and because the soils are so similar it is difficult to distinguish them where outcrops of fresh rock are few. Some outcrops of diorite which are not shown on the map are as follows: between Graham and Haw River; between Graham and Swepsonville; 6 miles west of Climax and at several other places between Climax and High Point; 5 miles south of Greensboro; 6 miles north of High Point; and near Buffalo Creek, about 8 miles northeast of Greensboro.

There is considerable variation in the diorite not only from place to place but apparently within the same mass. It is usually fine- to medium-grained but at some places is quite coarse. The color ranges from medium gray to dark greenish gray. Plagioclase and hornblende are the chief minerals, with a little quartz in some places. The hornblende is a greenish-colored variety and at some places the plagioclase is partially altered to epidote, thus giving the rock a greenish cast. Plagioclase commonly makes up about 65 percent of the rock but it ranges from about 50 to 75 percent.

At many places the diorite is massive and has no apparent schistosity, but at other outcrops it is quite schistose. It was not determined whether the diorite is all of one age or whether two or more periods of intrusion are represented. The range in degree of metamorphism of the diorite is no greater than the range in any of the other rock units mapped. It is quite possible that all the rock units, as mapped, include rocks of greatly different ages. However, it seems very likely that degree of metamorphism is not a good criterion of age in this area. Not only will different kinds of rocks react very differently to metamorphic forces; but the environment, particularly the depth at which metamorphism occurs and the distance from the metamorphic focal point, has a large effect on the degree of metamorphism.

Some of the diorite is definitely older than the older granite, which at a few places was observed to be intrusive into the diorite. At other places field relations suggest that the diorite was intrusive into the granite. If so there must be two ages of diorite intrusion.

Porphyritic granite.—This unit includes those granites thought to be younger than the sheared biotite granite described previously. At most outcrops the granite is porphyritic, but in a few places it is not. Most of it, whether porphyritic or not, appears to belong to the same period of intrusion. The largest area is in southeastern Forsyth and northwestern Guilford Counties where it crops out in irregularly shaped masses and elongate bodies paralleling the regional strike. It is intimately intruded into the gneisses and schists, which makes mapping difficult. In this area almost every outcrop of the granite is porphyritic. The other general area in which the granite occurs is in northern Stokes County, where many of the outcrops are of non-porphyritic granite.

The granite in southeastern Forsyth County and northwestern Guilford County is usually medium to very coarse grained, medium gray, and contains large phenocrysts of feldspar. Orthoclase crystals 8 inches long were observed in an outcrop 4 miles southwest of Belew Creek. The groundmass consists of feldspar, quartz, and biotite. At one exposure, 1¼ miles west of Union Cross on U. S. Highway 311, the granite is a medium-grained, equigranular light-gray rock consisting mostly of feldspar with some quartz and a little biotite, and containing numerous tiny clear rose-colored garnets. At many places, particularly southeast of Winston-Salem, dikes and fingers of granite can be seen cutting the biotite gneisses and schist. The granites have intruded these rocks much more complexly than could be shown on the map. At places the metamorphic rock appears to have been almost entirely digested by the granitic magma so that only small pods, lenses, and stringers of partially digested gneiss remain; and in many of these outcrops the granite has assumed in part the gneissosity of the metamorphic rocks. At other places the gneiss and schist appears to have been saturated with granitic liquors, resulting in the development of large phenocrysts of feldspar. At some places this process has progressed far enough to give the rock somewhat the appearance of a gneissic pegmatite. The elongated area in northeastern Stokes County is quite gneissic around the margins of the granite, adjacent to the contact with the gneiss and schist, but the central part is only slightly gneissic. The granite is equigranular, medium-grained, light gray to nearly white, and consists chiefly of quartz and feldspar in the central part but contains more mica near the margin. The small area along the State line a few miles west is coarse, and in places is a porphyritic, gneissic granite. The granite farther west is chiefly medium-grained, equigranular gray to pink rock with little or no schistosity.

Plate 9-A—Porphyritic granite intricately intruded into biotite gneiss and schist near Oak Ridge in Guilford County.

Plate 9-B—Close-up showing coarse texture of the granite.

In a small area northeast of Pinnacle and west of Sauratown Mountain the granite is gneissic and in places appears to be a mylotinized granite gneiss. The granite in this area has been greatly sheared and crushed. It contains considerable muscovite and chlorite which probably are, in part, of secondary origin. The granite in this particular area may be of a greater age than the rest of the granite of this unit.

The porphyritic granite is thought to be younger than the sheared biotite granite. Nowhere were the mafic schistose dikes, which are so plentiful in the sheared granite, observed to cut the porphyritic granite. Also, disregarding the schistosity and gneissic structure produced by partial assimilation of the country rock, the porphyritic granite shows no effects of shearing or other metamorphic stresses. It is younger than the gneisses, schists, and quartzites as it is intrusive into them, but it is older than Triassic dikes which cut it in a few places. It is probably younger than any of the other rock units except the Triassic.

Triassic (Newark group).—The Triassic rocks include shale, mudstone, sandy shale, sandstone, arkosic sandstone, arkose, and conglomerate and, in a few places, a few inches of bony coal. These deposits, which are of continental origin, crop out in an elongated basin beginning at Germanton and extending across southeastern Stokes and northwestern Rockingham Counties into Virginia. The part of the Triassic basin in North Carolina is about 40 miles long and generally from 3 to 6 miles wide.

The basal Triassic beds overlie the gneisses and schists along the southeastern edge of the basin, where the contact between the two rocks can be seen at several places. The lowest Triassic rock at many places is a rather coarse-grained arkosic sandstone but at a few places a basal conglomerate is the lowest and oldest Triassic rock. The Triassic rocks dip to the northwest, so that younger strata crop out successively in that direction. At several places where the contact with the gneisses was observed the basal conglomerate or arkose was only a few feet thick, with shales cropping out a very short distance above the contact. The higher strata, cropping out to the northwest, are alternating sandstones, arkose, conglomerates, and mudstone and shales, with apparently no regularity of sequence. Arkose and shale probably are the most common rocks. R. W. Stone gives the following section at Walnut Cove[1]:

SECTION OF TRIASSIC SEDIMENTARY ROCKS AT WALNUT COVE

	Feet
From base of sedimentary rocks to base of Carbonaceous shale, 1,600 feet, average dip 40°	1,220
Approximate thickness of Carbonaceous shale zone	250
From top of Carbonaceous shale zone to contact with gneiss, approximately 15,000 feet, average dip 25°	6,340
	7,810

It is quite possible that the highest Triassic beds were entirely removed by erosion and that the thickness of material deposited was much more than 7,810 feet.

Intruded into the Triassic sediments are many dikes which apparently are of late Triassic age. These dikes are fine- to medium-grained, dense, black diabase, ranging from a few feet to several hundred feet in width. The dikes at many places have baked and fractured the strata into which they were injected.

The contact with the gneiss along the northwest edge of the Triassic is a fault contact. It is believed to be a normal fault with downthrow to the southeast, and the vertical displacement must be at least equal to the present thickness of the Triassic beds, nearly 8,000 feet, and it may have been much more. The top of the Triassic, along the fault, is characterized by exceedingly coarse conglomerates. These conglomerates were seen at nearly every place along the contact where good outcrops were found. Boulders of gneiss up to 2 feet in diameter and 2½ to 3 feet long are not uncommon and boulders from 6 to 12 inches across are the rule. Generally the boulders are flattened and longer than wide. The matrix consists of smaller pebbles and cobbles and arkosic clays and sands, but in places there is surprisingly little matrix material. The belt of conglomerates at places apparently is more than half a mile wide.

The strike of the Triassic strata ranges from N. 28° E. to N. 85° E. and the average of 16 observations was about N. 61° E. All the Triassic beds except the border conglomerates dip to the north and northwest. Dips measured and recorded at 13 places ranged from 8° to 51° and averaged 35°. Where bedding could be found in the border conglomerates along the contact, the dip appeared to be quite steeply to the southeast. Farther from the fault the dip should flatten and may even reverse; however, time was not available to check this. The topography and geology of the Triassic basin are shown in the generalized cross-section, figure 2.

The Triassic beds were deposited in a subsiding basin of sedimentation. It is apparent that only a small part of the sediments originally deposited are still preserved. The dip of the beds, near the northwest edge of the basin, is as great or nearly as great, in most places, as the dip of the basal beds along the southeast margin. The faulting dropped the southeast part of the basin downward a distance at least equal to the thickness of the sediments. The fault must have been near the middle of the basin or even nearer the southeast side; otherwise the dips would be flatter toward the northwest side. It is apparent that the outcrop represents perhaps less than half of the original basin.

The faulting must have occurred after the main period of sedimentation because all the beds remaining, except for the border conglomerate, are truncated by the fault. Furthermore, if any considerable drop had occurred before deposition of the uppermost beds, these beds would have a much lower dip.

The sequence of events producing the present Triassic belt seems to have been:

1. Downwarping (or other type of subsidence) with sedimentation in the basin.
2. Intrusion of the diabase dikes.
3. Normal faulting, with downdrop of the southeastern part of the basin relative to the northwestern side. Simultaneously with this occurred erosion of the uplifted side and deposition of the border conglomerates.

[1] Stone, R. W., Coal on Dan River, North Carolina: U. S. Geol. Survey Bull. 471-B, p. 6, 1910.

4. Erosion to a peneplane so that all that remained of the Triassic basin was the southeastern part, and in this part, too, erosion had removed much material, beveling all the strata.
5. Planation of the Triassic by the Dan River and its tributaries, forming the sloping surface that terminates so abruptly against the gneisses to the southeast.

The age of these rocks has been definitely established as Triassic on the basis of fossil plants and animals found in them.

GROUND WATER[1]

SOURCE

The source of the ground water in the Greensboro area for all practical purposes is from precipitation as rain or snow. Little or no water is derived from the interior of the earth in the area.

The average yearly precipitation in the area is nearly 45 inches. In eastern United States stream flow carries off about one-third of the precipitation as direct run-off. Meinzer[2] estimates that about one-third of the precipitation reaches the water table. The remaining third is lost by evaporation and transpiration before reaching the water table.

In the Greensboro area, where the surficial materials in many places are impermeable clays, the recharge may be somewhat less than average. Thus recharge to the ground water in this area is probably somewhat less than 15 inches per year. Although seasonal fluctuations of the water table are considerable and there may be a considerable change in water level between dry and wet years, over a period of many years the net change in water level is zero, assuming no long term climatic change, so that the average annual recharge to the ground water is equaled by the average annual discharge. Ground water is discharged through springs, seeps, and wells, and by evaporation and transpiration. Most of the water discharged by the springs and seeps enters the streams and maintains their flow during periods of no rainfall.

OCCURRENCE

Large quantities of water are contained below the surface in the openings or interstices in the rocks. These interstices range in size from the minute pores in clays to large tunnels and caverns in lavas and limestones. The interstices in unconsolidated sedimentary rocks such as gravel, sand, and clay are the pores or openings between the sand or clay particles. Crystalline rocks such as granite, gneiss, and schist have little pore space between the component grains. The interstices in these rocks are the joints, fractures, cleavage planes, planes of schistosity, bedding planes, and solution channels. Consolidated sedimentary rocks, such as the Triassic sandstones and shales, have had their primary porosity reduced by compaction and by the deposition of minerals between the grains. However, in these rocks jointing and fracturing has produced secondary interstices in which water may accumulate. Several types of interstices are shown in figure 3.

The porosity of a rock is the percentage of the total volume that is occupied by the interstices. The porosity of rock materials covers a very wide range. The porosity of some clays is more than 50 percent, whereas the porosity of some crystalline rocks may be less than 1 percent. The porosity of clean sands and gravels usually is between 20 and 40 percent. When sands and clays are cemented and compacted to form sandstones and shales, the porosity is greatly decreased.

Because of the secondary interstices in the igneous and metamorphic rocks, such as joints, fractures, and cleavage planes, are formed or enlarged by weathering processes near the earth's surface, they decrease in number and size with depth. Solution and removal of minerals in the soil may result in a porosity of 50 percent or more, but the porosity decreases downward in the subsoil and in the partially decomposed and disintegrated bedrock. The solid bedrock may have a very low porosity.

A saturated rock or soil may have a large porosity and yet yield little water even though allowed to drain for a long time. A clay, for example, with a porosity of 50 percent might not yield any water by gravity because of the smallness of the pores, the water being retained because of molecular attraction. Some water also may be retained in a rock because the interstices are isolated or poorly interconnected. Even

[1] For a detailed discussion of the principles governing the occurrence and movement of ground water, see U. S. Geol. Survey Water-Supply Papers 489 and 494.
[2] Meinzer, O. E., Hydrology, p. 401, McGraw Hill, 1942.

in clean, coarse, well-sorted sand an appreciable part of the water will be retained as a thin film on the surface of the grains, and thicker films will be retained at the intersection of the surfaces of the grains. The ratio of the volume of water a saturated rock will yield by gravity, to the total volume of rock, is known as the specific yield and is stated as a percentage.

Probably the most important characteristic of an aquifer is its permeability, that is, its relative ability to transmit water. This characteristic may have little relation to the porosity; a clay, for example, with a porosity of 50 percent may transmit water very slowly, or not at all, whereas a sand or gravel with a porosity half as great may transmit large quantities of water in a short time. Clays are impermeable because the pores are so small that the water is held by molecular attraction. In silt and extremely fine sand the pores are larger and the molecular attraction is less but may still be so great that water is transmitted very

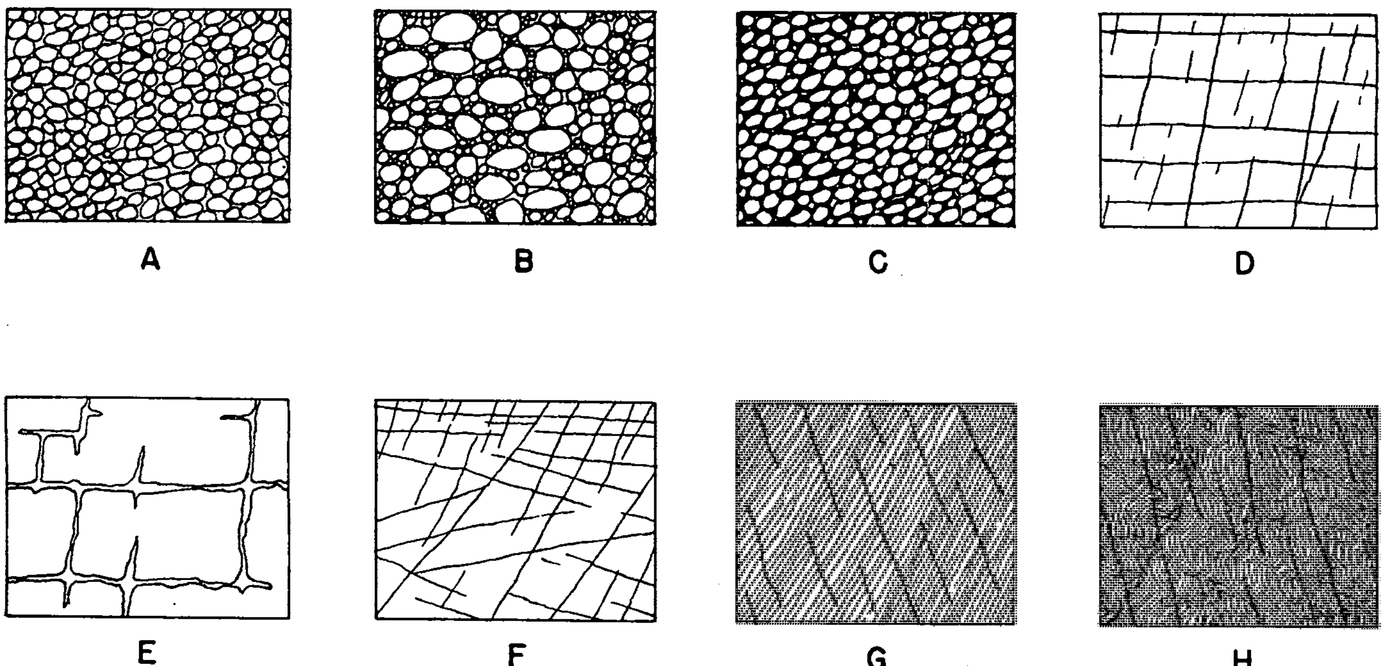


Fig. 3.—Diagram illustrating several types of rock interstices.

slowly. A small amount of clay or fine sand will greatly decrease the permeability of a medium or coarse sand. The concepts of porosity, specific yield, and permeability apply particularly to more or less homogeneous materials such as soil, clay, sand, gravel, semiconsolidated sandstones, and some limestones. It is more difficult to apply these concepts to rocks in which the interstices consist entirely of fractures, joints, cleavage planes, and similar openings because the rocks are non-homogeneous.

The movement of ground water is usually due entirely to the force of gravity, and ordinarily the velocity of flow varies directly with the hydraulic gradient; that is, the flow is laminar (non-turbulent). Under natural conditions the points of discharge are at a lower elevation than the points or areas of recharge.

In a humid region, such as the Greensboro area, recharge to the ground water is in the interstream areas. The ground water discharges into the perennial streams and lakes, and the lowest points on the water table are at these places. Rain water percolates more or less vertically downward to the water table and then moves laterally toward the point of discharge in some stream valley, lake, or swamp. The streams contribute to ground-water recharge only in periods of flood, when they recharge the alluvium and bedrock along their channels. This water generally drains quickly back into the streams when the floods pass.

During the winter and spring, when the water table is high, the head is greater, therefore the velocity is higher and the volume of discharge is greater than in the autumn when the water table is low.

THE WATER TABLE

Rain falling on an area percolates downward through the soil until it reaches the zone of saturation, beneath which all of the pores and interstices are completely filled with water. The surface of this zone of saturation is known as the water table. The water table is not a stationary surface but is continually fluctuating, rising during and immediately following periods of rainfall and declining during periods of fair weather. In humid regions such as the Greensboro area, the water table is an undulating surface, usually reflecting, in a subdued way, the irregularities of the topography. The relief—that is, the difference in elevation between high and low points—of the water table generally is much less than the relief of the topography.

The depth to the water table depends principally upon the climate, the topography, and the character of the rocks. As the climate is nearly uniform throughout the Greensboro area, and most of the rocks are consolidated, brittle rocks with similar types of interstices, differences in depth to the water table depends largely upon the topography. In stream valleys the water table may be at or very near the surface. On wide flat uplands the water table generally ranges from a few feet to a few tens of feet below the surface. On hills and in sharply dissected areas near the larger streams the water table may be more than 100 feet below the surface. The greatest depth to water measured in the Greensboro area was 161 feet in well 50 in Stokes County. This well was on a high hill rising above the valley of Dan River. The relation of the water table to the topography in homogeneous materials is illustrated in figure 4.

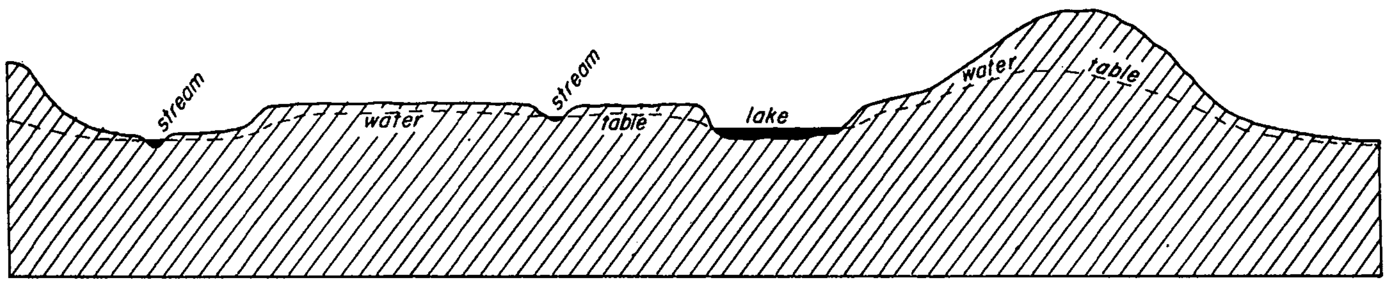


Fig. 4.—Diagrammatic section illustrating the relation of the water table to the topography.

FLUCTUATIONS OF THE WATER TABLE

Because the source of ground water is precipitation, the water table fluctuates with the rainfall. However, a number of factors complicate the correlation of ground-water level and rainfall. The intensity and duration of the rainfall has a considerable bearing upon the proportion of water that runs off directly, evaporates, and reaches the water table. A heavy rainfall of short duration may result in a high percentage of surface runoff because of the inability of the soil to transmit the water to the water table rapidly. The same amount of rain, falling over a longer period, may result in a much larger proportion of water reaching the water table. However, during the longer period of rainfall there might be an increase in the total amount of water evaporated, thus reducing to that extent the amount of water that will reach the water table.

Temperature also has a considerable effect. The viscosity of water varies inversely with temperature, so that cold water percolates through the earth more slowly than warm water. This means that water recharged during cold weather moves downward to the water table more slowly than water recharged when the weather is warm. When the ground is frozen, no water can percolate downward to the water table.

The evaporation capacity of the air, which is dependent upon temperature, humidity, and the rate of air movement, determines the rate of evaporation and thus has considerable bearing on the proportion of rainfall that may reach the water table. Transpiration losses through vegetation may have an even greater effect.

During the summer evaporation and transpiration losses are high and much of the rainfall occurs in short, heavy showers that result in high surface run-off. It is principally because of these three reasons that the ground-water level recedes during the summer and autumn although these months have the heaviest rainfall.

During the winter the vegetation is dormant so that little water is lost by transpiration, the evaporative capacity of the air is low and little water is lost by evaporation, and rain is apt to fall slowly and steadily. Therefore, the ground-water supplies are replenished during these months although the rainfall is less during these months than in the summer and autumn. However, the first winter rains often do not have as much effect on the water level as the late winter and spring rains because of the general deficiency in soil moisture by late autumn. Soil consisting of varying proportions of fine sand, silt, and clay will hold a considerable amount of water by the molecular attraction of the particles and this water does not percolate downward to the water table. After a long dry period this water, called the soil moisture, is depleted by evaporation and transpiration, perhaps for many feet below the surface. Before any water can reach the water table this soil moisture deficiency must be made up. This sometimes requires several weeks or months of winter rains, during which time the ground-water level continues to decline.

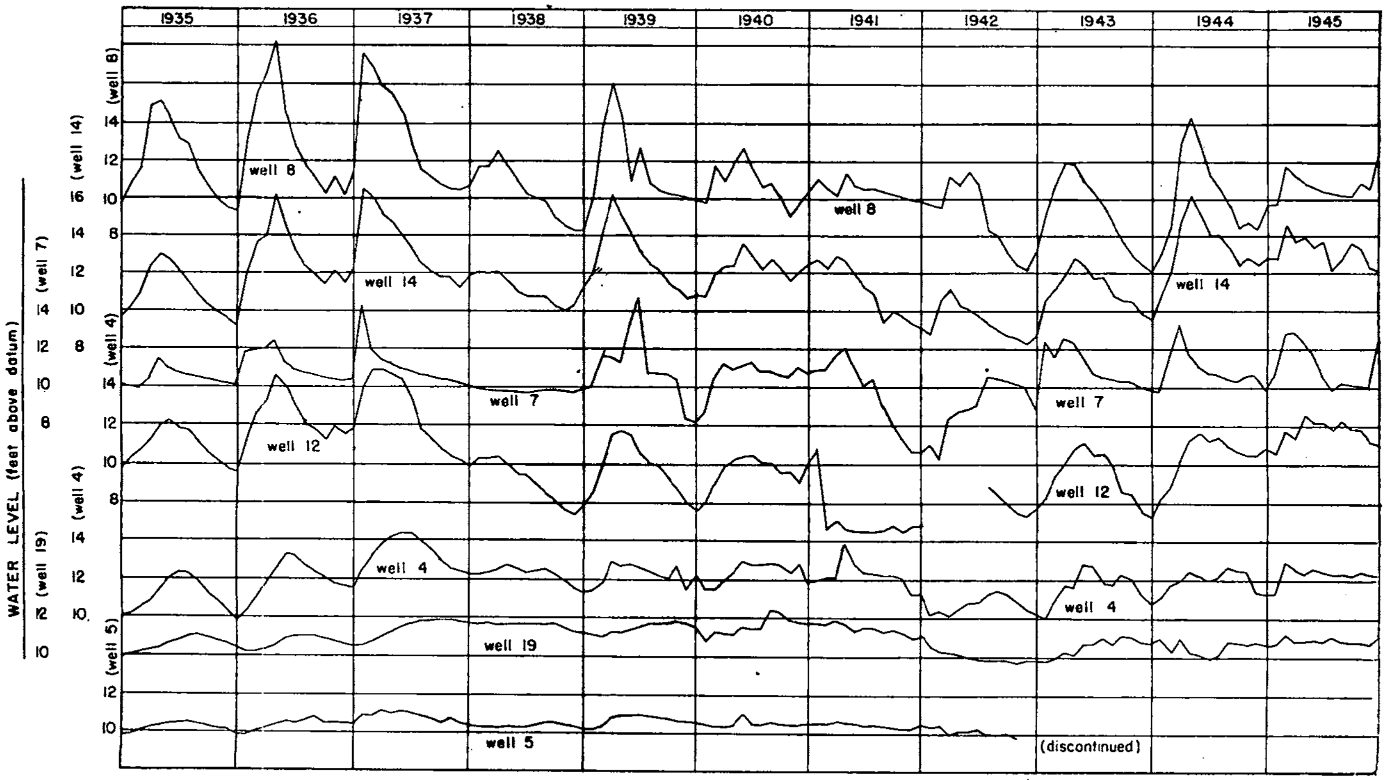


Fig. 5—Hydrographs of observation wells in the Greensboro area showing the height of water above the assumed datum near the end of each month.

The porosity and permeability of the soil differ from place to place and therefore affect the proportion of rainfall that produces ground-water recharge. The porosity and permeability of the soil may be changed by rainfall, heavy rains beating down and compacting the soil. The type of vegetation and land usage will have considerable effect on the porosity and permeability, and intensive cultivation usually reduces both.

RECORDS OF WATER-LEVEL FLUCTUATIONS IN THE GREENSBORO AREA

At the present time a continuous record is being obtained of the fluctuations of the water level in two wells in the Greensboro area. The water level is being measured monthly in six other wells in the area. A number of other wells were measured for several years but measurements have since been discontinued. Records through 1944 have been published by the U. S. Geological Survey[1].

The hydrographs for the six wells now being measured monthly and for one well which has been discontinued are shown in figure 5. For periods during which the water level was measured oftener than once a month, the water levels used in constructing these graphs are the last water levels measured each month. Wells 7 and 8 are about half a mile north of the center of High Point and are about 750 feet apart. Wells 12 and 14 are just southeast of High Point. Well 4 is about a quarter of a mile west of Colfax and well 19 is in Forsyth County, about 2½ miles west of well 4. Well 5, near Groomtown, is about 9 miles northeast of High Point. Study of figure 5 shows that the general trend of fluctuation of the water levels in these wells

[1] U. S. Geol. Survey Water-Supply Papers 777, 817, 840, 845, 886, 907, 937, 945, 987, 1017; 1935-1944, respectively.

is very similar, both as to seasonal trend and as to the trend from year to year. However, there is a considerable difference in range of fluctuation between wells, owing evidently to a difference in porosity or specific yield of the underlying material. Wells 7, 8, 12, and 14, in the vicinity of High Point, are dug in residual materials derived from the underlying greenstone schists or slate. The water levels in these wells fluctuate over a wide range, evidently because the soil has a high proportion of clay and thus a low specific yield. Wells 4, 5, and 19 are dug in material derived from the weathering of granite and gneiss which has a higher specific yield, so that a given amount of rainfall reaching the water table will not cause nearly as great a rise as it will at places where the specific yield is low.

The usual seasonal cycle of the water-level fluctuations in the Greensboro area begins with a marked rise in December or January, continuing until March or April, after which there is an almost continuous decline except when unusually heavy rainfall causes slight rises. The water level rises in winter, in spite of low rainfall, because a large part of the rainfall reaches the water table. Vegetation is dormant so that transpiration losses are very low, and the low temperature results in small evaporation losses. In March or April the vegetation begins to use large amounts of water and warmer weather causes a great increase in evaporation, so that the water level declines although rainfall is greater than during the winter. Transpiration and evaporation losses reach a maximum during the summer so that the decline of the water level continues in spite of the much greater rainfall in June, July, and August. The losses by transpiration and evaporation are less in September, October, and November but rainfall is also less, so that the decline of the water level continues. Furthermore, the soil moisture—that is, the water held by capillarity and thus not part of the ground-water body—has usually been depleted by the excessive transpiration and evaporation and this must be made up before any water can reach the water table. Continued heavy rainfall is necessary during the summer to raise the water level.

Figure 6 shows the fluctuations of the water level in well 2, Guilford County (Lindale Dairy Well), about 3 miles northeast of High Point, and in the Governor Holt well near Haw River. The curves of cumulative departure from normal rainfall at High Point and at Graham show the relation of the water level to rainfall (the normal rainfall used is the average for the period of record of the well and is not the same as the average for the period of record of the rain-gaging station).

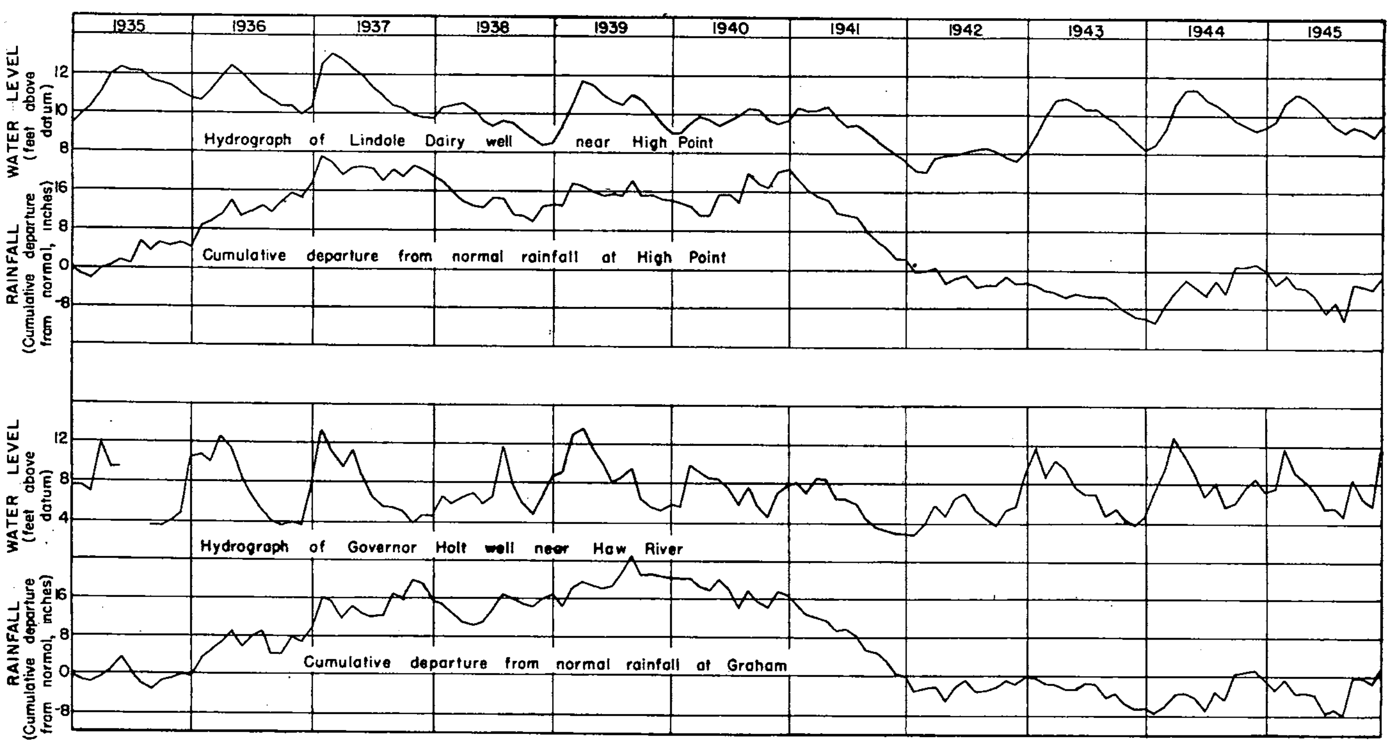


Fig. 6—Fluctuations of the water levels in two observation wells and cumulative departure from normal precipitation at nearby stations.

Above-normal rainfall during 1935 and 1936 resulted in high ground-water levels in the spring in 1935, 1936, and 1937. However, the excess of rain did not prevent the water level from declining to near-normal levels in the autumn of each year. Below-normal rainfall in the winter and spring of 1938 prevented the normal winter and spring rise; and although about the normal amount of rain fell during the remainder of the year, the water level in the Lindale well reached record low stages. Because of the above-normal rainfall during the last part of 1938 at Haw River, the Governor Holt well did not decline to record lows. Rainfall and water levels in both wells were not far from normal in 1939 and 1940. Below-normal rainfall in nearly every month of 1941 and in January 1942 resulted in record low levels in both wells during the first part of February 1942. Approximately normal rainfall during February and March did not suffice to raise the water level of either well back to normal, evidently because of a very large deficiency in soil moisture. With approximately normal rainfall during the remainder of the year, both wells were at below-normal levels. However, the water level at the end of the year was not far below normal and evidently the soil-moisture deficiency was not large because the water level made its usual spring recovery in 1943 with normal or below-normal rainfall. Above-normal rainfall in 1944 built up the water table to a very favorable position at the end of 1944, although no record high was reached.

UTILIZATION OF GROUND WATER

Ground water in the Greensboro area is obtained from wells and springs. The different types of wells include dug, bored, and drilled wells.

Dug wells.—More domestic water supplies in the Greensboro area are obtained from dug wells than from any other type. Dug wells in the area range from a few feet to nearly 100 feet in depth. The hole is generally dug between 30 and 60 inches in diameter. When the well is curbed with terra cotta or concrete pipe, the inside diameter usually is 24 to 30 inches. The inside diameter of masonry- or rock-curbed wells and uncurbed wells generally is somewhat greater. Dug wells have certain advantages over other types of wells but also have certain disadvantages. Probably the most important consideration that leads to the choice of a dug well is that of cost. Generally this is the least expensive method of obtaining a water supply, with the possible exception of bored wells. Furthermore, many wells on farms and on the fringes of towns are dug by the owner in his spare time or in slack seasons, so that there is no cash outlay from digging. However, cost is not always in favor of the dug well, particularly where bedrock is encountered before a satisfactory supply is obtained. The cost of dug wells under such conditions has been reported at several places to have exceeded the cost of the average drilled well in the neighborhood. A second advantage of the dug well is the large storage capacity as compared particularly with the small-diameter drilled wells. A well 24 inches in diameter will contain nearly 24 gallons of water per foot of depth, as compared to 1½ gallons and 1/6 gallon per foot of depth for wells 6 inches and 2 inches in diameter, respectively. Thus, even though the yield of a well may be very low, a fairly large quantity of water can be withdrawn in a short time.

Dug wells have two important disadvantages. Usually the depth of water in a dug well is not great, either because of the difficulty involved in digging below the water table or because bedrock is encountered. In periods of drought, therefore, many dug wells go dry. A second disadvantage is that the water in these wells is much more susceptible to pollution or contamination by the entrance of impure surface water. A survey made in Pennsylvania in 1930 and 1931, during which 17,665 water supplies were examined for purity, showed that the supplies from 90 percent of the drilled wells were safe whereas less than 50 percent of the supplies from dug wells were safe[1].

The danger of contamination of dug wells can be decreased by observing certain precautions. All dug wells should be covered tightly to prevent direct entrance of contaminating material, either solid or liquid. The well should be cased or curbed with tile or concrete pipe or similar material and the joints should be cemented to a depth of at least a few feet below the water table, but in any event to a depth of at least 10 feet below the surface. The space between the walls and the curbing should be filled, above the water-bearing bed, with clay. The dug well should be located several hundred feet from any source of contamination and up the ground-water slope from any nearby source of contamination.

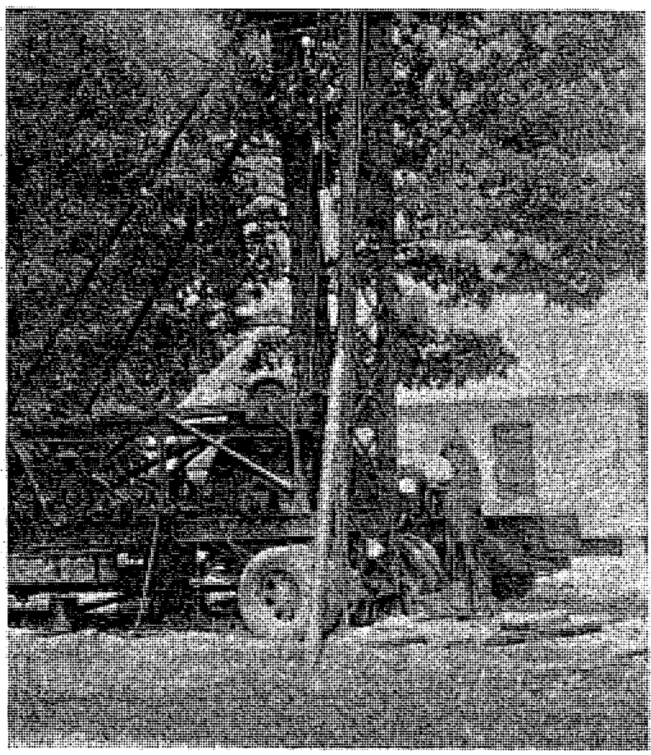
[1] Lohman, Stanley W., Ground water in northeastern Pennsylvania; Pennsylvania Topog. and Geol. Survey Bull. W4, p. 40, 1937.

Bored wells.—During recent years many wells have been bored in the Greensboro area. These wells are very similar to dug wells, but instead of being dug by hand the earth is removed by a large auger operated by a machine. Bored wells are quickly constructed and are relatively inexpensive. They nearly always are cased with a terra cotta or concrete pipe and are usually tightly covered. The average depth in the Greensboro area is probably not more than 30 or 40 feet, which is somewhat less than that of dug wells, as many dug wells continue into the broken bedrock whereas bored wells cannot be continued when rock or boulders of any considerable size are encountered. The usual diameter of bored wells is 18 to 24 inches. Bored wells as a group probably have a higher percentage of safety from pollution than dug wells as they are nearly always tightly cased and covered. Because wells can easily be bored for a considerable depth below the water table, this type of well is not so apt to go dry during periods of drought. However, bored wells cannot be used where the water table is below the zone of completely decayed and disintegrated rock.

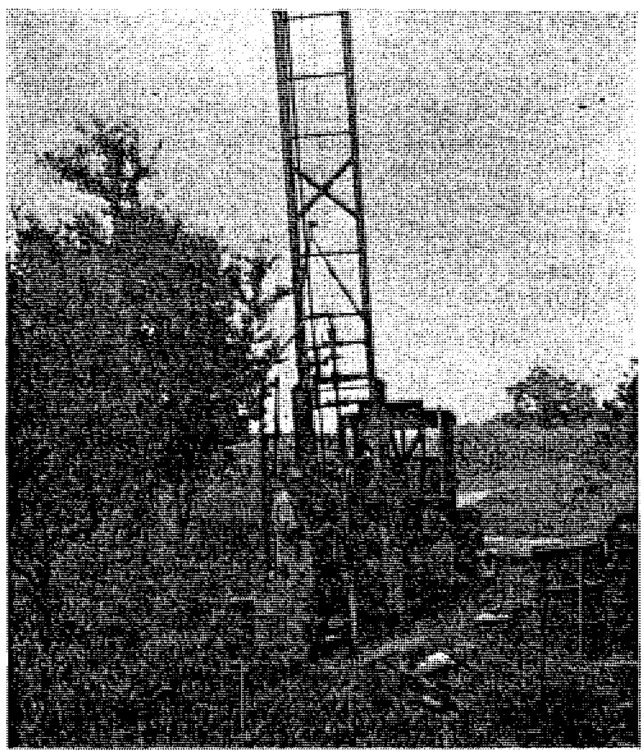
Drilled wells.—There are two methods of drilling wells in the area. The larger-diameter wells (6 to 10 inches) are usually drilled by the cable-tool (percussion) method, whereas nearly all wells 2 and 3 inches in diameter are sunk by core drilling with chilled shot.

In the cable-tool method a portable rig is used that consists of a derrick, engine, drum, and cable and the necessary drilling tools. After reaching the well site, the derrick is erected and the cable is run from the drum over a sheave at the top of the derrick, down to the string of tools, which consists of a short, heavy drill bit, a long drill stem for added weight and length, and a rope socket for attaching the cable to the drill stem. The well is drilled by abrasion of the rock by blows from the drill as it drops repeatedly after being raised a short distance by the machine. The drill is alternately raised and dropped about 25 or 30 times a minute. The well is always drilled with water in the hole, which holds the drill cuttings in suspension so that the drill does not fall on previous cuttings but is always cutting fresh material. Periodically, usually after drilling a few feet, the drill is withdrawn and a bailer is used to remove the cuttings. The bailer consists of a long cylinder with a valve at the bottom which permits free entrance of the mud and water but closes as the bailer is lifted.

Shot-drilled wells are drilled by rotation of a cutting bit on the end of a string of pipe rotated by machine. The drill pipe is usually ¾ inch or 1 inch in diameter and the cutting bit is from 2 to 6 inches in



A—Cable-tool (percussion) method.



B—Core-drilling with chilled shot.

Plate 10—Drilling rigs used in the two principal methods of drilling wells in the Greensboro area.

diameter, depending on the size of well desired, and 6 or 8 feet long. The cutting bit has a slot cut in the end which helps it to grasp the shot which are poured into the top of the well. The chilled shot fall to the bottom of the well and are caught and held by the softer metal of the cutting bit. Rotation of the bit causes chipping and abrasion of the rock. Water is forced down the inside of the drill pipe and returns to the surface around the outside of the pipe, bringing with it the drill cuttings. Cores are removed from the drill bit when it is withdrawn from the hole.

Nearly every well drilled by either method is cased. Usually the casing is driven down to solid rock, and usually the attempt is made to seat it in the rock so that shallow water cannot enter. Most cable-tool drilled wells in the Greensboro area, used for domestic supply, are 6 inches in diameter, although a few wells 4 or 5 inches in diameter have been drilled. Most industrial and municipal wells are 8 inches in diameter but a few are 10. The majority of shot-drilled wells are 2 inches in diameter but a considerable number of 2½- and 3-inch wells and a very few 4- and 6-inch wells have also been drilled by this method.

For domestic purposes a supply of a few hundred to a thousand gallons of water a day is usually sufficient for each family. Therefore a yield of 1 or 2 gallons a minute is about the minimum that will be satisfactory. A 6-inch well will hold 1½ gallons for each foot of well below the water table. Generally the wells are drilled deep enough that the well contains 30 feet or more of water, except where unusually large yields are obtained. The lower the yield, the deeper the well is drilled, both in an effort to obtain more water and also to increase the amount of water in storage. The smallest electrically operated deep well pump used generally has a capacity of about 3 or 4 gallons a minute, so that the storage will be exhausted in 15 or 20 minutes from a 6-inch well yielding 1 gallon a minute and having a storage of 30 feet of water. After the first 15 or 20 minutes the yield will be only 1 gallon a minute. The amount of water that could be removed from such a well in an 8-hour day would be 510 gallons, and this would require practically continuous pumping.

The above illustration suggests that a yield of 1 gallon a minute is sufficient to supply 200 or 300 gallons a day satisfactorily but that a larger yield is required if 500 or 1,000 gallons a day is needed. In a 2-inch well only 1/6 gallon per foot is held in storage, which is a negligible amount. Therefore, the amount of water that can be obtained at any time is approximately equal to the yield of the well. A well yielding only 1 gallon a minute will operate very inefficiently because most deep-well pumps are made to furnish at least 3 or 4 gallons a minute. Furthermore, it will require 50 minutes to obtain a 50-gallon barrel of water. For most domestic supplies from 2-inch wells, the minimum satisfactory yield is about 3 or 4 gallons a minute. For 6-inch wells, with their much larger storage capacity, a yield of 1½ or 2 gallons a minute is about the minimum satisfactory yield.

Users of larger amounts of water can determine the yield needed by dividing the total daily water required by the number of minutes during which the well will be pumped each day. Thus, if 10,000 gallons of water is needed and the well will be pumped 8 hours (480 minutes) a day, then a well yielding 21 gallons a minute will be needed. In no case should a well be pumped at capacity more than about 12 hours a day because continuous pumping at capacity usually results in a gradually decreasing yield.

FACTORS TO BE CONSIDERED IN SELECTING A WELL SITE

Everyone who has had experience with wells in this area knows that two wells a short distance apart may differ greatly in the amount of water yielded. One may be an excellent producer, whereas the other is a poor producer. Obviously a great deal of care should be given to the selection of the most favorable location. In spite of this, most well sites are chosen for their convenience and are as close as possible to the place where the water will be used, with the thought that less pipe will be needed from the well to the place where the water is used. Also, servicing the pump takes less time. Selection of a well site for these reasons generally is very poor economy. Drilling a well in rock costs from about $3.00 a foot for a 2-inch well to about $8.00 a foot for an 8-inch well. From 25 to 50 feet of small pipe can be laid at the surface for the cost of one foot of drilling in rock. Taking a chance on a poor site which may result in 40 to 50 feet of extra drilling in order to save a couple of hundred feet of pipe is poor economy. It is apparent that first consideration should be given to choosing the most favorable location for obtaining a satisfactory supply of water.

Although criteria for selecting well sites have not been thoroughly established, knowledge of certain geologic factors is very helpful. As the water moves through the pores in the soil and subsoil and through cracks in the rock, anything that will give a clue to the places where the pores and cracks are large and plentiful will help in selecting favorable well sites. Geologic factors to be considered are given below.

Rock texture.—Coarse-textured rocks generally are better aquifers than fine-textured ones. The probable reason is that any slippage along joints, cleavage planes, or fractures produces a certain amount of rotation of the mineral grains. Rotation of the grains in a coarse-grained rock naturally produces larger and more continuous openings than in a fine-grained rock.

Cleavage and schistosity.—Cleavage planes and planes of schistosity often serve as avenues for the movement of ground water. Where such planes are plentiful, and especially where movement along these planes has caused some degree of separation, the rock will yield more water.

Bedding planes.—Rocks of sedimentary origin have bedding planes along which water may move. In the Greensboro area many of the gneisses and schists are of sedimentary origin, and though the rocks are greatly metamorphosed the bedding planes still are important in the occurrence and movement of ground water. The bedding planes are especially important where the rock beds are separated slightly. Separation of the beds often occurs because of slippage between them, generally owing to folding of the rocks. Places where the rocks are closely folded are generally favorable for obtaining a satisfactory supply of water. Places where the beds are thin so that the bedding planes are closely spaced are also favorable.

Joints and fractures.—In many of the rocks of the Greensboro area the ground water occurs and moves in fractures and joints in the rock. Therefore, wells drilled at places where the rock is more closely jointed, sheared, or fractured will usually yield more water than wells drilled into massive rocks.

Quartz veins.—Because it is a hard, brittle mineral, quartz fractures and breaks during differential movements of the rock such as folding, shearing, and faulting. There has been a great deal of such movement subsequent to the emplacement of the quartz veins found in the Greensboro area, and most of them are fractured to some extent. Not all quartz veins serve as avenues for the movement of ground water, but many of the best wells in the area obtain most of their water from quartz veins.

Dikes.—Dikes are rock bodies emplaced while the rock was still molten. Usually they are in the nature of walls of lava extending nearly vertically through the formation into which they are intruded. The dike itself generally yields little water but often the strata adjacent to the dikes has been made more brittle by baking and have been fractured by the intrusion. In many places wells drilled near dikes have proved to be better-than-average water producers. This is particularly true of the Triassic rocks.

All the above factors, texture, cleavage, schistosity, bedding planes, joints, fractures, veins, and dikes should be considered in selecting a well site. Where rock outcrops are plentiful, much can be learned from them. However, where the rock is covered by a thick layer of soil and saprolite, the topography, which often reflects the character of the underlying rock, is an important indicator. Erosion is controlled largely by the relative resistance of the rock. Hills are left because the rock is more resistant; and depressions, such as valleys and draws, are cut at less resistant places. In many places the rock in the draws and valleys is less resistant because of the presence of fractures, joints, and other openings which facilitate the entrance of ground water and thus promote weathering. Therefore, wells drilled in draws and valleys should intersect more fractures and similar openings and thus yield more water. Also, the natural movement of ground water is toward the wells drilled in the depressions and away from the wells drilled on hills. The depression serves as a catchment basin feeding water towards the well located in it. In the Greensboro area wells drilled at such locations have an average yield more than three times that of wells drilled on hills. The average well drilled in a draw is also somewhat better than the average well drilled in a valley, and it seems probable that minor topographic features are more important than major ones. Thus, it may be wise to avoid a hill only a few feet high in selecting a well site; whereas, a depression only a few feet deep and a few tens of feet wide may be an excellent site.

Another factor to consider in the choice of a well site is the thickness of the mantle, that is, the thickness of the soil and weathered material above solid rock. Because the extent of chemical weathering of a rock depends largely upon the ease of access of water to the rock, a thick mantle of weathered material overlying the bedrock from which it was derived is an indication that the rock is jointed and fractured or has interstices of some other type through which water can move. Furthermore, the thick layer of mantle, which is generally quite porous although the permeability may be low, serves as a reservoir to feed water into the fractures.

Most drilled wells are cased to hard rock. The depth of casing, therefore, generally is directly related to the thickness of the mantle. In the Greensboro area 82 wells with 30 feet or less of casing had an average yield of 8.76 gallons a minute; 125 wells with 31 to 65 feet of casing had an average yield of 14.35 gallons a minute; and 100 wells with 66 or more feet of casing had an average yield of 20.52 gallons a minute.

COMPLETION AND TESTING OF DRILLED WELLS

Generally the casing in a drilled well is driven tightly into the rock to seal out direct entrance of water from the mantle. This lessens danger of contamination and prevents entrance of turbid water into the well, which sometimes occurs, particularly after a rainfall, in wells in which the casing is not tightly sealed in the rock. The space between the outside of the casing and the soil at the surface should be filled with cement or clay to prevent any surface water from running down along the outside of the casing. Surface drainage should be away from the well. The mouth of the well should be several inches above the surface and tightly closed.

The yield of only a small percentage of the wells drilled is accurately determined. The cost of adequately testing a drilled well is generally not more than about 5 percent of the cost of the well, and the information is nearly always worth many times the added cost. The length of test should be 2 hours or more on a well for domestic purposes, 24 hours or more on a well for a small industrial plant or public supply such as a school, and 48 hours or more on a well for a large industrial plant or a municipality. In making a pumping test the static level of the well should be measured accurately before starting the pump and the pumping level and yield should be measured at regular intervals during pumping. The well should be pumped at several different rates. After pumping ceases, the water level should be measured at intervals for several hours to determine the rate of recovery. With this information the proper size of pump and pump setting can be determined and an estimate of the pumping level at a future date can be made.

The majority of pumps used in the Greensboro area are deep-well pumps, although some shallow-well pumps are also used. The terms "deep-well pump" and "shallow-well pump" are somewhat misleading because the depth of the well does not determine the type of pump required. A shallow-well (suction) pump will lift water satisfactorily not more than about 25 feet and if the pumping level (distance to water level below the pump while the well is being pumped) is less than 25 feet, a shallow-well pump will be satisfactory regardless of the depth of the well. If the pumping level is at a greater distance, then a deep-well pump must be used. Many examples are known where dug wells 40 or 50 feet deep require deep-well pumps, whereas some drilled wells several hundred feet deep can be pumped with shallow-well pumps because their water levels are near the surface.

To obtain the most satisfactory service from a well, the owner or user should know certain essential facts about it. These include depth of well, diameter of casing and of the well below the casing, depth of casing, static water level, quantity of water yielded, and drawdown at the maximum yield. Knowledge of the depths at which water was encountered in the well is also very helpful. Data on the pump should include type of pump and amount of suction pipe if it is a shallow-well pump. The depth of setting of the cylinder, bowls, or jet should be known for a deep-well pump. With this information, decisions can readily be made regarding the possibility of increasing the yield by changing the pump installation. In order to determine the static water level and pumping level from time to time the pump should be installed so that these measurements can be made.

THE ROCK UNITS AND THEIR WATER-BEARING PROPERTIES

INTRODUCTION

The areas in which the different units crop out are shown on plate 1. As was explained in the description of the geology of the area, this is only a reconnaissance map and in some places is not completely accurate in detail. Many small areas of one type of rock occurring within larger areas of another type are not shown.

Data on 1,254 wells are tabulated and given with the county descriptions in this report. In order to compare the water-yielding properties of wells in the different rock units, tables were prepared showing the average depth, average yield, and other pertinent data for all drilled wells 3 inches or more in diameter, in each rock unit, for which there were sufficient data. The topographic location was noted for most wells, and other tables give the same data tabulated according to topographic location. These tables are given with the description of each rock unit.

Relative water-bearing properties of the rock units.—A table showing the relative merits of wells in different rock units is given below. Figure 7-A shows graphically the yield per foot of well for wells in the different rock units.

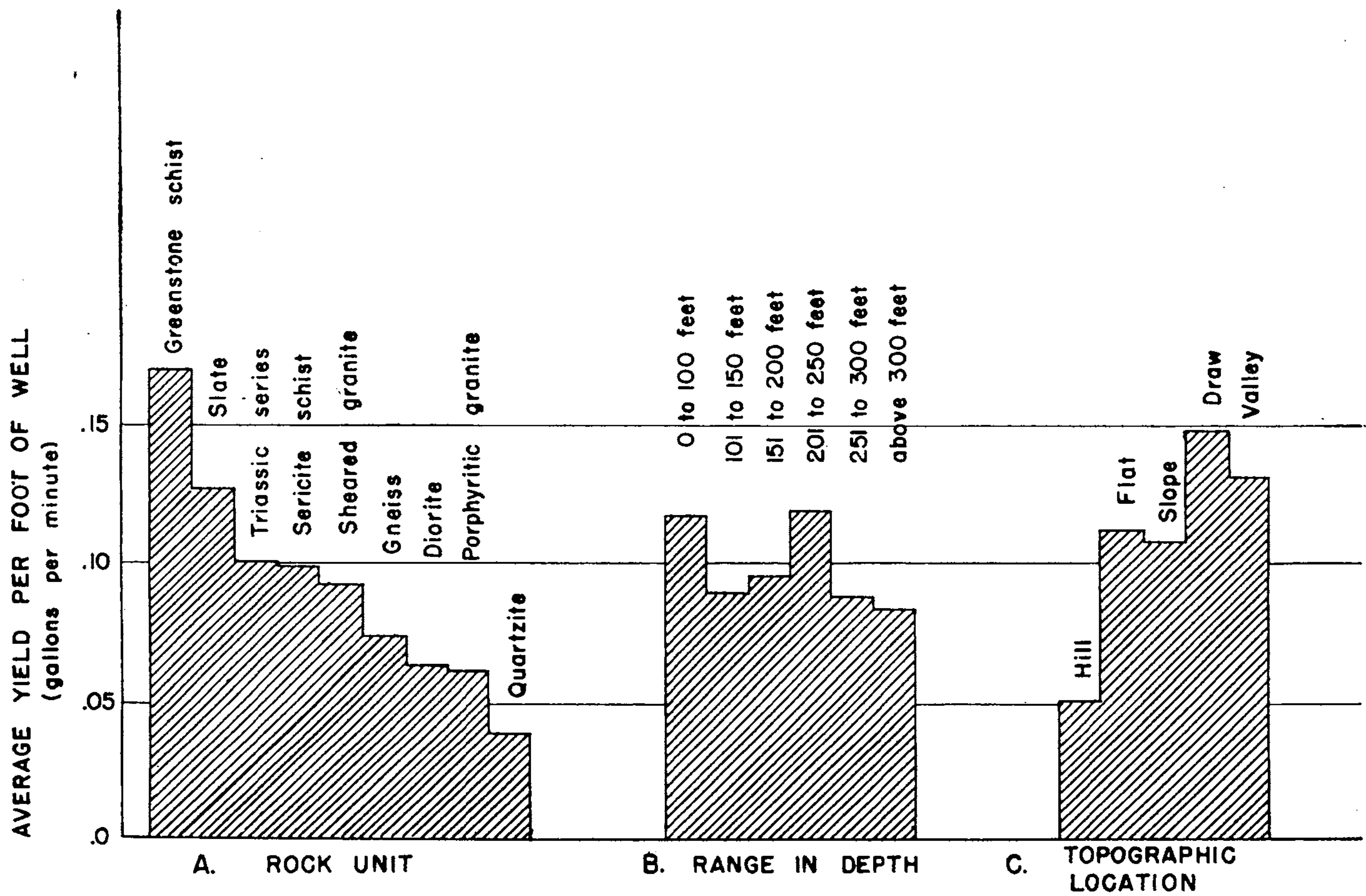


Fig. 7—A. Average yield, per foot of well, of wells in the different rock units.
B. Average yield, per foot of well, according to range in depth.
C. Average yield, per foot of well, according to topographic location.

The 812 wells have an average depth of 151 feet, an average yield of 14½ gallons a minute, and an average yield per foot of well of 0.097 gallons a minute. The lowest yield was zero and the highest yield was 212 gallons a minute. The number of wells yielding less than 1 gallon a minute is 103, about 11½ percent of the total.

TABLE 1—AVERAGE YIELD OF WELLS ACCORDING TO ROCK TYPE
(Drilled wells 3 inches or more in diameter)

Rock Unit	Number of Wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Gneiss	350	154	0—125	11½	.074	15
Quartzite	27	126	0—20	5⅓	.042	15
Greenstone schist	136	166	⅛—200	28	.170	8
Sericite schist	14	106	½—25	10½	.099	14
Slate	40	125	1—75	16	.126	2½
Sheared granite	116	150	0—212	14	.093	14
Diorite	26	07	0—25	6	.063	31
Porphyritic granite	47	141	0—30	8	.061	11
Triassic	50	171	1—150	17	.100	2
Diabase dikes (Triassic)	3	186	----------	0	----------	----------
Greenstone and granite	3	185	----------	26	----------	----------
All Wells	812	151	0—212	14½	.097	11½

Greenstone schist has by far the highest average yield and average yield per foot of well, nearly 65 percent greater than the average yield of wells in Triassic rocks, which have the next highest average yield. Wells in the slates and sheared granites have only slightly lower average yields than wells in the Triassic. However, wells in the slates have a much higher average yield per foot of well than those in either the Triassic rocks or the sheared granite. Wells in the gneiss, with an average yield of 11½ gallons a minute, are fifth in yield but are sixth in average yield per foot of well. Average yields of wells in the other rock units range downward to 5 gallons a minute and to 0.042 gallons a minute per foot of well in the quartzite unit.

Certain factors make this table of comparative average yields somewhat misleading. Cities, towns, and industries are not distributed evenly throughout the Greensboro area but are concentrated in a few places. Thus, municipalities and industries, which seek and obtain much larger yields than are obtained from domestic wells, are concentrated on certain of the rock units, whereas few municipal and industrial wells are located in some of the other rock units. Nearly all the industrial developments and municipalities in Alamance and Guilford Counties are underlain by greenstone or sheared granite. In Forsyth County nearly all municipal and industrial supplies are obtained from gneiss. Most of the industries in Stokes County and the only municipality using well water are located in the Triassic. Most of the industries and municipalities using ground water in Rockingham County are also located in the Triassic. There are few industrial and municipal wells in Caswell County and all of these are in gneiss.

The effect that this concentration of large ground-water users in certain of the rock units has on the average yield of wells of the different units is considerable. The greenstone schist, with the highest average yield, has the highest proportion of industrial and municipal wells; 41 percent of the wells used in compiling the above table were of this type. The Triassic rocks, which have the second highest average yield, are a close second with 38 percent of municipal and industrial wells. The slate, granite, and gneiss which average third, fourth, and fifth in average yield are also third, fourth, and fifth with 20, 15½, and 12½ percent, respectively, of industrial and municipal wells. (The porphyritic granite and biotite granite were combined to obtain the figure for granite.) The diorite, which is sixth in percent of municipal and industrial wells, is seventh in average yield. The chlorite-sericite schist and the quartzite and schist have no municipal or industrial wells and are sixth and eighth (last), respectively, in average yields.

The following table summarizes the data for industrial and municipal wells drilled in six of the rock units and probably gives a more accurate estimate of the relative amounts of water that can be obtained from wells drilled in these rocks.

TABLE 2—AVERAGE YIELD OF MUNICIPAL AND INDUSTRIAL WELLS[1] ACCORDING TO ROCK TYPE
(Wells 5 inches or more in diameter)

Type of Rock	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 10 gallons a minute
			Range	Average	Per foot of well	
Granite	26	361	2—212	33⅓	.093	34
Gneiss	44	286	1—125	34½	.121	9
Greenstone	56	282	3—200	55½	.197	3½
Slate	8	315	5— 32	22	.071	12½
Triassic	19	291	8—150	35	.120	21
Diorite	3	181	10— 25	17	.092	0
All wells	156	297	1—212	41	.138	13

[1] Includes colleges, airports, county homes, hospitals, prison camps, broadcasting stations, etc., but does not include county schools.

In table 2, as in table 1, wells in the greenstone schist are shown to have a considerably higher average yield than wells in any other rock unit. The average yield is 60 percent greater than the average yield of wells in the Triassic, which have the second highest average yield. This compares closely with the 65 percent advantage for 3-inch and larger wells in greenstone schist shown in table 1, and it is evident that the large proportion of industrial and municipal wells was not responsible for the higher average yield for wells in this particular rock unit. It seems certain that in the Greensboro area the greenstone schist will yield, on the average, more water than any other rock.

In table 2, as in table 1, wells in the Triassic are second in average yield, but the yield of wells in granite and in gneiss are so close as to be almost equal to the Triassic, and in yield per foot of well the gneiss actually is second to the greenstone schist. The most significant changes in ratings between the two tables is the advance of the gneiss from sixth to second place in yield per foot of well, and the drop of the slates from a strong second to a poor fifth in both average yield and average yield per foot of well. Of considerable significance is the column showing percent of the wells that yield less than 10 gallons a minute. Only 3½ percent of the wells in the greenstone schist yield less than 10 gallons a minute, whereas 34 percent of the wells in granite yield less than 10 gallons a minute. This indicates that the range in yield of wells in greenstone schist is not nearly so great as in granite. The tendency in granite would seem to be for some wells to yield very little, whereas others would have large yields. In the greenstone schist, the wells would have more nearly uniform yields. Wells in gneiss, slate, and in the Triassic have ranges between these two extremes. There are too few industrial and municipal wells in the diorite to form any conclusion about them.

Effect of topographic location.—The topographic location was noted for 802 of the 812 wells of table 1. The number of wells, average depth, range in yield, average yield, and percent of wells yielding less than 1 gallon a minute for wells in five different topographic locations are given in table 3a and the average yield per foot of well for wells in the different topographic locations is shown graphically in figure 7-C.

TABLE 3a—AVERAGE YIELD OF WELLS ACCORDING TO TOPOGRAPHIC LOCATION
(Drilled wells 3 inches or more in diameter)

Topographic Location	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	282	147	0—125	7½	.052	28
Flat	152	154	0—200	17	.113	3
Slope	228	127	0—120	14	.108	6
Draw	66	180	½—212	27	.148	3
Valley	74	212	0—150	28	.132	1
All wells	802	151	0—212	14½	.097	12½

The relative low average yield and average yield per foot of well of wells drilled on hills is strikingly shown in this table. Wells on hills yield just slightly more than one-half as much as wells drilled on slopes and between one-third and one-fourth as much as wells drilled in draws or valleys. The difference in average yield per foot of well is as great or greater. Furthermore, 28 percent of the wells drilled on hills yield less than 1 gallon a minute, as compared with 1 to 6 percent for wells drilled in other topographic locations.

There are several reasons why wells drilled on hills yield less water than wells drilled in other locations. In homogeneous rocks, hills are apt to be formed because the underlying rock is more resistant to erosion than it is in the surrounding area. In some places the greater resistance is due to a difference in rock which makes it harder but in most places the rock has more resistance to erosion because it is less jointed or fractured. Joints and fractures facilitate entrance of ground water which promotes chemical decay and permits mechanical erosion. Thus, depressions such as draws and valleys suggest that the rock underlying the depressions has more openings through which ground water can move than the rock underlying the hills. Flat areas in the Greensboro area usually are peneplane remnants and do not indicate anything about the resistance of the underlying rock. Theoretically, wells in flat areas should have about the same yield as the average for wells in all topographic locations. Actually, according to table 3, the average yield is somewhat larger than the average for all topographic locations possibly because in flat areas recharge to ground water is apt to be greater than elsewhere. However, the average yield for all locations is lowered by the large number of wells drilled on hills as compared to the number of wells drilled in draws and valleys.

In non-homogeneous rocks such as the bedded gneisses and schists and the Triassic sedimentary rocks, the topography in many places is often controlled by the relative ease of circulation of ground water, just as in homogeneous rocks. In the bedded rocks, however, circulation of water occurs along cleavage and bedding planes as well as along joints and fractures. Where bedding planes and cleavage planes dip steeply, most wells will end in the same kind of rock as that exposed within a few hundred feet of the well.

A second reason that wells on hills yield less water than wells in valleys and draws is that the direction of movement of the ground water is towards the valleys where it discharges into the streams; therefore, the natural movement of the ground water is away from the wells drilled on the hills and toward the wells drilled in the valleys.

Table 3a shows that wells drilled in draws have a 12 percent higher yield per foot of well than wells drilled in valleys. Draws include minor depressions which may or may not contain small streams. The distinction between a draw and a valley is more or less arbitrary and depends upon the interpretation of the observer. As used here, small, relatively narrow depressions with angular or rounded sides and bottom are considered to be draws. Valleys are much larger and generally have a flood plain or bottomland and a perennial stream. It seems probable that the reason for the better record of wells in draws is because the draws more exactly mark the location of the structural weakness in the rocks. Valleys may have originated at their present location because of a zone of weakness but this zone of weakness may be relatively small in comparison with the present size of the valley. Therefore, most of the wells drilled in the valleys quite possibly are not drilled into the zone of weakness that originally determined the course of the stream. On the other hand, a well drilled in a relatively narrow draw will have a very good chance of striking the zone of weakness. It would seem, then, that the minor topographic features are more important in choosing a well site than the larger features.

TABLE 3b—AVERAGE YIELD OF WELLS ACCORDING TO DEPTH

Range in depth	Number of wells	Average depth (feet)	Average depth below water table[1]	Yield (gallons a minute)				Percent of wells yielding less than 1 gallon a minute
				Range	Average	Per foot of well	Per foot of well below water table	
0—100	383	75	40	0—100	8.9	0.118	0.222	13½
101—150	203	122	87	0—85	11.0	.090	.126	12⅓
151—200	88	174	139	0—120	16.7	.096	.120	13½
201—250	24	227	192	1—200	27.4	.120	.143	4
251—300	22	280	245	0—150	24.5	.089	.100	18
Above 300	86	479	444	0—212	40.3	.084	.091	7
All wells	806	150	....	0—212	14.6	.097	....	....

[1] Assuming the water table to be an average of 35 feet below the surface.

Relation of depth of well to yield.—The relation of the depth of a well to the amount of water the well will yield is given in table 3b and shown graphically in figure 7-B.

Table 3b shows that wells less than 100 feet deep have a greater average yield per foot of well below the water table than wells in any other depth range. It also shows that the yield per foot of well for wells more than 250 feet deep is much less than in wells of shallower depths.

It is evident that the rocks below 250 feet are much poorer aquifers than above that depth. Actually the difference in the water yielding properties of the rock above and below 250 feet is even greater than is apparent from the table. The average yield per foot of well below the water table of all wells less than 250 feet is 0.143 gallon a minute. If the average yield per foot of well of the upper 250 feet of the wells more than 250 feet deep is assumed to be 0.143 gallon a minute, the yield per foot of well of that part of the well below 250 feet is only 0.074 gallon a minute, which is only about one-half as much.

The reason for the decrease in yield with increasing depth not only is that the number of fractures, joints, and other openings through which the water moves becomes much less in depth, but also the weight of the overlying rock causes the fracture and joints to be tighter and narrower.

Drilling to great depths is seldom sound policy in the rocks of the Greensboro area; if considerable quantities of water are not encountered above 250 or 300 feet, there usually is little chance of obtaining a large amount at greater depth. However, if the well yields 40 gallons a minute at 250 feet and a yield of 50 gallons a minute is desired, the chances are good that the additional amount can be obtained by drilling 75 or 100 feet more.

GNEISS

This unit forms a broad belt trending northeast and cropping out in Forsyth, Stokes, Guilford, Rockingham, and Caswell Counties. It underlies a larger total area than any other unit, nearly 50 percent of the Greensboro area.

The principal rock is mica-feldspar gneiss with different amounts of quartz. Other important rocks include mica schist, quartz-mica schist and, at a few places, crystalline limestone. Most of these rocks appear to be bedded, the beds dipping at moderate angles, and probably are chiefly of sedimentary origin.

TABLE 4—AVERAGE YIELD OF WELLS IN MICA-FELDSPAR GNEISS AND SCHIST
(Drilled wells 3 inches or more in diameter)

ACCORDING TO DEPTH

Range in depth (feet)	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
0—100	137	78	0—50	7.1	.091	15
101—150	100	123	0—85	9.4	.077	15
151—200	49	174	0—100	12.8	.073	21
201—250	15	225	1—35	10.7	.048	6
251—300	11	279	0—40	10.2	.037	27
Above 300	38	426	0—125	31.2	.073	8
All wells	350	154	0—125	11.5	.074	15

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	147	146	0—125	6.3	.043	29
Flat	43	164	2—75	13.8	.084	0
Slope	99	131	0—100	10.7	.082	9
Draw	30	160	2½—85	22.5	.136	0
Valley	28	257	0—100	24.1	.098	3
Not given	3	68	3—15	7.7	.113	0

Included with this unit are plagioclase-hornblende gneisses and hornblende schists which may be of igneous oiigin and, if so, are intrusive into the other gneisses and schists.

Most wells drilled in this rock unit yield sufficient water for domestic supplies, and wells drilled for municipalities or for industrial plants yield an average of about 35 gallons a minute. By careful selection of drilling sites, the average yield probably can be increased by 50 percent or more.

Because this unit underlies nearly one-half the entire area, more records were obtained of wells drilled in it than for any other rock unit. Comparative data for wells drilled in the different rock units are given in table 1. The average yield of 352 wells, 3 inches or more in diameter, drilled in the gneiss is 11½ gallons a minute. According to these figures, wells in gneiss are below the average for wells in the Greensboro area. However, as explained previously, table 1 is somewhat misleading because the proportion of municipal and industrial wells in the gneiss is relatively low. Table 2 gives the comparative data for municipal and industrial wells in the different rock units. According to this table wells in the gneiss unit, with an average yield of 34½ gallons a minute, rank a very close third in average amount of water yielded, being exceeded only by wells in the greenstone schist and the Triassic rocks.

Table 4 gives the average yield for wells in gneiss according to range in depth and according to topographic location.

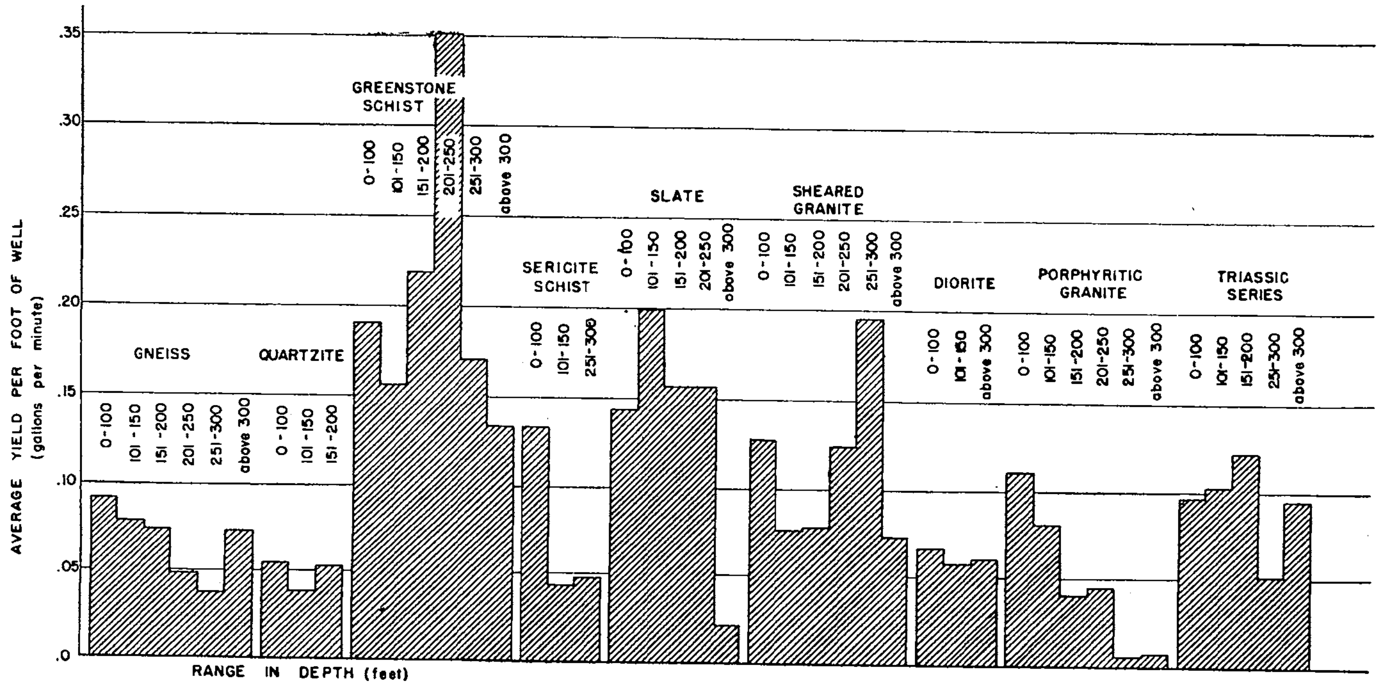


Fig. 8—Average yield, per foot of well, of wells in the different rock units, according to range in depth.

The third column gives the average depth and the fifth gives the average yield. The sixth column gives the yield per foot of well. This column shows that, although the yield increases with depth, the largest yield per foot of well is obtained in the first 100 feet. With every increase in depth range, the yield per foot of well decreases except in the last group, those wells more than 300 feet in depth. (The yield in this group is higher because a large proportion of the wells are municipal and industrial wells.) The yield per foot of well in the 0-100 foot bracket is actually considerably greater than shown in the table because the first 25 or 30 feet is above the water table and therefore yields no water. The average depth below the water table probably would be about 50 feet, which would give an average yield per foot of well of 0.14 gallon a minute. The relation of depth to yield is shown graphically in figure 8.

The outstanding fact shown by the table of wells arranged according to topographic location is that wells drilled on hills have an average yield of only 6.4 gallons a minute; less than 56 percent of the average yield for all the wells. The yield per foot of well is in almost the same ratio. The average yield of wells drilled on flat areas, per foot of well, is twice that of wells drilled on hills; and the yield of wells on slopes, per foot of well, is nearly as much. The average yield of wells drilled in valleys, per foot of well, is 2⅓ times as great as the yield of wells on hills, and the yield of wells in draws is more than 3 times as great. The above data demonstrate clearly the desirability of avoiding hills in selecting sites for drilling wells. The advantage of drilling in depressions such as draws and valleys is also apparent. The relation of topography to yield is shown graphically in figure 9.

Topographic location usually is not expected to be as important a factor in the yield of wells in bedded rocks is it is in homogeneous rocks. However, the dip of the bedding is 45° or more at many places and at few places is less than 25° or 30°. A well 200 feet deep, drilled into beds dipping at an agle of 45°, will encounter strata cropping out only 200 feet from the well. Drilled in strata dipping at an angle of 30°, a 200-foot well will enter strata cropping out only about 350 feet from the well. The cleavage and schistosity of these rocks dips as steeply or more steeply, so that water moving along bedding planes, cleavage planes, or planes of schistosity generally must enter the ground within a few hundred feet of the well. It is clear, then, that hills, the presence of many of which are due to the absence of such openings along which ground water can move, are generally unfavorable sites for drilling wells.

When the bedding planes are flat, a well will intersect the maximum number of planes; but there is less opportunity for water to enter the bedding plane openings at the surface. When the bedding planes are vertical, there will be the maximum opportunity for entrance of ground water into the strata, but the well will not cross any of these planes. Therefore, with respect to bedding planes, the best locations are where the bedding dips at moderate angles. Cleavage planes and planes of schistosity are rarely horizontal but at many places are vertical. Locations where these planes dip moderately probably are best. Rocks such as the mica schists and quartz-mica schists, in which these planes are closely spaced, are apt to yield more water than rocks in which the planes are more widely spaced, such as the feldspar gneisses.

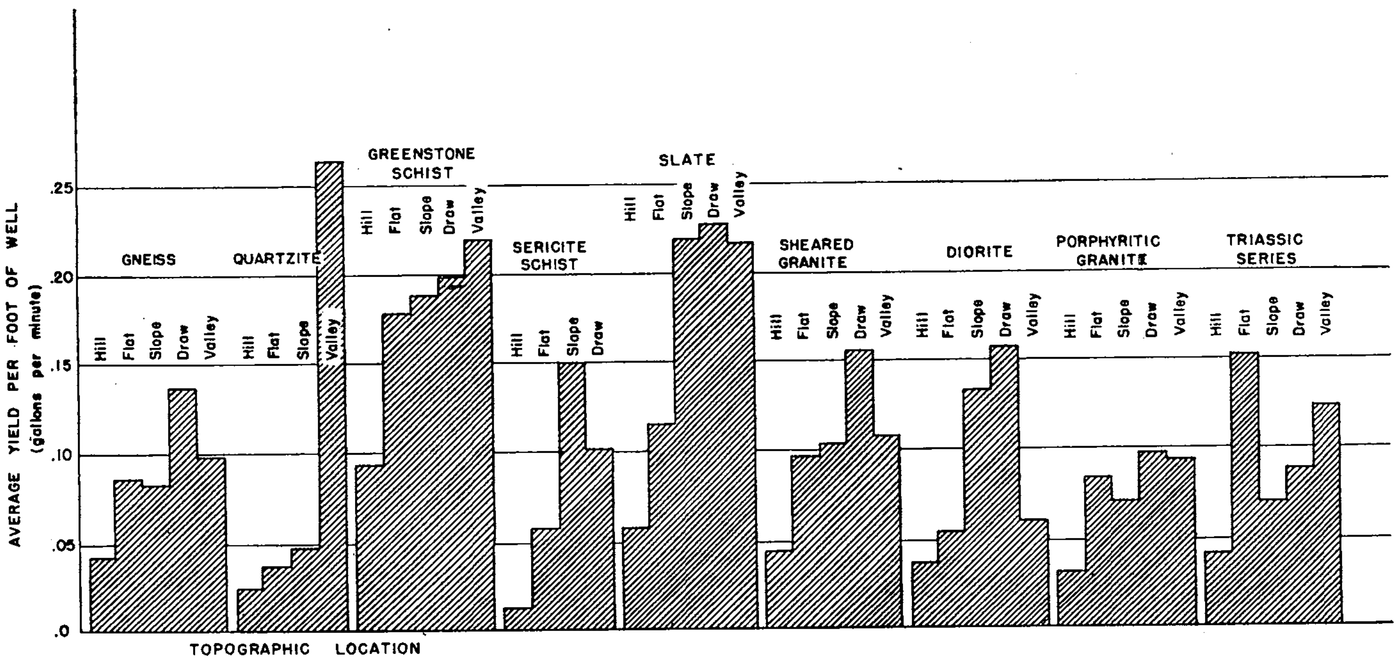


Fig. 9—Average yield, per foot of well, of wells in the different rock units, according to topographic location.

It is probable that a large proportion of the ground water moves along joints and fractures. The coarser-grained gneisses under stress will fracture more than the mica schists, which are apt to conform to the stress by rock flowage; therefore, fracturing and jointing are probably more important in the gneisses than in the schists. Fracturing is usually greater on the crests of anticlines than anywhere else and these fractures have a tendency to open so that the crests of anticlines are very favorable sites for drilling.

Most drilled wells in these rocks are 4 to 8 inches in diameter and are drilled with a churn drill. A few 2-inch and 3-inch wells have been core-drilled with chilled shot. Generally the only difficulty experienced in drilling wells in these rocks is at places where the bedding planes or cleavage planes or planes of schistosity are not quite vertical. In such places there is a tendency for the drill to be deflected from the vertical when a hard layer is encountered. A number of holes have been abandoned because they became so crooked that drilling could not proceed. Weathering is usually quite deep in these rocks, so that dug and bored wells can be readily constructed at most places.

Analyses were made of water from 13 wells in this rock unit. These analyses are given in the county descriptions immediately following the tables of well data. Analyses of water from wells in the gneiss include numbers 30, 39, 79, and 82 in Caswell County; 2, 3, 93, and 147 in Forsyth County; 142 and 204 in Rockingham County; and 24, 82, and 89 in Stokes County. Analyses of samples from spring A in Caswell

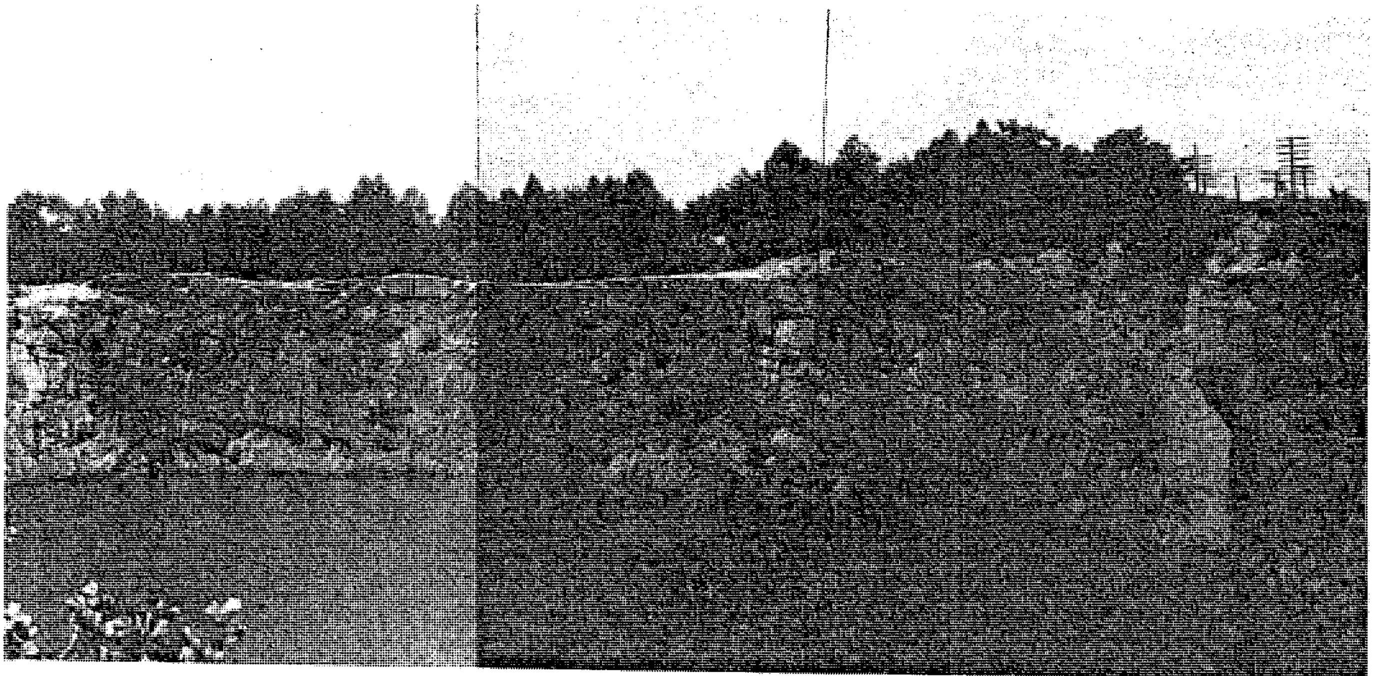


Plate 11—Bedded gneiss in a quarry at Stacey, Rockingham County. Ground water moves along the joints and other fractures and along the bedding planes.

County and spring A in Stokes County are also given in the tables. Of the 13 samples of well water, five were soft, having a hardness less than 60 parts per million; three were moderately hard, having a hardness between 60 and 120 parts per million; three were hard, having a hardness between 120 and 180 parts per million; and two were very hard, having a hardness of more than 180 parts per million.

The hardness of the water depends upon the particular type of gneiss and schist into which a well is drilled and upon the depth of the well, the water generally becoming harder with increasing depth. The hardness in one of the two wells yielding very hard water, Forsyth County well 93, is evidently due to calcium and magneisum chloride. The highest hardness, 342 parts per million, was found in well 89 in Stokes County. The chloride content of this water was moderately high, but the hardness was mostly bicarbonate hardness. The well is only 125 feet deep, and the hardness is unusually high for a well of that depth. It is quite possible that the well was drilled into a limestone lens. Limestone is known to crop out along the strike a few miles to the southwest.

The maximum amount of iron in any sample from the gneiss was 0.26 part per million, which is not enough to be objectionable. Of the 10 samples in which iron was determined, seven had less than 0.04 part per million.

QUARTZITE AND SCHIST

These rocks crop out only in a belt extending northeastward part of the way across Stokes County.

The rock consists of quartzite, quartz-muscovite schist, and quartz-chlorite schist. At many places the quartzite contains some muscovite or chlorite, and at a few places it contains some biotite. Much of the quartzite contains enough of these micaceous minerals to give it the banded appearance of a gneiss.

The quartzite caps the mountains and hills of the area and is several hundred feet thick. The slopes and bases of the mountains are formed by the schists. Bedding in the quartzites is readily apparent and the dips are moderately low, generally being about 10° to 15°. Most, if not all, of the rocks are of sedimentary origin.

The data in table 1 indicate that this unit is the poorest water-bearer in the area. However, it probably is a better aquifer than would appear from the data. All the other rock units have a number of industrial and municipal wells, whereas no such wells have been drilled in the rocks of this unit; all the wells being used for domestic supplies except a few at county schools. However, even after eliminating these inequalities in the statistics it is apparent that the unit is a relatively poor aquifer.

Table 5 gives the average yield of wells and average yield per foot of well according to depth range and according to topographic location.

TABLE 5—AVERAGE YIELD OF WELLS IN QUARTZITE AND SCHIST
(Drilled wells 3 inches or more in diameter)

ACCORDING TO DEPTH

Range in Depth (feet)	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells Yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
0—100	16	86	¾— 20	5	.055	6
101—150	7	114	¾— 8	4½	.038	14
151—200	3	180	0— 17½	9	.053	33
Above 300	1	700	------	⅓	.0005	------
All wells	27	126	0— 20	5	.040	15

ACCORDING TO TOPOGRAPHIC LOCATION

TOPOGRAPHIC LOCATION	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	12	159	0 —18	4	.025	33
Flat	2	97	2½— 5	4	.038	0
Slope	12	103	2½—11	5	.048	0
Valley	1	76	------	20	.264	0

Like wells in the gneiss unit, wells in the quartzite in the 0-100 foot range have a greater yield per foot of well than wells in any other range. It is evident that the number and size of openings through which ground water circulates decreases with depth. The average yield for all the wells of 0.04 gallon a minute per foot of well is only 54 percent of the average for wells in the gneiss unit. Excluding industrial and municipal wells in the latter, the average yield of wells in the quartzite is 67 percent of the average yield in gneiss. It seems probable that the latter figure is more nearly the correct ratio of the relative yield of wells in the two units. The relation of depth of well to yield is shown graphically in figure 8.

Table 5 also shows that wells on hills have a much lower average yield than wells drilled in other topographic locations. The only wells yielding less than 1 gallon a minute were drilled on hills. Of the 12 wells drilled on hills, four yielded less than that amount. Wells on flat areas have a 50 percent greater average yield than wells on hills and wells on slopes nearly 100 percent greater average yield. The quartzite is massive and dips at low angles so that the intersections of bedding planes with the land surface are widely spaced. Because the beds are thick, not many bedding planes will be intersected in a well. Where the beds are thinner there are more openings for the movement of ground water. Quartzite is a brittle rock, and where it is folded sharply many fractures and joints are formed. Such places are favorable sites for wells;

however, sharp folding of the quartzite is rare, probably because the schist has absorbed most of the deforming stresses. The tendency in the schist is for the mica flakes to glide over one another so that intense deformation results principally in rock flowage rather than in intense fracturing. Therefore, the avenues of ground-water movement in the schists probably are chiefly cleavage planes and planes of schistosity. Although such planes are very plentiful in these schists, the micaceous minerals are fine-grained and conform so closely to one another that little open space is left for the movement of water. In the schists, hills tend to form where fractures, cleavage planes, and other openings are at a minimum, and depressions where these openings are most plentiful. Therefore, the depressions are generally more favorable sites for wells. The quartzite nearly always forms hills and these should be avoided if possible. The relation of topography to yield is shown graphically in figure 9.

Wells 50 and 61 in Stokes County, for which analyses are given in the table of analyses, penetrate these rocks. The water from well 50, which is 700 feet deep, is very hard and has a rather high content of chloride and sulfate. The water from well 61 is soft and is low in these two constituents. It has an iron content of 0.22 part per million, which is not enough to be objectionable.

GREENSTONE SCHIST

The greenstone schist crops out in southeastern Guilford County, the northwestern half of Alamance County, and the south-central part of Caswell County. In areal extent it is closely associated with the sheared granite. The greenstone schist consists of green basic rocks which are slightly to highly schistose. The commonest type is a fine-grained olive-green schist consisting chiefly of greenish-colored hornblende and epidotized plagioclase with some chlorite. At other places the greenstone schist is coarser-grained and the schistosity is not so apparent.

All these rocks appear to be of igneous origin and most of them probably were extrusive, at most places as lava flows but at some places as coarse tuffs and breccias.

The schistosity strikes northeast and the dip ranges from moderately steep to vertical.

According to the data obtained in the Greensboro area, the greenstone schist is the best aquifer in the area. As shown in table 1, the 136 wells penetrating the greenstone schist have a 53 percent higher average yield than the wells in any other unit, and a 35 percent higher yield per foot of well. The average yield of municipal and industrial wells in greenstone schist, shown in table 2, is more than 58 percent greater than the average yield of similar wells in other units, and the average yield per foot of well is nearly 63 percent greater.

The average yield of wells in greenstone schist, according to range in depth and according to topographic location, is shown in table 6 below.

Wells in the 0-100 foot range have a 12 percent greater average yield per foot of well than the average yield for all wells in greenstone schist. Although the average yield per foot of well is considerably lower in the 101-150 foot range than in the 0-100 foot range, the average yield of wells in the next two ranges is considerably greater. It appears that both the yield and the yield per foot of well increase up to a depth of about 250 feet. However, assuming that the water table is about 20 or 25 feet below the surface in the average well, there is only about 50 feet of rock through which water can enter the wells in the 0-100 foot depth range. Assuming 50 feet instead of 71 feet for the average depth in this range, the average yield per foot of well in this group is 0.267 gallon a minute, which is greater than that of any other group except the five wells in the 201-250 foot group. Beyond 250 feet the yield per foot of well decreases markedly. The relation of depth to yield is shown graphically in figure 8.

Topographic location has a very important bearing on the yield of wells in the greenstone schist. Wells on hills have an average yield 28 percent less than the average for wells at other locations; per foot of well their average yield is 47 percent less. Further, nine of the 35 wells drilled on hills yielded less than 1 gallon a minute. Only two of the 100 wells drilled in other topographic locations yielded less than that amount. Both the average yield and average yield per foot of well for wells drilled in valleys and draws is considerably more than twice as great as they are for the wells drilled on hills. The relation of topography to yield is shown graphically in figure 9.

The movement of ground water through the greenstone schists is along planes of schistosity and cleavage, fractures, and joints. At most places the planes of schistosity are well developed, and these openings

TABLE 6—AVERAGE YIELD OF WELLS IN THE GREENSTONE SCHIST
(Drilled wells 3 inches or more in diameter)

ACCORDING TO DEPTH

Range in depth (feet)	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells Yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
0—100	67	71	⅛—100	13	.190	10
101—150	24	117	¼— 75	18	.156	12½
151—200	11	167	2½—120	36½	.219	0
201—250	5	237	20—200	83	.351	0
251—300	6	288	¼—150	49	.170	17
Above 300	22	461	20—200	62	.134	0
All wells	135	166	⅛—200	28	.170	------

ACCORDING TO TOPOGRAPHIC LOCATION

TOPOGRAPHIC LOCATION	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	35	172	⅛—100	18	.094	25
Flat	30	170	¼—200	30	.178	3
Slope	39	134	1—120	25	.188	3
Draw	13	200	9—150	39	.198	0
Valley	18	191	7—100	42	.220	0

are very important avenues of ground-water movement. Because the chief minerals are hornblende and plagioclase, which are relatively hard and brittle, more openings form along these planes in the greenstone schist than in mica schists. Fractures and joints also have a greater tendency to form in these relatively brittle rocks, and there is a tendency for brecciation along planes of movement.

One of the chief reasons for the relatively high yield of wells in the greenstone schist is the abundance of quartz veins, which may follow the schistosity or cut across at almost any angle. The veins or veinlets following the strike of the schistosity are usually a fraction of an inch to a few inches thick. At many places they are so closely spaced in the schist as to give it a banded appearance somewhat resembling that of a gneiss. As many as six veinlets have been counted in a distance of 1 foot across the strike. The quartz veins cutting across the schistosity are usually much thicker, veins 1 or 2 feet thick being not uncommon. Wherever observed the quartz veins are greatly fractured, and it is probable that the extensive fracturing in the veins extends to depths of at least a few hundred feet. These vein systems are very important avenues of ground-water movement and, where they do not dip too steeply, many of them might be encountered in a single well.

Where veins crop out at the surface, wells may be located so that the veins will be struck 100 to 250 feet below the surface, with the hope that if the same vein or veins do not continue to that depth other parallel veins will be encountered at about that depth.

It is evident from table 6 that hills in greenstone schist signify more resistant, less fractured rocks, as is true in the other rock units, and such locations are to be avoided.

The greenstone schist is deeply weathered at many places and drilling in this unit is fairly easy. A great many wells 2 inches in diameter have been core drilled with chilled shot in this rock. These were not included in compiling the statistics given in table 6, but the records are included in the tables of well data with the county descriptions. Most of them yield 2 to 5 gallons a minute, and very few yield less than 1 gallon a minute. About the only difficulty encountered in drilling either these or the larger-diameter wells, which are drilled with a percussion drill, is at a few places where the schistosity is not quite vertical and hard layers deflect the drill, causing the hole to become crooked. At most places weathering has been deep enough to permit ready construction of bored and dug wells, but at a few places the unweathered rock is close enough to the surface to prevent the boring of wells and blasting in the bottoms of dug wells is necessary.

The water level generally is from a few feet to about 40 feet below the surface but is 50 or 60 feet in a few wells.

Analyses of seven water samples from wells in the greenstone schist are given in the tables of analyses with the county descriptions. These include numbers 51, 55-60, 132, 139, and 149 in Alamance County; 67 in Caswell County; and 328 in Guilford County.

Only one of these analyses indicates soft water and that was from a well only 30 feet deep. Three analyses were of moderately hard waters, two of hard waters, and one of very hard water. In general, the deeper wells have harder water than the shallower wells; but no close correlation can be made between depth and hardness. Slightly hard to very hard water was reported from 42 wells and soft to moderately soft water from 31 wells in the greenstone schist. The iron content was determined on five of the seven samples analyzed and ranged from 0.01 to 1.3 parts per million. The iron content of three of the five was 0.03 part per million or less. The water from only a few wells was reported by the users to contain an objectionable amount of iron.

SERICITE SCHIST

This unit crops out in a belt extending northeastward from a point near Guilford College nearly to South Country Line Creek, about 2 miles southwest of Pleasant Grove in Caswell County.

Weathering is so deep at most places that exposures of unweathered rock, even in deep cuts, are rare. At most places the rock appears to be chiefly quartz-chlorite-sericite schist, or quartz-sericite schist. The schist is closely associated with the greenstone schist and may have been formed by sedimentary processes during intervals when the volcanism that produced the greenstone schist was inactive. It may be that the sericite schist, the greenstone schist, and the slates were all formed during the same general period.

Data given in table 1 indicate that this is a much poorer aquifer than the greenstone schist. Of the nine units it ranks sixth in average yield and fourth in average yield per foot of well. However, because no municipal or industrial wells have been drilled in this unit, it probably has a relatively higher rank than the data seem to indicate. Only 14 wells were included in the tabulation, hardly enough on which to base positive conclusions. The average depth and average yield of these wells, according to range in depth and according to topographic location, are given in table 7.

TABLE 7—AVERAGE YIELD OF WELLS IN SERICITE SCHIST
(Drilled wells 3 inches or more in diameter)

ACCORDING TO DEPTH

Range in depth (feet)	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells Yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
0—100	9	77	½—20	10.2	.133	22
101—150	4	130	4—25	10	.082	0
251—300	1	290	------	14	.048	0
All wells	14	104	½—25	10.5	.099	14

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	3	60	½— 4	2	.033	67
Flat	4	162	5—25	13½	.083	0
Slope	5	86	4—20	13	.150	0
Draw	2	99	5—15	10	.101	0

According to this table the wells less than 100 feet deep yield nearly twice as much water per foot of wells as the wells more than 100 feet deep. It is evident that the rock in the first 100 feet yields water much more prolifically than it does below 100 feet, although it is probable that the ratio would not be so great if the table were based on a largre number of wells.

Of the 14 wells, two yield less than 1 gallon a minute.

According to this table, wells drilled on hills have both the lowest average yield and the lowest average yield per foot of well, and wells on the slopes have the highest average yield and the highest average yield per foot of well. The seven wells located on slopes and in draws have an average yield per foot of well nearly twice as great as the seven wells located on hills and in flat areas.

Wells are readily drilled in this rock with either a percussion drill or a shot drill. The rock is generally deeply weathered and both bored and dug wells are easily constructed.

No analyses were made of water from this unit. Most users report moderately soft water, but a few report slightly to moderately hard water. A few users reported objectionable amounts of iron.

SLATE

These rocks crop out over most of southeastern Alamance County and in narrow irregular belts extending northeastward from Climax nearly to Burlington. Small areas also crop out near High Point and in the extreme southeast corner of Caswell County. The rocks are chiefly slaty and schistose tuffs and fine-grained sericite schist and were probably formed from fine-grained volcanic ash. Other types include schistose and gneissic volcanic breccia and true clay slate. At some places the tuffaceous material is mixed with sand grains and pebbles and other products of erosion and was evidently deposited under water.

The cleavage and schistosity are prominent at many places, but at other places the rock is fairly massive. The finer-grained phases apparently have a better cleavage and schistosity than the coarser-grained phases. The cleavage and schistosity strikes generally to the northeast. The dip at most places is vertical or nearly so.

According to table 1, the average yield of wells in these rocks is exceeded by wells in the greenstone schist and in the Triassic. The average yield per foot of well is exceeded only by wells in the greenstone schist. However, in table 2, which includes only industrial and municipal wells, the slates rank fourth in both average yield and average yield per foot of well. The average depth of these eight wells in the slate is 315 feet, an increase of 150 percent over the average depth of all drilled wells in slate, whereas the increase in average yield is only 37 percent. This suggests that deep drilling results in very little increase in yield. The data, however, may be somewhat misleading. If the two deepest wells in slate, 735 feet and 750 feet deep, are omitted the average depth of the remaining six industrial and municipal wells is only 172 feet and the average yield is 25 gallons a minute. The average yield per foot of well then is 0.148 gallon a minute, which is higher than in any other unit except the greenstone schist. Too much weight, therefore, should not be given the data of table 2 for wells in slate. It is probable that the slate is about as good an aquifer as any other rock unit except the greenstone schist. In table 8, below, data for wells in slate are arranged according to range in depth and according to topographic location.

Only 40 wells were used in this tabulation, and 27 of these were less than 100 feet deep. Conclusions based on the few wells more than 100 feet deep are somewhat uncertain. It appears from the table that not only the average yield but also the average yield per foot of well is greater in every depth range beyond 100 feet than it is in the 0-100 foot range, up to 250 feet.

It will be remembered that this is almost exactly the case in the greenstone schists. It should be pointed out, however, that the wells in the 0-100 foot group, with an average depth of 71 feet, actually have an average depth of only about 50 feet below the water table, and that because all the water must enter through this 50 feet, the yield per foot of well is correspondingly greater. Assuming an average depth of 50 feet below the water table for wells in this group, the average yield per foot of well is 0.231, which is considerably greater than the average yield per foot of well in any of the deeper group. It is probable, however, that the yield per foot of well decreases less with depth in the greenstone schist and in the slates than in the other rock units.

It appears that drilling beyond 250 or 300 feet in the slates, as well as in the other units, is generally unprofitable. The relation of depth to yield is shown graphically in figure 8.

TABLE 8—AVERAGE YIELD OF WELLS IN SLATE
(Drilled wells 3 inches or more in diameter)

ACCORDING TO DEPTH

Range in depth (feet)	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells Yieding less than 1 gallon a minute
			Range	Average	Per foot of well	
0—100	27	71	1—30	11½	0.144	4
101—150	7	121	4—75	24	.200	0
151—200	3	181	.....	28	.156	0
201—250	1	204	.....	32	.156	0
Above 300	2	743	5—25	15	.021	0
All wells	40	125	1—75	16	.126	2½

ACCORDING TO TOPOGRAPHIC LOCATION

TOPOGRAPHIC LOCATION	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	9	152	3—15	9	0.058	0
Flat	17	135	1—30	15½	.115	6
Slope	8	121	7½—75	26	.220	0
Draw	1	35	.....	8	.228	0
Valley	4	60	3—20	13	.217	0
Not specified	1	100	.....	15	.150	0

In the slates most of the movement of ground water is along cleavage planes, fractures, and joints and along quartz veins. There are more of these opening near the surface, and with increasing depth the weight of the overlying material prevents them from remaining open.

Quartz veins are avenues of ground-water movement in the slates that are as important as they are in the greenstone schists. The veins in the slates, however, commonly cut across the cleavage, following fractures, whereas many of them follow the cleavage planes in greenstone schist.

The veins generally are from a fraction of a foot to several feet thick, and often seem to occur in groups or clusters. They are usually greatly fractured and broken at the surface and probably are also fractured and broken below the surface. Because quartz is so brittle and breaks into angular fragments, any movement along the vein leaves openings between the angular fragments. Quartz veins are recognized by most drillers as important sources of water, and many wells have been located by drillers so as to intersect veins at some distance below the ground surface. Many of the wells with the greatest yield are reported by the drillers or owners to be yielding water from quartz veins.

Topographic location is an important factor in the yield of wells in slate. Wells drilled on hills have an average yield per foot of well much less than those drilled at any other location. Wells drilled on slopes, in draws, and in valleys have an average yield per foot of well nearly 4 times as great as wells drilled on hills. It is evident that, in the slates, the hills definitely are underlain by rock which is less fractured and jointed and has less cleavage planes than the rock in adjoining areas. Hence, there are fewer openings for the movement of ground water. The relation of topography to yield is shown graphically in figure 9.

Wells are drilled both with the percussion drill and the shot drill. Generally drilling progresses at a satisfactory rate, but at some places, particularly where massive, silicified slate is encountered, drilling is slow and difficult.

Many dug wells and a few bored wells are used. At a number of places the unweathered rock is so close to the surface that blasting is necessary to complete the dug wells. A number of wells, which were dug to

A

B

Plate 12—Slate containing quartz veins, through the fractures of which ground water circulates.

solid rock, went dry during the drought of 1941-1942, and many of these were deepened by drilling a well 6 inches in diameter in the bottom.

Analyses were made of four samples of water from wells in slate and include wells 18, 38, 194, and 212 in Alamance County. Of the four samples, three were soft (less than 60 parts per million), and the fourth was very hard (480 parts per million). The well yielding the very hard water is only 58 feet deep, and, in addition to being hard, the water also has a chloride content of 165 parts per million. This water is not characteristic of the slate. About half the users reporting on hardness reported slightly hard to hard water, the other half reporting soft to moderately soft water. Most of the waters reported soft were from wells drilled in fine-grained sericite schist, whereas the hard waters were from wells drilled in slaty tuffs and breccias.

Iron was determined on only two of the four samples and was only 0.01 part per million in each. Of the users reporting, about one-third reported little to much iron and two-thirds reported no iron.

SHEARED GRANITE

The sheared biotite granite crops out in central and northeastern Guilford County; south-central, central, and northwestern Alamance County; and southeastern Caswell County. It is a very distinctive unit and at most places is easily distinguished from other granites. It has been greatly sheared and at many places has a schistose or gneissic structure. It is cut by innumerable greenish-colored basic schistose dikes which greatly resemble the greenstone schist. In places the dikes occupy nearly as great a total area as the granite which they intrude, and they generally are more numerous near the southeastern margin of the granite belt.

The granite is chiefly a light-pink to gray coarse-grained rock consisting of orthoclase, plagioclase, biotite, and quartz, and minor accessories. The biotite occurs in large tabular crystals which have been smeared and wrapped around the surfaces of the feldspar crystals.

The granite is about an average aquifer, drilled wells yielding at most places satisfactory amounts for domestic users and, at favorable locations, generally yielding 25 to 50 gallons a minute for industries and municipalities. Several exceptionally good wells yield from 100 to 212 gallons a minute.

According to table 1, the sheared granite is a close fourth in average yield and in average yield per foot of well. The average yield of wells in granite in the Greensboro area is 14 gallons a minute.

In the Halifax area the average yield of wells in granite was only 10.6 gallons a minute[1]. However, the average depth in that area was only 128 feet, so that the average yield per foot of well was 0.084, only about 10 percent less than that of the sheared granites of the Greensboro area.

In table 2 the average yield of industrial and municipal wells in granite, including wells in both the sheared granite and the porphyritic granite, is nearly 2½ times as much as the average yield of all wells in granite, but the average depth is also 2½ times as great so that the yield per foot of well is the same.

If it were not for the generally larger diameter of the industrial and municipal wells, they probably would have a lower yield per foot of well. In table 2 the granite ranks fourth of the six units, both in average yield and average yield per foot of well. The average depth of these wells is considerably greater than in any other unit, owing in part to several exceptionally deep wells which were continued to excessive depths after failure to obtain water at moderate depths.

In table 9 the average depth, average yield, and other data for wells in the sheared granite are tabulated according to range in depth and according to topographic location.

TABLE 9—AVERAGE YIELD OF WELLS IN SHEARED BIOTITE GRANITE
(Drilled wells 3 inches or more in diameter)

ACCORDING TO DEPTH

Range in depth (feet)	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells Yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
0—100	67	71	¼— 38	9	0.128	15
101—150	25	128	0— 40	10	.076	16
151—200	10	178	0— 26	14	.078	10
201—250	1	240	------	30	.125	0
251—300	2	266	4—100	52	.195	0
Above 300	12	585	2—212	43	.073	8
All wells	116	150	0—212	14	.093	(?)

ACCORDING TO TOPOGRAPHIC LOCATION

TOPOGRAPHIC LOCATION	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	37	134	0—30	6	0.045	38
Flat	28	156	0—60	15⅓	.097	7
Slope	34	127	½—70	13	.104	3
Draw	10	251	3—212	39	.156	0
Valley	8	167	3— 30	18	.108	0

The average yield per foot of well in the 0-100 foot range is greater than in any other range except the 251-300 foot range and is 37 percent greater than the average for all ranges. The average yield per foot of depth for wells in the different depth ranges is shown graphically in figure 8. The wells in the 0-100 foot range have an average depth of about 71 feet, but because the water table is generally 20 to 25 feet below the surface, the average thickness of water-bearing rock penetrated by this group of wells is less

[1] Mundorff, M. J., Ground water in the Halifax area, North Carolina; North Carolina Dept. Cons. and Devel. Bull. 51, p. 22, 1946.

than 50 feet. Assuming an average depth below the water table of 50 feet, the wells in this group have an average yield per foot of 0.183 gallon a minute, which is nearly twice the average for all wells in granite.

In the report on the ground-water resources of the Halifax area[1] it was concluded that much of the water from wells in granite of that area was obtained from the fractured and jointed rock just below the weathered mantle. This conclusion also appears to be valid for wells in the sheared granite of the Greensboro area.

Topography appears to be as important a factor in the yield of wells in granite as it is in other rocks. Wells located on hills in the granite have an average yield of only 43 percent as much as the average for all the wells and the average yield per foot of well is only about 47 percent of the average for all the wells. Wells drilled in draws have by far the highest average yield and yield per foot of well. It seems probable

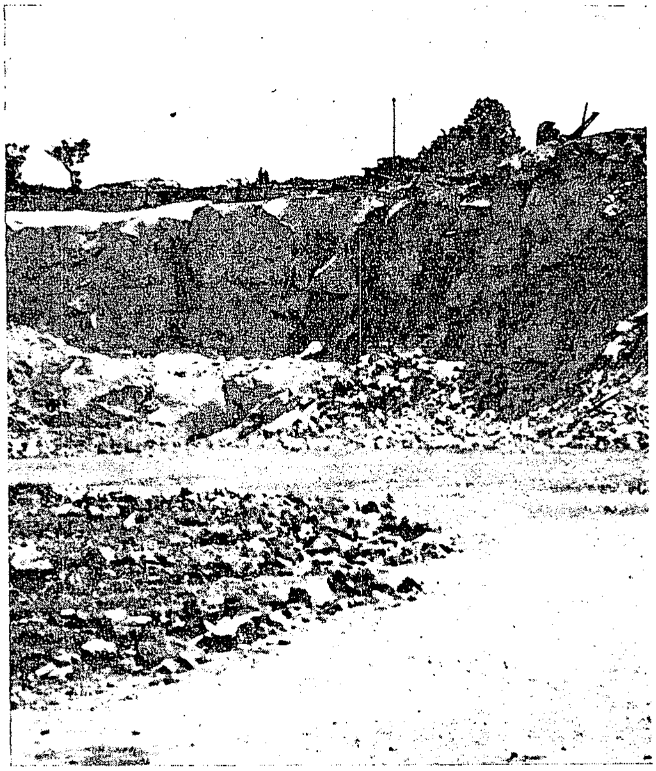


Plate 13—Granite quarry in east edge of Winston-Salem. Dark areas are from ground-water seeps from joints. Most of the seeps are from the horizontal joints.

that topographic location is even more important in this rock unit than in the others. The relation between topographic location and average yield per foot of well is shown graphically in figure 9.

Many dug wells are used for domestic supplies in this unit; however, the yield generally is not large. Probably a larger proportion of dug wells fail during droughts in this unit than in any other rock. A great many dug wells failed during the drought of 1941 and 1942. Many of these were originally dug to solid rock so could not be deepened by digging and were deepened by drilling a 6-inch hole in the bottom of the well. Adequate yields were obtained in most such wells by drilling 10 to 50 feet. At some places the solid granite is so close to the surface that the water table is close to or below the top of the rock, and dug wells are generally unsatisfactory. At these places drilled wells are most commonly used, but springs are utilized also.

Analyses were made of samples of water from eight wells drilled in the sheared granite. These are wells 65 and 113 in Alamance County; wells 117 and 137 in Caswell County; and wells 201, 206, 343, and

[1] Op. cit., p. 21.

345 in Guilford County. The water from five of the eight wells ranged from moderately hard to very hard, and from three wells the water was soft. Iron was determined in five of the eight samples, the maximum iron content of any sample being 0.04 part per million.

DIORITE

Diorite crops out at many places in the Greensboro area, but at most places the area occupied is relatively small. The diorite has about the same areal distribution as the granite and greenstone, occurring as small patches in them. The diorite is usually a fine- to medium-grained dark greenish-gray massive rock. At a few places it is somewhat schistose. The rock is generally not deeply weathered and many wells enter solid rock only 20 or 25 feet below the surface.

This unit is one of the poorest aquifers in the area. The average yield of drilled wells in diorite, according to table 1, is only 6 gallons a minute, and the average yield per foot of well is only 0.063 gallon a minute.

Table 10 gives data on the wells according to range in depth and according to topographic location.

TABLE 10—AVERAGE YIELD OF WELLS IN DIORITE
(Drilled wells 3 inches or more in diameter)

ACCORDING TO DEPTH

Range in depth (feet)	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells Yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
0—100	17	63	½—15	4½	0.068	35
101—150	8	128½	0—25	7½	.058	25
Above 300	1	408	------	25	.061	0
All wells	26	07	0—25	6	.063	31

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	16	91	0—15	3½	0.039	37
Flat	2	93	1½—10	6	.056	0
Slope	5	75	1—25	10	.133	20
Draw	2	51	1—15	8	.158	50
Valley	1	408	------	25	.061	0

Nearly a third of the 26 wells of table 10 yield less than 1 gallon a minute. It is also apparent from the table that the yield per foot of well decreases considerably with depth.

Topography is a very important factor according to the table, the average yield of wells on hills being only one-third as great as it is for wells at other topographic locations. Wells in draws yield, on the average, 4 times as much water as wells on hills.

Because solid rock is close to the surface at many places, dug wells are apt to fail during a drought. The rock is tough and drills slowly, so that some drillers prefer not to drill in it.

By selecting well sites in favorable topographic locations and where the residual mantle is thick, adequate supplies for domestic and limited industrial use probably can be obtained from the diorite at most places. Rarely, however, can adequate supplies be obtained for large industrial establishments and municipalities.

A sample of water from one well in diorite was analysed. The sample was from well 171 in Alamance County. The water is hard but contains no iron. Most wells in diorite probably yield moderately hard to hard water.

PORPHYRITIC GRANITE

All the granite believed to be younger than the sheared biotite granite is included in this unit. It crops out chiefly in southeastern Forsyth County, northwestern Guilford County, and northern Stokes County. It is chiefly a very coarse gray porphyritic granite but also includes some fine- to medium-grained light-gray granite. It is relatively massive at most places, showing little effect of metamorphism. However, at many places it has been intimately injected into gneiss and schist, the resulting rock having some of the characteristics of a granite and some of a metamorphic rock.

Although the soil and subsoil generally are not thick, the granite at many places has disintegrated to considerable depth without any marked change in volume or appearance. The material crumbles easily to a grit and is very easily eroded. The worst gullying and washing seen in the area was in this material.

As is shown by table 1, this unit is one of the poorer aquifers in the area. The average yield of drilled wells in it is somewhat more than in diorite, but the average yield per foot of well is slightly less.

The table below gives data on drilled wells according to range in depth and according to topographic location.

TABLE 11—AVERAGE YIELD OF WELLS IN PORPHYRITIC GRANITE
(Drilled wells 3 inches or more in diameter)

ACCORDING TO DEPTH

Range in depth (feet)	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells Yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
0—100	23	78	½—30	9	0.112	17
101—150	13	124	3½—20	10	.081	0
151—200	5	175	3—10	7	.041	0
201—250	2	219	5—15	10	.046	0
251—300	1	275	-----	2	.007	0
Above 300	3	542	0— 8	5	.009	33
All wells	47	141	0—30	8	.061	----

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	15	194	0—20	6½	0.033	20
Flat	14	146	2—30	12½	.085	------
Slope	12	98	1—16	7	.072	8
Draw	5	76	½—14	7+	.098	20
Valley	1	105	------	10	.095	0

According to this table, the average yield of wells less than 100 feet deep is actually more than the average yield of wells over 100 feet deep. The yield per foot of well, of course, decreases greatly with increasing depth. It is evident that continuing a hole to any considerable depth, in the hope of increasing the yield of a well materially, is unwise.

Topographic location is a very important factor in the yield of wells in this unit. Wells on the hills yield only one-half to one-third as much water per foot of well as wells drilled at other locations. Wells drilled in draws have the largest yield per foot of well. Figures 8 and 9 illustrate, the relation of depth and topography, respectively, to yield.

Except in a few places where the solid rock is close to the surface and a well cannot be dug sufficiently deep, dug wells generally furnish adequate supplies for domestic purposes. Drilled wells usually furnish adequate yields for domestic purposes and, if careful attention is given to the selection of the well sites, probably will yield sufficient water for many industrial users and small towns.

Analyses were made of water samples from four wells drilled in porphyritic granite. These include well 124 in Forsyth County and wells 22, 43, and 111 in Guilford County. The water from two wells was moderately hard and that from the other two was soft. The water from this granite apparently is generally somewhat softer than the water from the sheared granite. Iron was determined in three of the four samples, 0.03 part per million being the maximum.

TRIASSIC (NEWARK GROUP)

The Triassic rocks crop out in a basin, generally 3 to 6 miles wide, extending northeastward from Germanton across southeastern Stokes County and northwestern Rockingham County into Virginia. The rocks include shale, mudstone, sandstone, arkose, and conglomerate. The strike of these strata averages about N. 61° E. and the dip averages about 35° to the northwest. These strata were formed as continental deposits in a synclinal basin and lie unconformably upon the crystalline gneisses and schists. The southeastern margin of the Triassic belt is the feather edge of the Triassic, pinching out against the underlying crystalline rocks. The northwestern margin is faulted downward against the crystalline rocks, and the Triassic rocks along the fault may be as much as 8,000 feet thick in places.

The Triassic rocks contain many strata of sand, arkose, and conglomerate which have considerable porosity between the grains. However, these pores are poorly interconnected so that in most of these strata the movement of ground water in these pores is negligible. Therefore, the occurrence and movement of ground water in the Triassic rocks is in joints and fractures as it is in the igneous and metamorphic rocks of the Greensboro area.

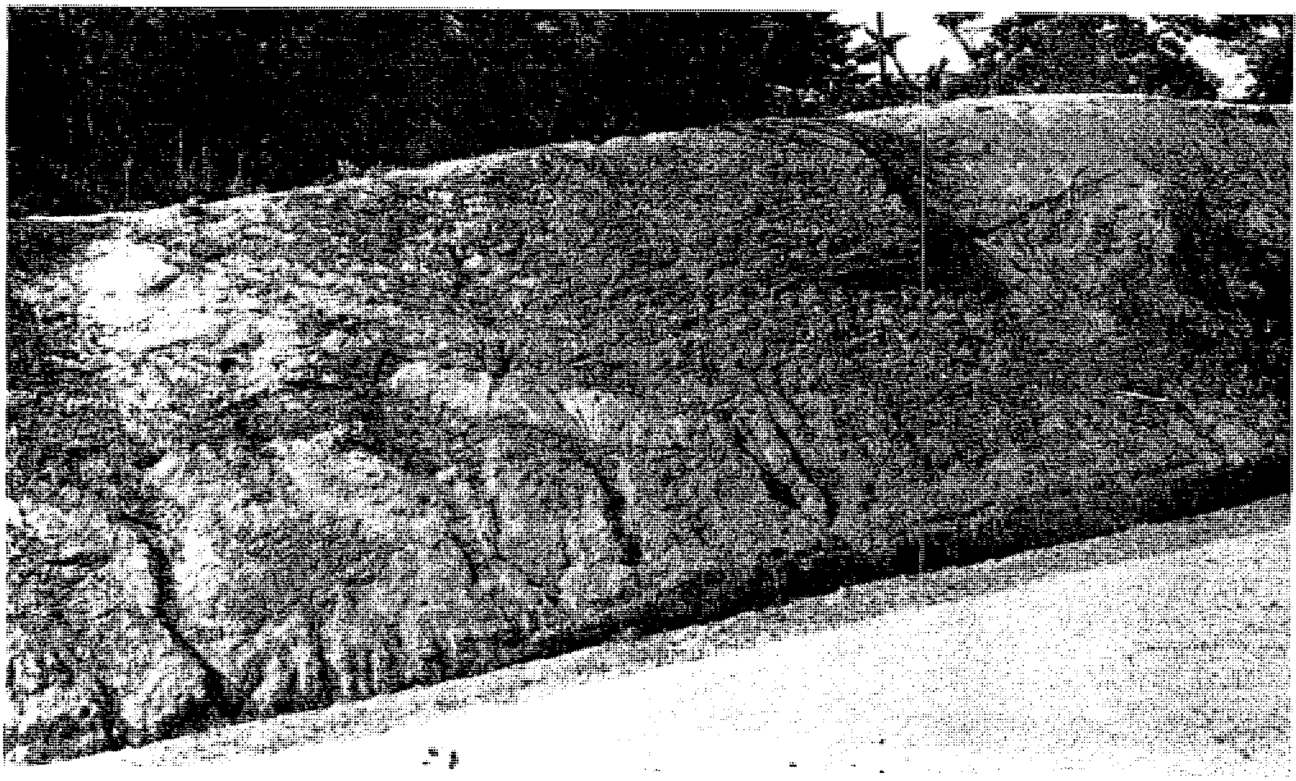


Plate 14—Triassic arkosic sandstone and shale between Walnut Cove and Madison. Ground water moves along joints and other fractures and bedding planes. Although the rock itself is quite porous, the pores are so small and poorly connected that movement through them is relatively slow.

The Triassic is one of the better aquifers in the Greensboro area, according to table 1. Wells in it rank second in average yield and third in average yield per foot of well. It has exactly the same relative rank in table 2, which includes industrial and municipal wells in the Greensboro area. Only one of the 50 wells included in the tabulation of table 1 failed to obtain 1 gallon a minute. The average yield of the 50 wells is 17 gallons a minute, and the average yield per foot of well is 0.100 gallon a minute.

The table below gives data for wells in the Triassic according to depth range and according to topographic location.

TABLE 12—AVERAGE YIELD OF WELLS IN TRIASSIC ROCKS
(Drilled wells 3 inches or more in diameter)

ACCORDING TO DEPTH

Range in depth (feet)	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells Yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
0—100	20	79	1— 25	8	0.097	5
101—150	15	120	2— 50	12½	.104	0
151—200	7	181	3— 75	24	.124	0
251—300	1	290	--------	15	.052	0
Above 300	7	501	3—150	34	.096	0
All wells	50	171	1—150	17	.100	2

ACCORDING TO TOPOGRAPHIC LOCATION

TOPOGRAPHIC LOCATION	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	8	124	2— 10	5½	0.043	------
Flat	12	111	1— 75	17	.152	8
Slope	14	153	2— 25	11	.071	------
Draw	3	370	10— 75	33	.090	------
Valley	13	219	3—150	27	.124	------

The Triassic is one of the few rocks in which the yield per foot of well appears to increase with depth. However, the first 25 to 30 feet of well is above the water table and does not yield any water; therefore, the yield per foot of well in the 0-100 foot range is really about 50 percent larger than shown by the table and is considerably greater than in any other range. Nevertheless, drilling several hundred feet deep in the Triassic appears to give better results than in most other rocks.

As in all the other rock units, hills should be avoided in the selection of well sites, the average yield per foot of well of wells drilled on hills being less than 40 percent of the yield of wells drilled in other locations. For some reason, possibly because of greater opportunity for recharge, the wells drilled on flat areas have the largest yield per foot of well.

The Triassic rocks generally yield adequate supplies for domestic purposes; the fact that only one well in the 50 yielded less than 1 gallon a minute indicates that few wells will be failures. At most places the Triassic rocks yield adequate supplies for small towns and for many industrial purposes. However, an unusually large number of wells, which yielded large quantities of water during pumping tests of 24 to 48 hours duration, failed to maintain their yield. The yield of several wells which were tested at 75 gallons a minute declined in a few years to about 15 gallons a minute. It is evident that adequate testing of a well in the Triassic is even more important than in other rock types.

The Triassic rocks generally drill easily and drilling progresses rapidly except where diabase dikes, which are quite common, are struck. Little water can be obtained from the dikes and wells should not be drilled in them. However, the rock adjacent to such a dike is often more greatly shattered and fractured than elsewhere, and many of the best wells in Triassic rocks are drilled adjacent to dikes.

Because the Triassic rocks form a basin and the topography is generally not very rugged, the water table usually is not as far below the surface as in other rocks. Dug wells usually furnish adequate supplies, although they are subject to contamination.

Analyses were made of water samples from four wells in Triassic rocks. Included are wells 7, 42, and 62 in Rockingham County and well 113 in Stokes County. The water from one well was soft and that from the other three was moderately to exceedingly hard. The hardest waters had above-normal amounts of sulfate and chloride also. The iron content of three of the four samples was determined and ranged from 0.06 to 0.36 part per million.

COUNTY DESCRIPTIONS

INTRODUCTION

Included in the description of each of the six counties is a brief discussion of the geography, topography, physiography, drainage, and geology. The water supply in various parts of the county and in the different rock units cropping out in the county is discussed in somewhat greater detail. A brief description of each public water supply is given. At the end of each county description tables of well data give information on wells in the county; the location of the wells is shown on plate 2. In the table the first column gives the well number and corresponds to the numbers on plate 2, which show the location of the wells. The second column gives the distance and direction from the nearest city, town, or village, the location which is shown on plate 2. The distance was scaled from county maps of the State Highway Department and is usually accurate to a quarter of a mile. The third column gives the name of the owner of the well. The fourth column gives the name of the driller; some of the names are abbreviated to save space, and the complete name is given in footnotes. Column 5 shows the type of the well, that is, the manner in which it was constructed. This column is also abbreviated and the complete type name is given in footnotes. Columns 6 and 7 give the depth of the well and the depth of the casing. The information regarding depth is usually quite accurate because the charge for construction of a well is nearly always based on a certain rate per foot of completed depth. The diameter is given in column 8 and is usually accurate. Column 9 gives the depth to the water level below the land surface. This is the level of the water when the well is not being pumped, and is known as the static level. Figures followed by the letter "R" are reported depths and some may be inaccurate. Some of the figures show the depth to water when the well was completed; others are the depth at some subsequent time when the pump was repaired. Figures followed by the letter "M" are the depths measured during the investigation. The depth actually was measured to the nearest 0.01 foot from some fixed point at the surface, such as the top of the casing or curbing. Because the water level fluctuates considerably, the use of figures of such accuracy is unnecessary; therefore, the levels in the tables are given only to the closest one-half foot and are referred to the land surface. Column 9 gives the yield in gallons a minute. The figures in this column differ greatly in degree of accuracy. Many of them are based on bailer tests by the driller. Some of these may be inaccurate because the test was of short duration. In others the drawdown was very small and the capacity of the well is much greater than is shown. In some wells the figure for yield is based on the capacity of the pump and the length of time necessary to draw the water level down to the suction or intake of the pump. A few wells have had accurate pumping tests of a few to 48 hours duration. Where such tests were made, the essential facts are given in column 12, headed "Remarks". Column 10, headed "Chief aquifer," gives the type of rock in which the well was drilled. This information is based on areal geology, observations made during the course of the investigation, and statements of the driller, owner, and others. Because of the thick layer of soil and disintegrated rock in many places and the complexity of the geology, the rock into which the well was drilled may not always be exactly as given in the table. Column 11 gives the type of topographic location. Five types are included; hills, flats, slopes, draws, and valleys. No doubt there is some ground for criticism of some of the designations. There could be no difference of opinion regarding the topographic location of the city well at Rural Hall, which is located on the top of a sharp hill, or the location of the well of Copeland Fabrics, Inc., at Hopedale, which is in a valley. Many of the wells can whether the location of a well on a low, al opinion. Similarly, a well on the very nce from the crest might be considered signation "draw" is used for any slight draws grade into valleys and the distinc-rsonal opinion of the observer. The last ests, quantity and quality of water, tem-is given or an analysis of the water is

from wells and springs in the county. ells from which the water samples were

alyses for Alamance, Caswell, and Guil-

57-127)

he southeastern part of the Greensboro ed towns and villages. The four incor-Southern Railway, which crosses the rporated places are located on streams, mills around which the villages grew. and industry, most of which is textile

and its surface is formed by the par-ter part of the county is a relatively flat ce, which has changed little since it was ks and rivers, which have cut several

epresenting monadnocks on the pene-nty, are the most prominent of these ly part of the county, no data are avail-ve the surrounding plateau.

iwest corner draining into Rocky River, ies include Reedy Fork, Stony Creek, and Cane Creek. All of these streams

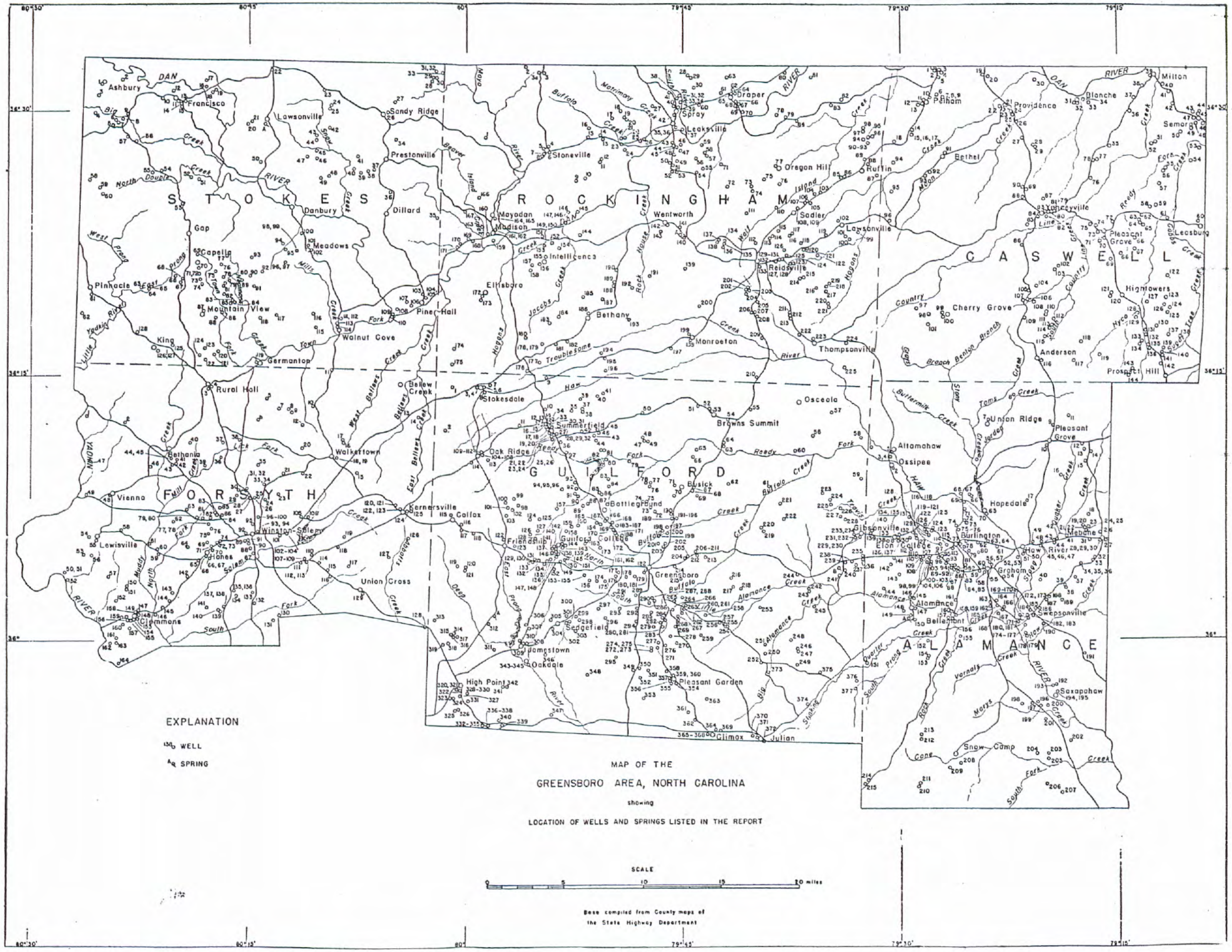
epresented in Alamance County. These distribution of these rocks is shown in

nd a number of smaller ones, some of is the county in a generally northeast The other large area lies to the north-through Elon College, Altamahaw, and County is also underlain by greenstone Union Ridge and Pleasant Grove.

gneissic rocks, all of which are green in ntly were mostly mafic extrusives in-clase, hornblende, and chlorite. These

STATE BULLETIN 55, PLATE 2

UNITED STATES DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY
IN COOPERATION WITH
NORTH CAROLINA DEPARTMENT OF CONSERVATION AND DEVELOPMENT



be as positively located. However, others are borderline cases, and whether the location of a well on a low, gentle rise should be given as "flat" or "hill" is a matter of personal opinion. Similarly, a well on the very crest of a hill is unquestionably on a "hill", but a well a short distance from the crest might be considered to be on the hill by one observer and on a slope by another. The designation "draw" is used for any slight to moderate depression leading downward to a stream valley, but draws grade into valleys and the distinction between the two is necessarily arbitrary and is based on the personal opinion of the observer. The last column, headed "Remarks," gives information regarding pumping tests, quantity and quality of water, temperature of the water, and other information. If a log of the well is given or an analysis of the water is given following the table of well data, it is so stated in this column.

Following the table of well data is a table of analyses of water from wells and springs in the county. The numbers at the heads of the columns are the numbers of the wells from which the water samples were taken.

Logs of one or more wells are given following the tables of analyses for Alamance, Caswell, and Guilford Counties.

Population figures given are from the 1940 census.

ALAMANCE COUNTY

(Area, 434 square miles; population, 57,427)

Geography, physiography, and drainage.—Alamance County, in the southeastern part of the Greensboro area, has four incorporated cities and towns and eight unincorporated towns and villages. The four incorporated places are located on interstream divides and are on the Southern Railway, which crosses the county from east to west slightly north of its center. All the unincorporated places are located on streams, water from which furnishes or formerly furnished power for the mills around which the villages grew. Activity in the county is about equally divided between agriculture and industry, most of which is textile manufacture.

Alamance County is in the central Piedmont of North Carolina, and its surface is formed by the partially dissected peneplane of that physiographic province. The greater part of the county is a relatively flat or only gently rolling plateau formed by the uplifted peneplane surface, which has changed little since it was developed. More rugged topography is found near the larger creeks and rivers, which have cut several hundred feet into the plateau in some places.

Above the upland surface of plateau rise a few rounded hills representing monadnocks on the peneplane. The Cane Creek Mountains, in the southern part of the county, are the most prominent of these monadnocks. Because topographic maps have not been made for any part of the county, no data are available regarding the altitude of these mountains or their elevation above the surrounding plateau.

All of Alamance County, except 6 or 8 square miles of the southwest corner draining into Rocky River, is drained by Haw River and its tributaries. The principal tributaries include Reedy Fork, Stony Creek, Back Creek, Haw Creek, Alamance Creek, Stinking Quarter Creek, and Cane Creek. All of these streams enter the Haw within the county.

Geology.—Four of the geologic units of the Greensboro area are represented in Alamance County. These are the greenstone schist, slates, sheared granite, and diorite. The distribution of these rocks is shown in plate 1.

The greenstone schist crops out in two large irregular areas and a number of smaller ones, some of which were too small to map. The largest area extends nearly across the county in a generally northeast direction through Alamance, Bellemont, Graham, and Haw River. The other large area lies to the northwest and is roughly parallel to the first. It extends from Gibsonville through Elon College, Altamahaw, and Ossipee to Pleasant Grove. The northwestern corner of Alamance County is also underlain by greenstone and the rock crops out in a number of small areas in the vicinity of Union Ridge and Pleasant Grove.

The greenstone schist includes several varieties of schistose and gneissic rocks, all of which are green in color and are of igneous origin. Prior to metamorphism they apparently were mostly mafic extrusives including flows, tuffs, and breccias. The principal minerals are plagioclase, hornblende, and chlorite. These rocks have undergone a great deal of deformation and have been greatly sheared. In most places they are highly schistose but in a few places are fairly massive. The coarse-grained rocks appear to be less schistose than the finer-grained ones. At most places the greenstone schist is deeply weathered, the soil being brown to red in color. In other places, particularly south of Elon College and Gibsonville, the unweathered rock comes nearly to the surface.

The tuffaceous slate underlies all of the southeastern third of Alamance County, with the exception of a few relatively small areas in the vicinity of Snow Camp and Saxapahaw. The tuffaceous slates are principally felsic tuffs and breccias which have been considerably metamorphosed and have become slaty and schistose and, in a few places, gneissic. They also include clay slate, in a few places, and schists and slates which probably were formed from mixtures of volcanic ash and land waste. The last-mentioned variety is found particularly in the vicinity of Mebane and between Mebane and Swepsonville. Further south the slates are mostly metamorphosed tuffs and breccias. Outcrops of coarse tuffs and breccias are particularly plentiful in the Cane Creek Mountains and the southwestern corner of the county.

The sheared granite crops out in a number of irregularly shaped areas separated from each other by the areas of greenstone schist. Most of the granite areas are elongated in a northeasterly direction. The largest area of granite extends from Elon College and Burlington through Hopedale, and extends northeast and west of Pleasant Grove. Another large area of granite crops out west and north of Snow Camp and extends into Guilford County. A number of small areas crop out in the Cane Creek Mountains and in the vicinity of Saxapahaw.

The granite at most places is a coarse-grained pinkish-gray gneissic biotite granite. At a few places it is light gray in color and somewhat finer-grained. The biotite occurs in large tabular crystals which have been smeared around the feldspar crystals during the deformation of the rock. Megascopic and microscopic examination reveal that the granite has undergone considerable metamorphism, probably as much as the greenstone and slates.

One of the outstanding features of the granite is the green slaty and schistose mafic dikes which have been intruded into it. These are very numerous and, in places, the area of outcrop of the dikes exceeds the outcrop area of the granite into which the dikes were intruded. The dikes are so similar to much of the greenstone schist that many specimens of the one cannot be distinguished from those of the other.

The mapped areas of diorite are relatively small. The largest is north of Union Ridge and extends northeastward into Caswell County. Stony Creek Mountain is in the southwestern end of this area and is underlain by diorite. Another area cropping out to the west is mostly in Caswell County. A third area is southwest of Alamance, on the north side of Stinking Quarter Creek, and extends southwestward into Guilford County. Another small area extends southwest and northeast from Swepsonville.

Diorite crops out in a number of other places which are too small to map or which could not be readily distinguished from the greenstone schists because of the similarity of the overlying soils. Diorite crops out in a number of places in the area between Graham, Haw River, and Swepsonville. It also crops out at several places a few miles south of Burlington. The diorite ranges from moderately fine to coarse in texture and from medium gray to dark greenish gray or dark gray in color. The minerals are chiefly plagioclase and hornblende. At most places, particularly in the areas mapped as diorite, the diorite is massive and appears to have undergone little or no metamorphism. In a few places, mostly in those outcrops that were not mapped separately but were included in the greenstone schists, the diorite is quite schistose. It is possible that two ages of diorite are represented.

Ground water.—Most of the domestic and industrial water supplies and two of the four municipal supplies are obtained from wells. A few domestic supplies are obtained from springs. A great many of the domestic wells are dug, particularly on farms because the farmer can dig his own well during slack seasons. Nearly all these wells obtain their water from the weathered and disintegrated zone between the soil and the underlying unweathered rock. In some places dug wells have been unsuccessful because the underlying rock is so close to the surface. Either the water table is below the top of the rock or so close to it that little water can be obtained under normal conditions, and during periods of drought the well goes completely dry. At many places it has been necessary either to deepen the well by blasting or drilling in the bottom, or to drill a new well. Usually the well has been deepened by drilling in the bottom and a great many wells in the vicinity of Burlington and Graham were deepened thus following the drought of 1941-1942.

The failure of dug wells was not confined to any one rock type in Alamance County, and it appears that the rock in all four units will be so close to the surface at some places as to make dug wells unsatisfactory.

Bored wells are used chiefly in suburban areas just beyond the limits of public water supplies. As these wells can be constructed only in completely weathered rock, they cannot be used at many places. Many of these also went dry during the 1941-1942 drought and were deepened by drilling in the bottom.

Many wells have been drilled in Alamance County, and recently there has been a definite trend towards drilled wells, particularly since so many dug and bored wells failed during the drought of 1941-1942. Both core-drilled wells, 2 or 3 inches in diameter, and percussion-drilled wells, 4 to 8 inches in diameter, are used. Most wells drilled in the bottom of dug or bored wells are 6 inches in diameter and have been churn drilled.

Records of more than 200 drilled wells are included in the table of well data. The record of 148 wells, 3 inches or more in diameter, were complete enough for use in compiling table 13, below.

TABLE 13—SUMMARY OF DATA ON WELLS IN ALAMANCE COUNTY
(Drilled wells 3 inches or more in diameter)

ACCORDING TO ROCK TYPE

Type of Rock	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells Yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Greenstone schist	60	171	⅛—150	21.2	0.122	13.3
Slate	36	109	1— 75	16.3	.150	3
Sheared granite	37	158	1/16—212	20.1	.127	8
Diorite	15	109	0— 25	7.1	.065	20
All wells	148	148	0—212	18.3	.124	10

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	47	127	0— 38	8.4	0.066	23.5
Flat	41	148	1/16—112	19.3	.130	7.3
Slope	34	121	1— 90	18.9	.156	3
Draw	13	241	3—212	45.5	.189	0
Valley	13	186	3— 70	22.6	.121	0

The average depth of wells in greenstone schist and granite is considerably greater than the average depth of wells in the slates and diorites, probably owing to the considerable number of relatively deep municipal and industrial wells included in the first two units. The average yield of wells in the greenstone schist and granite is very nearly the same. Although the average yield of wells in the greenstone schist is slightly larger than the average yield of wells in granite, because of the greater depth of wells in the greenstone schist the average yield per foot of well in granite is slightly greater than in greenstone schist.

The average yield per foot of well is considerably greater for wells in the slates than for wells in any other rock. This is rather surprising because the greenstone schist ranks well ahead of the slates for the Greensboro area as a whole. The average yield and average yield per foot of well for all wells in the county is considerably greater than for the entire Greensboro area. One reason may be that a large proportion of municipal and industrial wells is included. Another reason, and probably the most important, is that almost all the wells are drilled in rocks that rank high as aquifers according to table 1.

Table 13 shows the relation of topographic location to the average yield of wells. The average yield and average yield per foot of wells drilled in draws is the greatest. It is obvious that hills should be avoided in selecting well sites and that draws are the most favorable sites.

Quartz veins also are an important factor influencing the yields of wells. There are many quartz veins in the greenstone schist and the slates of Alamance County but very few in the granite or diorite. These veins range from a fraction of an inch to several feet in thickness, and in many places where they are thin they are closely spaced. The veins generally are moderately steep to vertical and probably persist to considerable depth, at least beyond the depth of most wells. The quartz is usually greatly fractured, and the veins therefore serve as important avenues of ground-water circulation. Wells located so as to intersect such veins frequently obtain yields of water much larger than average.

Although there are few quartz veins in the granite, there are innumerable green schistose dikes, and it is possible that ground water circulates more freely in the dike than it does in the granite. Also, the granite is probably more fractured and broken adjacent to the dike than elsewhere. Therefore, wells that intersect one or more dikes probably yield more water than those drilled entirely in granite.

Another factor that has an important bearing on the yield of many wells is the thickness of the mantle. It is in this layer of soil and disintegrated rock that the water from the surface accumulates and is fed into the fractures and joints of the underlying rock. Where the mantle is thick, there is much greater opportunity for the accumulation and storage of ground water to feed the fissures. Well sites therefore should be selected where the mantle is thick.

Analyses of 12 samples of water from wells in Alamance County are given in a table following the well records. Of these, five are from wells in greenstone schist, four from wells in the slate unit, two are from wells in the granite, and one from a well in diorite. The water ranged in hardness from 30 to 480 parts per million. The water having a hardness of 480 parts per million is from a well 58 feet deep in schist (slate unit) and is not characteristic of water from that rock.

The iron content ranged from 0.0 to 0.5 part per million. In only one sample was the iron content more than 0.03 part per million. The water from the greenstone schist ranged in hardness from 30 to 148 parts per million and in iron content from 0.01 to 0.5 part per million.

The water from the slate ranged in hardness from 3.2 to 480 parts per million. However, the water from three of the four samples was soft. In only two of the analyses is the iron content reported, and in both of these it is 0.01 part per million. The two analyses of water from wells in granite are nearly identical. Both are of hard water and show a low iron content. The water from the well in diorite is similar to the water from the wells in granite.

Temperatures range from 60° to 63° F. and average 62° F.

Municipal supplies.—There are four municipal water supplies in Alamance County. Wells are the source of two of these and streams are the source of the other two. In addition to the municipal supplies, many houses in several villages are supplied with water from wells or streams, through distribution systems owned and operated by the mills around which the villages are located.

Burlington, the largest city, has a population of 12,198 and has had a municipal supply since 1905. From 1905 to 1921 the supply was obtained from wells, including wells 76, 77, and 113 in the tables; well 113 is now being used by the May Hosiery Mills of May, McEwan, Kaiser Co., Inc. In 1920 the yield from the wells became insufficient and a surface supply was developed, which was first used during Christmas week of 1920. The water is obtained from Stony Creek, 3 miles northeast of the center of Burlington. The dam is 30 feet high and the reservoir has an area of 140 acres and a capacity of 500,000,000 gallons. Four electrically driven centrifugal pumps with a total capacity of 9,000 gallons a minute force the water to a 1,750,000-gallon raw-water reservoir at the treatment plant in the city. Treatment consists of coagulation with the addition of alum and lime, filtration, and chlorination. The water flows by gravity from the raw-water reservoir, through the treatment plant, into the clear-water basin which has a capacity of 450,000 gallons. The treatment plant has a capacity of 4,000,000 gallons a day. Distribution pumps consist of 1 diesel-driven and 2 electrically driven centrifugal pumps, with a total capacity of 5,950 gallons a minute. Pressure ranges from about 50 to 70 pounds per square inch. A 100,000-gallon and a 1,500,000-gallon elevated tank are connected to the mains to furnish additional storage and equalize pressure. There are about 3,400 taps. The maximum consumption in 1942 was about 4,000,000 gallons a day and the average was about 3,000,000 gallons a day.

The water supply for Elon College, population 494, is obtained from two drilled wells, numbers 132 and 133 in the table. Well 132 is 300 feet deep and has a tested yield of 150 gallons a minute but the pump has a capacity of only 60 gallons a minute. Well 133 has a capacity of 23 gallons a minute. Both wells are in greenstone schist. The electrically driven pumps deliver the water into the distribution system. The total capacity of pumps is about 85 gallons a minute. A 50,000-gallon tank is connected to the system, furnishing storage and equalizing the pressure, which is maintained at about 45 pounds per square inch. There are about 90 taps and the water consumption is about 70,000 gallons a day. The water is not treated.

Graham, population 4,339, has had a public water supply since 1906. The water is obtained from six drilled wells, numbers 55 through 60 in the tables of well data. The depths of the wells range from 354 to 1,005 feet and yields range from about 30 to 45 gallons a minute. All of the wells are believed to be in greenstone schist. Wells 56 and 57, pumped by air lift and a piston pump, respectively, discharge into a 500,000-gallon round concrete reservoir. A 75,000-gallon elevated tank furnishes additional storage and equalizes the pressure. The other wells are equipped with turbine pumps and discharge directly into the system. The pumping level is about 225 to 250 feet below the surface. The maximum capacity is about 300,000 gallons a day. Maximum consumption is about 280,000 gallons a day and the average is about 250,000 gallons a day. The water is not treated.

Mebane, population 2,060, has had a public supply since 1919. The chief source of supply is Mill Creek, about 1¼ miles north of the town. Well 26, located at the water plant, in the north edge of Mebane, is used as an auxiliary supply. The well is 735 feet deep in slate and yields 25 gallons a minute.

The water is pumped from Mill Creek by two centrifugal pumps and the well is equipped with a deep-well piston pump. The largest storage is in a 250,000-gallon round concrete reservoir. A 75,000-gallon elevated tank furnishes additional storage and equalizes the pressure on the system. Treatment consists of coagulation with the addition of alum, filtration, and chlorination. The capacity of the plant is about 400,000 gallons a day. Consumption averages about 175,000 gallons a day and the maximum is about 200,000 gallons a day.

During the drought of 1941 the supply from Mill Creek was inadequate. Wells 26, 28, and 30 were used to supplement the supply but were insufficient. Additional water was obtained from another small creek about 3 miles north of Mebane.

The water supply at the village of Alamance is owned and operated by the Standard Hosiery Mills, Inc. The source is Alamance Creek, at the dam. Treatment consists of coagulation with alum, soda ash, and lime, filtration, and chlorination. Storage is in a 75,000-gallon elevated tank, 50,000 gallons of water being held in reserve in case of fire. Water is supplied to about 40 or 50 families, in addition to the mill. Consumption averages about 150,000 gallons daily, most of which is used in the mill.

At Belmont, wells 157 to 160, belonging to Burlington Mills Corporation, supply a number of homes. The wells are 80 to 185 feet deep and 2 inches in diameter and yield 2½ to 5 gallons a minute each.

At Swepsonville the mills and many homes are supplied with water from wells 169 to 171 and 174 to 177, belonging to Virginia Mills Company, Inc. These wells range from 58 to 408 feet in depth and from 2 to 8 inches in diameter. Yields range from 1 to about 25 gallons a minute. The wells apparently are in diorite.

Wells 194 and 195 at Saxapahaw, drilled in slate, supply the mills and village. These wells, owned by the Sellars Manufacturing Company, are 168 and 204 feet deep, respectively, are 6 inches in diameter, and yield 30 and 32 gallons a minute, respectively.

RECORDS OF WELLS IN ALAMANCE COUNTY

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
1	1 mile W of Altamahaw	L. M. Sutton	Heater Well Co.	B-Dr	99	79	6		4½	Granite	Hill	Had 15 gallons a minute at 76 feet but water would not clear.
2	Ossippee	OssippeeWeaving Co.	Vir. Mach. Co.	Dr	335	30	10		40	Greenstone	Slope	Temperature 60° F. Hardness 120 parts per million.
3	Do	Dr. C. E. Kernodle	Dan. Well Co.	D-Dr	114		6		5	do	Hill	Dug 50 feet, drilled remainder
4	Do	County School	E. A. Ingold	Dr	152	30±	6	15R	30	do	do	Reported 15 feet of draw-down.
5	Altamahaw	Altamahaw Mill	F. L. Smith	Dr	160	20	6		70	do	Valley	Used for drinking, soaking, humidifying.
6	2½ miles S of Union Ridge	Staley Kernodle	do	Dr	300?		6		¼±	do	Flat	Not used, insufficient water.
7	½ mile N of Union Ridge	Dr. S. F. Scott	do	Dr	69	40	6	6R	25	Granite	Draw	
8	2½ miles NE of Union Ridge	Van Bowman	do	Dr	75±		6			do	Hill	
9	1 mile N of Pleasant Grove	C. R. McCauley	do	Dr	109	90	6	19½M	12	do	Slope	Reported soft, free from iron.
10	Pleasant Grove	County School	Heater Well Co.	Dr	121	100	6	35±R	10	Greenstone	Flat	Do
11	2¼ miles NE of Pleasant Grove	School (Negro)	F. L. Smith	Dr	46	30	6	18R	30	Granite	Hill	Do
12	2 miles E of Pleasant Grove	L. W. Roney	Heater Well Co.	D-Dr	82	30	6	32R	1	do	do	Dug 30 feet.
13	2½ miles E of Pleasant Grove	J. E. Sellers	do	Dr	115	55	6		10	do	do	Reported moderately hard water.
14	3 miles E of Pleasant Grove	O. S. Sellars	F. L. Smith	Dr	113½	40	6	20R	4–5	Granite?	Flat	Reported soft water, no iron.
15	3 miles E-SE of Pleasant Grove	Cross Rds. Church	Heater Well Co.	D-Dr	82	69	6		15	Schist	do	Dug 30 feet.
16	2 miles S of Pleasant Grove	W. L. Barnette		Dug	38		24	31M		Granite		Good supply, soft water reported.
17	3 miles N of Haw River	Earl B. Horner	F. L. Smith	D-Dr	90		6		¼	do	Hill	Dug 45 feet.
18	1¾ miles NW of Mebane	Otis Tate	do	Dr	58	17	6	8–13R	1½	Schist	Flat	Analysis in table.
19	1½ miles NW of Mebane	Woodlawn Comm. Center	Adair	Dr	103	25–30	6			do	do	Large supply reported.
20	Do	J. B. Weaver	F. L. Smith	Dr	59	32	6	32R	1½	do	do	Soft water, no iron reported.
21	1⅛ miles NW of Mebane	W. L. King	do	D-Dr	45		6	30R	-1	do	do	Dug 32 feet. Reported soft, no iron stain.
22	Do	George E. Wyatt	do	Dr	75	18	6	35R	3	do		Reported slightly hard, no iron stain.
23	1 mile NW of Mebane	E. W. Wilkerson	do	Dr	42		6		8	do		
24	1 mile W-NW of Mebane	J. R. Holt	do	Dr	63	52	6	30M	10	do		Reported soft, no iron stain.
25	Do	W. A. Holt	E. A. Ingold	Dr	75	50	6		15	do		do
26	Mebane	Town of Mebane	Sydnor Well Co.	Dr	735		8		25?	Schist	Flat	Used only as auxiliary and emergency supply.
27	Do	Southern Railway Co.		Dug	80		96	40R	10	do	do	Not used now.
28	Do	Mebane Royal Co.	Sydnor Well Co.	Dr	189	38	8		30	do	do	Water reported to contain much iron. Not used.
29	Do	Fitch-Riggs Lumber Co.	C. R. Heater	Dr	97	60±	6		20	do	do	Water reported to contain much iron.
30	Do	Mebane Yarn Mills, Inc.		Dr	185		6		25	do	do	Water reported soft, free from iron.
31	Do	Brick Yard	C. R. Heater	Dr	100+		3			do	do	
32	1¼ miles S of Mebane	S. A. Lynch	W. P. Phillippi	Cr-Dr	100½		2		4	do	do	Water reported moderately soft, no iron.
33	Do	R. E. McCauley	F. L. Smith	D-Dr	92	70?	6		30	do	do	Dug 30 feet. Water reported soft.
34	2 miles SW of Mebane	W. T. McGee	do	D-Dr	150	130	6		26	do	do	Dug 30 feet. Water reported slightly hard.
35	Do	Charles Ellis	do	D-Dr	118	118	6	35±R	25	do	do	Dug 27 feet. Water reported soft.
36	Do	Marvin Laws	do	Dr	58		6	23M	12	do	do	Soft water reported, little iron.
37	3 miles SW of Mebane	V. S Garrett	Heater Well Co.	Dr	88	54	6	20R	4	do	do	

[1] Vir. Mach. Co.=Virginia Machinery & Well Co.; Dan. Well Co.=Danville Well Drilling Co.; Sydnor Well Co.=Sydnor Pump & Well Co.
[2] Dr=Drilled, Br=Bored, Cr-Dr=Core Drilled, B-Dr=Bored and Drilled, D-Dr= Dug and Drilled.
[3] Depth to water from land surface; R=Reported, M=Measured.

RECORDS OF WELLS IN ALAMANCE COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
38	3 miles NE of Swepsonville	A. L. Turner	E. A. Ingold	Dr	89		6		8	Schist		Analysis in table.
39	Do	J. J. Fenton	F. L. Smith	Dr	96	70	6	8±R	40	Greenstone		Water reported hard.
40	3 miles N of Swepsonville	Kerr Scott	E. A. Ingold	Dr	99½		6	32½M		do	Ridge	Water reported slightly hard.
41	3 miles E of Haw River	Ellis Allen	F. L. Smith	Dr	93	86	6	25R	15	Schist	Hill	
42	2 miles E of Haw River	D. C. Patterson	?	Dr	48		6			Greenstone	Flat	
43	Do	S. K. Scott	E. A. Ingold	Dr	116	40	6		6½	do	Steep hill	Water reported soft, with no iron.
44	Do	Augustus Holt	Hudson Well Co.	Dr	84		6			do	do	
45	1¼ miles E of Haw River	A. S. Hall	F. L. Smith	D-Dr	64		6	40R	5	do	Slope	Water reported soft, with no iron
46	Do	Mrs. Grace Brooks	C. H. Davis	B-Dr	130		6		½-1	do	Flat hill	Bored 40 feet.
47	Do	Paul Bason	do	D-Dr	75	43	6	35R		do		Dug 43 feet. Water reported soft, no iron.
48	Do	C. E. Ray	F. L. Smith	D-Dr	70	45	6		10-12	do	Slope	Dug 45 feet. Water reported soft, no iron.
49	½ mile E of Haw River	Travora Mfg. Co.	Heater Well Co.	Dr	61	50	8	15-20R	20	do	Flat	Water reported soft, no iron.
50	Haw River	Tabardrey Mfg. Co.	Vir. Mach. Co.	Dr	450		8	30R	90?	do	Slope	Tested at 90 gallons a minute with 136-foot drawdown, but yield has decreased greatly.
51	¼ mile S of Haw River	Tabardrey Mfg. Co.	Sydnor Well Co.	Dr	600		8	47R	74	Greenstone	Slope	Log in table. Analysis in table.
52	½ mile S of Haw River	Dr. W. H. Stratford	?	Dr	64½		6		15	do	do	Water reported hard.
53	Do	Mrs. D. B. May	W. P. Phillippi	Dr	50		2		15	do	Draw	
54	1 mile SE of Graham	P. S. Dixon	do	Dr	106		2		4-5	Diorite	Valley	Rock 16 feet below surface, water reported soft.
55	Graham	City	Vir. Mach. Co.	Dr	1005	100	8	15-20R	30	Greenstone	Hill	Water obtained in first 250 feet.
56	Do	do	Sydnor Well Co.	Dr	465	60-65	8	15-20R	40±	do	Valley	Analysis in table is tap sample of water from wells 55 to 60 inclusive. Temperature of water from well 57 is 62½° F.; of well 58, 63° F.
57	Do	do	do	Dr	441	60±	8	15-20R	40±	do	do	
58	Do	do	do	Dr	501	45	8	15-20R	45	do	Flat	
59	Do	do	Heater Well Co.	Dr	354	120	8		30	do	Draw	
60	Do	do	Sydnor Well Co.	Dr	400-500		8		30	do	Flat	
61	2½ miles E of Burlington	Travelers Rest	F. L. Smith	Dr	102		6		15	do	Slope	Water reported moderately soft, no iron.
62	1½ miles E of Burlington	Pepsi-Cola Plant	do	Dr	162	30	6		84	do	do	
63	2 miles E of Burlington	C. F. Parks	do	D-Dr	49		6	30½M	8	do	Hill	Dug 34 feet, drilled remainder, uncased.
64	Do	T. E. Parks	do	Dr	64		6		8	do	Slope	Water reported soft.
65	Hopedale, 2½ miles NE of Burlington	Copeland Fabrics, Inc.	Sydnor Well Co.	Dr	470		8		30?	Granite	Valley	Analysis in table.
66	Glencoe, 3 miles N of Burlington	Carolina Mills	W. B. Mayhew	Dr	108		2		7+	do	Slope	Hard water reported, no iron.
67	Glencoe	do	do	Dr	190	65	2		7	do	do	
68	Do	John Ford	F. L. Smith	Dr	87		6		¼	Greenstone		Wells 95 feet and 193 feet deep failed to obtain water.
69	Do	G. L. Murray	do	Dr	63	12	6		18	do	Valley	Water reported soft, no iron.
70	Do	Charles Williams	J. R. Cummings	Dr	80+		6			Granite		
71	Do	County School	F. L. Smith	Dr	262½	30	6	50R	6	do	Hill	No water beyond 150 feet.
72	2 miles N of Burlington	I. Johnson	do	Dr	60±		6			do	Slope	Water reported soft, no iron.
73	Do	J. D. Christopher	do	Dr	78	12	6		3½	do	Draw	
74	Do	D. L. Owens	do	Dr	87		6	20R		do		Water reported moderately soft, no iron.
75	1 mile N of Burlington	C. H. Page, Jr.	W. P. Phillippi	Dr	100+		2		2½	do	Valley	Water reported soft, no iron.
76	Burlington	City		Dr	750		8		55	Granite	Draw	Not used.
77	Do	do	Sydnor Well Co.	Dr	455		6		35	do	do	Do
78	Do	Celanese Lanese Corp.	do	Dr	390		8	50R	60?	do	Flat	Water reported soft, no iron
79	Do	Lawrence S. Holt's Sons	do	Dr	500		8			do	Hollow	Not in use.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN ALAMANCE COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
80	Burlington	Cherokee Flooring Corp.	Heater Well Co.	Dr	200	70	6	14M	15	Granite	Flat	Water reported hard, with some iron.
81	1½ miles S of Burlington	Bruce Mann	F. L. Smith	Dr	70-80		6		3	do	Draw	
82	Do	Robert Foust	do	Dr	80?	62?	6	19M		Greenstone	Flat	Water not used, always muddy and rusty.
83	Do	S. Homewood		Dr	55	20	6	15R	20±	do	do	Water reported soft, no iron.
84	Do	Bob Fonville	F. L. Smith	Dr	93		6		4½	do	Slope	
85	Do	Bill Hutson	do	Dr	48	22	6		2½	do	do	
86	Do	Alvis Aldridge	do	D-Dr	53		6		10	Diorite	do	Dug 40 feet.
87	Do	C. W. May	do	D-Dr	70	20	6		2½	do	Hill	Dug 20 feet. Water reported hard, no iron.
88	Do	J. A. Vaughan	do	Dr	73		6	31R	9	Greenstone		Water reported slightly hard.
89	Do	T. L. Stanford	do	Dr	64	31	6		2½	Diorite	Hill	Water reported hard, no iron.
90	Do	Ed King	Hudson Well Co.	D-Dr	119		6	23M	20	Greenstone	Draw	
91	Do	J. J. Scearse	F. L. Smith	Dr	68		6	26M	20			
92	Do	E. L. Bost		Br	30	30	18	15R		Greenstone		Water reported soft, no iron.
93	Do	Green Gables Inn	F. L. Smith	Dr	60		6		7	do	Valley	
94	Do	F. L. Smith	do	Dr	68		6		8	do	Slope	
95	Do	E. Leon Gilliam	do	Dr	69	8	6	12R	2½	do		Water reported soft, no iron.
96	2 miles SE of Burlington	M. J. Stone	do	Dr	105		6		6	do	Hill	Water reported hard, no iron.
97	Do	J. F. Robertson	do	Dr	130		6		1/16	Granite	Flat	Insufficient water, not used.
98	Do	H. W. Paylor	do	D-Dr	42	38	6	19R	15	Greenstone	do	
99	Do	John Vernon	do	Dr	55		6	25R	20	do	do	
100	Burlington	C. E. Thomas	do	D-Dr	57	55	6	21R	35-40	do	do	Water reported soft, no iron.
101	2 miles SW of Burlington	Lloyd Batiff	F. L. Smith	D-Dr	75		6		6	Greenstone	Hill	Water reported hard, no iron.
102	Do	J. T. Baxter	do	Dr	107	93	6		4	do	do	Water reported soft, no iron.
103	Do	Galey Henshaw	do	Dr	140		6		15	do	do	Water reported soft.
104	Do	W. M. Newell	W. P. Phillippi	Dr	90		2		4-5	do	Slope	
105	Do	H. M. Pearson	F. L. Smith	Dr	70		6		6	do	do	
106	Do	R. W. Wagoner	do	Dr	85	66	6	20R	5	do	Valley	Water reported soft.
107	Do	Raymond Bell	do	Dr	55		6	8R	11	Slate	do	Many quartz veins exposed nearby. Water reported slightly hard, no iron.
108	Do	J. P. Trull	do	Dr	52		6	20R		do	Hill	Water reported hard.
109	Do	W. E. Bell	do	Dr	67	15	6	8R	3	do	Valley	
110	Do	A. J. Malcolm	do	Dr	84	58	6	19R	20	do	Slope	Water reported hard.
111	Do	G. P. Mattos	do	Dr	90±	82	6		7-8	do	do	Do
112	2 miles W of Burlington	A. L. Apple	Heater Well Co.	Dr	130	87	6		½	Granite		
113	Burlington	May Hosiery Mills	Sydnor Well Co.	Dr	634		10-8		212	Granite?	Draw	Analysis in table.
114	Do	City	Heater Well Co.	Dr	301		8		8	Granite	Flat	Not used
115	Do	Burlington Mills, Plaid Mill	Sydnor Well Co.	Dr	?		8?		10?	do	do	
116	1 mile W of Burlington	Dr. R. W. Brannock	F. L. Smith	Dr	85	45	6		2-3	do	Slope	
117	Do	Dr. S. C. Spoon	do	Dr	120	19	6		12	do	Flat	Water obtained at 19 feet.
118	Do	Ralph Holt	do	Dr	165	29	6		20	do	do	Water obtained at 29 feet.
119	1½ miles NW of Burlington	Ed Brown	do	D-Dr	50±		6		10	Greenstone	do	
120	Do	Glenn Huffman	do	Dr	70	65	6		6	do	do	
121	Do	J. C. Riley	do	D-Dr	42	30	6		15	do	do	
122	Do	L. V. Johnson	do	Dr	65	21	6		20	do	do	Water reported soft, no iron.
123	Do	W. E. Spencer	Dan. Well Co.	Dr	154		6		9	do	Draw	
124	Do	Pure Oil Plant	F. L. Smith	Dr	73	65	6	13M	25	do	Flat	
125	Do	Glen Raven School	do	Dr	70	20	6		6		do	Not used now.
126	2 miles NW of Burlington	Glen Raven Mill	F. L. Smith	Dr	81	85	6		10	Greenstone	Hill	
127	2½ miles W of Burlington	T. M. Amick	do	Dr	55	25	6		5	do	Slope	
128	1 mile E of Elon College	J. B. Brown	Heater Well Co.	Dr	150	90	6		0	Diorite?	Hill	Not used, no water.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN ALAMANCE COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
129	1 mile E of Elon College	Carolina Biological Supply Co.	Heater Well Co.	Dr	156	45	6		25+	Granite	Draw	Static level only a few feet below surface.
130	Do.	C. A. Porterfield	F. L. Smith	Dr	81	60	6		7	do	Slope	
131	1½ miles NE of Elon College	Boyd Gurner	do	D-Dr	108		6		0	Diabase?		Dug 20 feet.
132	Elon College	Town	Heater Well Co.	Dr	300	80	8	50R	150	Greenstone	Draw	Analysis in table.
133	Do.	do	Vir. Mach. Co.	Dr	900	100	8		23	do	Ridge	
134	Do.	Elon College	Heater Well Co.	Dr	140		8		25		Flat	Log in table.
135	Do.	do.	do.	Dr	215	83	8		35	Greenstone	do	Do
136	Do.	Elon Orphanage	F. L. Smith	Dr	201	130	6¼-5⅝		19	and Granite	Slope	Do
137	Do.	do	Heater Well Co.	Dr	100		6		14	Greenstone	do	
138	Do.	Elon Nergo School	F. L. Smith	Dr	125	102	6		6	do		
139	Gibsonville	City	do	Dr	335½	91	8	53R	112	do	Flat	Analyiss in table.
140	Do.	H. Huffines	do	Dr	76	67	6		20-25	do		
141	4 miles SW of Burlington	Correct Time Inn	do	Dr	93		6	20R	15	do	Slope	Water reported hard, no iron
142	Do.	St. Marks Church	do	Dr	81	65	6		12	Slate	Flat	
143	2 miles N of Alamance	E. T. Sharpe	do	Dr	118		6	30R	75±	do	Slope	Quartz veins at 112 and 118 feet.
144	2 miles NW of Alamance	T. L. Hoffman	do	Dr	32	12	6	5R	7	Greenstone	Valley	Water reported lightly hard.
145	½ mile N of Alamance	E. E. Edwards	W. P. Phillippi	Dr	42	20	2			do	Slope	Water repurted hard
146	Do.	B. E. Clapp	do	Dr	190		2			do	Hill	
147	Alamance	W. G. Pike	F. L. Smith	D-Dr	40		6	22½M	3	do		Dug 24 feet.
148	½ mile W of Alamance	J. N. Brown & J. L. Brothers	do	D-Dr	97		6	35R	1	do	Hill	Hardness about 150 parts per million
149	1 mile S of Alamance	M. E. Evans	do	Dr	30		6			do	Flat	Analysis in table
150	Do.	J. M. Crouse	do	D-Dr	51½		6		18	Slate	Valley	Hardness about 35 parts per million
151	5 miles SW of Alamance	J. E. Stafford	F. L. Smith	D-Dr	63		4		8	Granite	Slope	Dug 27 feet.
152	2½ miles S of Alamance	E. Patterson	do	Dr	109		6		0	Diabase	Hill	Drilled into a dike.
153	3 miles S of Alamance	Dr. W. L. Isley	W. P. Phillippi	Dr	57		2		5	Granite	Flat	
154	Do.	do	do	Dr	53		2		4-5	do	do	
155	1 mile S of Bellemont	L. S. Cooke	F. L. Smith	D-Dr	83½		6		½	Greenstone	Hill	Dug 43 feet. Water reported slightly hard.
156	Bellemont	J. H. Thompson	do	D-Dr	90		6		4	do	do	Dug 35 feet. Water reported soft.
157	Do.	BurlingtonMillsCorp.	W. B. Mayhew	Dr	80±		2		5	do	do	
158	Do.	do	do	Dr	85		2		5-6	do	Valley	
159	Do.	do	do	Br	90		2		5	do	do	
160	Do.	do	do	Br	185		2		2½	do	do	Water reported hard.
161	1 mile N of Bellemont	P. W. Wrightsell	W. P. Phillippi	Dr	185	40	2		2	Granite	Hill	Water reported to contain a little iron.
162	3 miles S of Graham	Boyd Perry	Hudson Well Co.	D-Dr	58		6			Greenstone		Dug 35 feet.
163	Do.	Frank Mann	do	D-Dr	48		6	26M	¼	do	Hill	Dug 32 feet. Water reported slightly hard.
164	Do.	E. G. Henderson	F. L. Smith	D-Dr	46		6	15R	⅛	do	do	Dug 15 feet.
165	Do.	D. B. Martin	do	Dr	51½		6	12½M	4	do	Slope	Supplies two homes.
166	2 miles W of Swepsonville	D. V. Loy	E. A. Ingold	Dr	69	33	6		1	do	do	Water reported slightly hard.
167	Do.	Robert Whitimore	F. L. Smith	Dr	79		6		5-6	do	Hill	
168	Do.	Mrs. R. G. Crawford	E. A. Ingold	D-Dr	84		3		2	do	do	Dug 40 feet.
169	Swepsonville	Virginia Mills Co.	W. B. Mayhew	Dr	258	70	2		2½	Diorite	do	
170	Do.	do	do	Dr	53	50	2		4	do	do	
170a	Do.	do	do	Dr	200		2	50R	5	do		
171	Do.	do	Sydnor Well Co.?	Dr	408		8	265R	25±	do	Valley	Anaylisis in table.
172	Do.	C. P. Thompson	E. A. Ingold	Dr	143		6		15	do	Hill	Supplies several homes.
173	Do.	H. E. Kirkpatrick	do	Dr	70		6	14R	1½	do	Ridge	
174	Do.	Virginia Mills Co.	do	Dr	109		6			do	Hollow	Supplies several homes, good yield reported.
175	Do.	do	Hudson Well Co.	Dr	59		6	14R	3	Greenstone	Slope	
176	Swepsonville	Virginia Mills Co.	Hudson Well Co.	Dr	65	20	6		10	Diorite	Slope	
177	Do.	do	do	Dr	71		6	7½M	15	do	Draw	Drawdown 25 feet.
178	1 mile S of Swepsonville	T. A. Burke	E. A. Ingold	D-Dr	69		6	32R	3	Slope	Hill	
179	1½ milesS of Swepsonville	H. E. Kirkpatrick		D-Dr	70		6			do		Dug 56 feet.
180	Swepsonville	W. J. Teer	E. A. Ingold	D-Dr	90		6	25R		Diorite	Hill	Dug 40 feet.
181	Do.	Mrs J. W. Burke	do	Dr	57		6		1	do	do	Water slightly hard.
182	Do.	E. L. Phillips	F. L. Smith	Dr	114		6		1±	do	Ridge	

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN ALAMANCE COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
183	Swepsonville	H. M. Marshall	E. A. Ingold	Dr	85		3		3-4	Diorite	Ridge	
184	Do.	James D. Burke	Hudson Well Co.	Dr	50	8	6	15M	4	do	Slope	
185	Do.	Alexander Wilson School	E. A. Ingold	Dr	126		6		10	do	Flat	Satisfactory supply.
186	Do.	C. M. Ray	do	Dr	110		6		5+	do	Ridge	Temperature 62½° F.; Water soft.
187	2 miles NE of Swepsonville	H. A. Scott	do	Dr	104		6		20	Greenstone	Flat	Water slightly hard.
188	Do.	Ralph Scott	F. L. Smith	Dr	92	42	6	26½M	38	do	Ridge	
189	3 miles NE of Swepsonville	J. W. Farrell	E. A. Ingold	Dr	67	15	6		1/6	do	Hill	Temperature 63° F.
190	2 miles E of Swepsonville	Negro High School	F. L. Smith	Dr	50		6	20R	15	Slate	do	
191	3½ miles NE of Saxapahaw	Clyde Shoe	do	D-Dr	40	27½	8		1	do		Dug 27½ feet.
192	½ mile N of Saxapahaw	L. B. Quackenbush	do	Dr	44±		6		4-5	do	Hill	
193	Do.	Walter Andrews	do	D-Dr	79½		6		25	do	Slope	Dug 55 feet.
194	Saxapahaw	Sellers Mfg. Co.	Heater Well Co.	Dr	168	40	6		30	do	do	Analysis in table.
195	Do.	do	F. L. Smith	Dr	204	65	6		32	do	do	
196	1 mile W of Saxapahaw	J. M. Johnson	J. C. Quackenbush	Dr	33½	12	6	12R		Granite	do	Water not hard, no iron.
197	Do.	R. A. Stanford	F. L. Smith	Dr	139	120	6		25	do	Ridge	
198	2 miles W of Saxapahaw	Mrs. J. W. Coveney	do	Dr	101	27	6	20R	1	do	Flat	Water slightly hard.
199	1 mile SW of Saxapahaw	W. L. Holt	Heater Well Co.	Dr	98	61	6	23R	16	do	Hill	Water contains no iron.
200	1 mile S of Saxapahaw	Saxapahaw School	do	Dr	119	75	6		10	do	Slope	Water slightly hard.
201	1½ miles S of Saxapahaw	Lewis Aldridge	Sedon Quackenbush	Dr	65		6	20R	25	Granite	Hill	Only a few feet of casing used.
202	3 miles SE of Saxapahaw	Eli-Whitney School	Heater Well Co.	Dr	120+	35±	6		10	Slate	Slope	
203	4 miles S of Saxapahaw	A. F. Zachery	W. P. Phillippi	Dr	47		2		4±	do	Hill	Water contains some iron.
204	Do.	A. N. McBane		Dr	72	40±	2		3-4	do	Low hill	Water very hard, some iron.
205	Do.	George Zachery	W. P. Phillippi	Dr	95	40	2		3	do	Valley	Went through quartz vein
206	5 miles S of Saxapahaw	Burton Newlin	Hudson Well Co.	Dr	58	18	6	20R	3	do	Hill	Quartz veins at 20 and 50 feet. Water hard.
207	6 miles S of Saxapahaw	Harold F. Braxton	T. A. Leadbetter	Dr	102	100	6		20	do	Ridge	Hard Water.
208	½ mile SE of Snow Camp	Logan Durham	Hudson Well Co.	Dr	68	20±	6			do	Slope	
209	1 mile SW of Snow Camp	Sylvan School	Heater Well Co.	Dr	165	90	6		7	Granite	Hill	Pumping level 50 feet below surface.
210	3 miles SW of Snow Camp	T. C. Fogleman	G. G. Clayton	Dr	64	15	6	20R	4	Slate	do	Water contains no iron.
211	Do.	T. E. Fogleman	T. A. Leadbetter	Dr	41	12	6	20R		do	Slope	Satisfactory supply.
212	2½ miles NW of Snow Camp	F. D. Hornaday	do	Dr	65		6	22R	20	do	Valley	Analysis in table.
213	3 mile NW of Snow Camp	do	do	Dr	78	60	5	40R	21	do	Flat	
214	6 miles SW of Snow Camp	J. N. Isley	G. G. Clayton	Dr	35		6		8	do	Draw	Water contains much iron
215	Do.	W. A. Lindley	T. A. Leadbetter	Dr	60		6			do	Hill	Very little water.

RECORDS OF SPRINGS IN ALAMANCE COUNTY

	Location	Owner	Yield gallons a minute	Chief aquifer	Topographic location	Remarks
A	1 mile S of Alamance	E. M. Holt School	5-10	Greenstone	Draw	Depression Spring. Has supplied school of several hundred students for more than 10 years without failure.

[1], [2], [3] Footnotes given at beginning of table.

ANALYSES OF GROUND WATER FROM ALAMANCE COUNTY, NORTH CAROLINA

(Analysts: M. D. Foster and E. W. Lohr, U. S. Geological Survey, except no. 51 which was analyzed by E. E. Randolph, N. C. State College. Numbers at heads of columns correspond to numbers in table of well data)

(parts per million)

	18	38	51	55-60	05	113	132
Silica (SiO_2)	....	....	22	31	26	....	47
Iron (Fe)	....	....	.5	.03	.02	0.01	.01
Calcium (Ca)	....	....	46	38	37	37	13
Magnesium (Mg)	....	....	3.6	13	11	12	7.2
Sodium and Potassium (Na+K)	....	....	16	13	25	10	7.3
Carbonate (CO_3)	....	....	....	0	0	0	0
Bicarbonate (HCO_3)	320	55	128	159	178	146	88
Sulfate (SO_4)	a2	a1	2.8	11	19	14	1
Chloride (Cl)	165	2.5	40	22	16	16	2.8
Fluoride (F)	....	....	....	.2	.0	....	.0
Nitrate (NO_3)	0.0	.8	....	4.5	3.5	9.1	1.0
Dissolved solids	....	....	....	221	217	....	122
Total hardness as $CaCO_3$	480	52	129	148	138	142	62
Date of collection	June 30, 1942	June 2, 1942	Nov. 27, 1937	May 22, 1942	July 7, 1942	June 2, 1942	Aug 6, 1942
Depth (feet)	58	89	600	Avg. 500	470	634	300
Chief aquifer	Schist (Slate unit)	Schist (Slate unit)	Green-stone schist	Green-stone schist	Granite	Granite	Green-stone schist

a By turbidity

ANALYSES OF GROUND WATER FROM ALAMANCE COUNTY, NORTH CAROLINA—*Continued*

(parts per million)

	139	149	171	194	212
Silica (SiO_2)	40	....	28	....	....
Iron (Fe)	.01	....	.0	0.01	0.01
Calcium (Ca)	16	....	32	6.9	7.8
Magnesium (Mg)	6.2	....	12	3.6	4.1
Sodium and Potassium (Na+K)	14	....	33	8	10
Carbonate (CO_3)	0	....	0	0	0
Bicarbonate (HCO_3)	110	44	177	50	52
Sulfate (SO_4)	2	a1	17	1.0	2.1
Chloride (Cl)	2.5	1	26	4.4	7.0
Fluoride (F)	.0	.0	.4	....	....
Nitrate (NO_3)	.0	.9	.0	1.8	4.3
Dissolved solids	129	....	233	....	....
Total hardness as $CaCO_3$	65	30	129	32	36
Date of collection	July 10, 1942	July 9, 1942	May 21, 1942	June 25, 1942	June 26, 1942
Depth (feet)	335	30	408	179	65
Chief aquifer	Greenstone schist	Greenstone schist	Diorite	Slate	Slate

a By turbidity

LOG OF WELL 50, AT HAW RIVER
(Driller's log)

	Thickness (feet)	Depth (feet)
Greenstone schist:		
Earth	14	14
Sandstone and blue flint	16	30
Blue flint	31	61
Blue flint and sandstone, drifty	9	70
Blue flint, not so hard	5	75
Blue flint and sandstone (stands on end), drifty	10	85
Blue flint (estimated total capacity of well at this depth is 3 to 5 gallons a minute)	42	127
Blue flint (estimated total capacity at this depth is 15 gallons a minute)	41	168
Hard blue granite, crevices at 185 and 190 feet (estimated yield at this depth 20 gallons a minute)	24	192
Blue flint, crevice at 200 feet, some water	8	200
Blue granite	45	245
(Tested at 250 feet; static level 30 feet, pumping level 150 feet below surface after pumping 60 gallons a minute for 25 hours.)		
Blue granite	18	263
Blue flint, with crevice at 285 feet	41	304
Gray granite (well tested at 350 feet same result as 250-foot test)	98	402
Soft blue granite	3	405
Hard blue granite	50	455
Final test: Static level 30 feet below surface, pumping level 156 feet after pumping 102 gallons a minute for 10 hours and 90 gallons a minute for 14 hours.		

(Greenstone schist crops out near the well. Virginia Machinery and Well Co., who drilled the well, report that the rock is a metamorphosed volcanic. It is evident that the "blue flint" and "blue grainte" of the driller are phases of the unit designed as greenstone schist in this report. The word "drifty" used by the driller signifies that the rock has a tendency to cause the drill to deviate from the vertical.)

LOG OF WELL 51, AT HAW RIVER
(Driller's log, slightly modified)

	Thickness (feet)	Depth (feet)
Greenstone schist:		
Clay and brown sand	22	22
Clay granite, with very hard streaks and soft seams; trickle of water at 55 feet	51	73
Rock, dark green with hard and soft spots	16	89
Granite, black, reasonably hard, no seams	50	139
Granite, white	11	150
Granite, blue and gray and white in alternating layers	82	232
Rock, dark green, sith soft spot at 237 feet	12	244
Rock, lighter green, with traces of flint	3	247
Granite, blue	18	265
Rock, light gray, moderately hard to hard	66	331
Rock, darker gray with bluish cast	15	346
Rock, dark blue, dark green and light green with some flint, in layers	50	396
Rock, very tough, dark green	16	412
Rock, light green, not so hard	7	419
Rock, dark green, with traces of flint	17	436
Granite, blue	28	464
Granite, gray	81	545
Granite, soft	4	549
Clay, white	2	551
Rock, soft light green, becoming harder	3	554
Rock, very hard, dark green	5	559
Rock, dark geen fairly hard, with some streaks of softer, lighter green rock. Material falling more or less constantly	41	600
Water veins apparently encountered at 551 and 566 feet		

LOG OF WELL 132, AT ELON COLLEGE
(Log based on examined cuttings)

	Thickness (feet)	Depth (feet)
(No samples)	90	90
Pegmatite, or coarse granite (sample marked 90 feet)	----	90
(No samples)	30	120
Granite	40	160
(No samples)	25	125
Schist, dark green, with hornblende and chlorite grains (probably a dike)	40	285
Granite	55	280
Schist (dike?), chlorite and hornblende grains	5	285
Granite	5	290

CASWELL COUNTY

(Area, 435 square miles; population, 20,032)

Geography, physiography, and drainage.—Caswell County is in the northeastern part of the Greensboro area. Its northern boundary is the North Carolina-Virginia State line. Milton is the only incorporated town, Yanceyville, the county seat, being unincorporated. The county is dominantly agricultural, having only one textile mill and a few lumber and woodworking plants.

Caswell County is in the Piedmont Upland section of the Piedmont physiographic province. The surface is the partially dissected and uplifted peneplane which was developed on the underlying crystalline rocks. A large part of the county is a nearly flat or gently rolling upland or plateau. This upland surface is interrupted in a few places by low hills which were left as monadnocks during the development of the peneplane. Stony Creek Mountain, near the center of the county's southern boundary, is the most prominent. Dissection of the upland surface has been much greater near the larger streams than elsewhere and the topography near these streams is quite irregular. The surface is particularly rugged near Dan River and near the mouths of the larger streams emptying into Dan River. The only map showing the topography of any part of the county is that of the Danville quadrangle which shows the topography of a few square miles in northwestern Caswell County. In that quadrangle Dan River has cut a gorge from one-fourth to one-half mile wide, about 250 feet below the general level of the upland surface.

All of Caswell County except the southwestern corner, which drains into Haw River by way of Stony Creek, is drained by Dan River and its tributaries. The principal tributaries in Caswell County are Hogans Creek, Moon Creek, Country Line Creek, and Hyco Creek. All of these flow to the northeast in nearly parallel courses. Their courses and those of many of the smaller streams are clearly influenced by the structure of the underlying rocks, which also strike northeast.

Geology.—Six of the nine geologic units of the Greensboro area crop out in Caswell County. These are the gneiss, sericite schist, greenstone schist, slate, sheared granite, and diorite units. The distribution of these rocks is shown on plate 1.

The gneiss underlies approximately the northwestern two-thirds of Caswell County. The principal varieties are quartz-mica-feldspar gneiss and quartz-mica schist, the schist usually containing some garnet. At many places small areas or lenses of hornblende-plagioclase gneiss or hornblende schist are also included.

The greenstone schist crops out in a belt extending northeastward across the south-central part of the county. Within this belt are the two areas mapped as diorite. Because the soil derived from greenstone schist and diorite are so similar, it is very difficult to separate these two rocks. It is probable that the area mapped as greenstone schist contains small patches of diorite and that the areas mapped as diorite contain some greenstone schist. The greenstone schist consists of green mafic igneous rocks which have undergone considerable metamorphism and are therefore commonly schistose and, at some places, gneissic. Most of these rocks appear to have originated as andesitic lava flows or tuffs and breccias. The diorite is medium gray to greenish gray and at most places is medium-grained. At many places it is relatively massive but in others is somewhat schistose.

The sericite schist crops out as a narrow tongue extending northeastward from the southwestern corner of the county nearly to the center of the county. At most places the bedrock is covered by a very thick weathered mantle. The soil and subsoil are usually red. At the few places where bedrock was seen it was a quartz-chlorite-sericite schist or quartz-sericite schist.

The sheared granite crops out in the southeastern corner of Caswell County, where it underlies an area of about 40 square miles. Another small area crops out north of Leasburg. Except in the immediate vicinity of the larger creeks the surface is quite flat. The granite in this county has all the features which are so characteristic of this unit. It is typically a light-pink coarse-grained biotite granite which has been greatly sheared and in some places has become schistose and gneissic. The biotite occurs in large deformed tabular crystals wrapping around the feldspar crystals. The granite is cut by many green mafic schistore dikes.

The slate crops out only in the extreme southeastern corner of the county, where it underlies 1 or 2 square miles. It occupies several small areas within the belt chiefly underlain by granite.

Ground water.—Practically all water supplies in Caswell County are obtained from wells or springs. Most domestic water supplies, the few industrial supplies, and both municipal supplies are obtained from wells. A few domestic supplies are obtained from springs.

Most domestic wells are dug and are generally about 20 to 50 feet deep. The water in these wells is obtained from the weathered and disintegrated rock material between the soil and the underlying bedrock. In a few places, particularly in areas underlain by granite, the solid rock is so close to the surface that wells cannot be dug deep enough to obtain satisfactory water supplies. In these areas drilled wells are used. Some dug wells failed during the drought of 1941-42, and many of these were deepened by drilling in the bottom. Most of the dug wells that failed during the drought are in areas underlain by granite.

Bored wells are used in some parts of Caswell County. Because bored wells can be constructed only in completely disintegrated materials, they are not satisfactory in some areas. The areas underlain by gneiss and schist usually have a thicker layer of weathered material than the areas underlain by granite and diorite and therefore bored wells are more satisfactory in the former.

Drilled wells are used in all types of rock but the best wells are in gneisses and schists. Table 14, below, summarizes the data for wells in Caswell County.

TABLE 14—SUMMARY OF DATA ON WELLS IN CASWELL COUNTY
(Drilled wells 3 inches or more in diameter)

ACCORDING TO ROCK TYPE

Type of Rock	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Gneiss	58	120	¼—75	9.5	0.079	12
Greenstone schist	8	150	¼—11	11.0	.073	12
Sericite schist	4	85	½—15	6.8	.079	50
Sheared granite	24	78	⅜—20	4.7	.060	25
Diorite	11	81	½—25	4.9	.060	45
All wells	105	110	¼—75	7.9	.074	20

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of wells	Average depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of well	
Hill	46	97	¼—75	5.4	0.056	33
Flat	20	117	2½—75	11.6	.099	0
Slope	29	108	½—60	7.3	.068	17
Draw	9	133	2½—55	14.9	.112	11
Valley	1	135	....	6	.045	0

According to this table the wells in greenstone schist have the greatest average yield, but because they also have the greatest average depth the yield per foot of well is less than the yield per foot of well in both the gneiss and the sericite schist. Both the yield and yield per foot of wells in granite and in diorite are much less than in the other three rock units.

Topographic location has an important bearing on the average yield and average yield per foot of well. Wells on hills have an average yield only 55 percent as large as wells at other locations and an average yield per foot of well only 65 percent as large. Wells drilled in draws have a considerably better average yield and average yield per foot of well than wells drilled at any other location. The record of the one well drilled in a valley is insufficient to use in forming any conclusions regarding the advantage or disadvantage of drilling wells in valleys.

In general, the data obtained in Caswell County indicate that the best wells are drilled in gneisses and schists and the best locations are in draws. One reason that the granite and diorite are relatively poor aquifers is the thinness of the mantle above solid rock, which does not form an adequate reservoir to collect and store the rainfall. The importance of a thick mantle is indicated by the fact that 12 wells with 30 feet or less of casing had an average yield of only 3 gallons a minute, whereas 10 wells with 31 feet of casing or more had an average yield of 12.6 gallons a minute.

Analyses were made of water samples from seven wells and one spring in Caswell County. Of the four samples from wells in gneiss, three were hard and one was moderately soft. Iron was determined on two of the samples and was 0.01 and 0.26 part per million. All four samples were predominantly bicarbonate waters. The one sample from a spring in gneiss was a moderately hard bicarbonate water. The iron content was 0.39 part per million. Of the two samples from wells in granite, one was soft and the other moderately hard. Both are bicarbonate waters. The one well in greenstone schist yields exceptionally hard water, the hardness being 402 parts per million. The iron content, 1.3 parts per million, is also high. The water is chiefly of the bicarbonate type but also contains considerable sulfate and chloride.

Temperatures of the water from wells range from 60° to 61°F. and average nearly 61°F.

Municipal supplies.—There are only two municipal water supplies in Caswell County. Both are obtained from wells.

Milton, population 329, has had a public water supply since 1940. The water is obtained from a well 312 feet deep drilled in gneiss and schist. The well, number 39 in the table, has a tested yield of 75 gallons a minute. The water is pumped by a deep-well piston pump discharging directly into the mains. An elevated tank with a capacity of 28,000 gallons is connected with the system and serves as storage. There are about 50 service taps and the average consumption is about 10,000 gallons a day. The water is not treated. An analysis of a sample of water from the well is given in the table of analyses. The water is quite hard, but the iron content is moderately low and probably causes little if any trouble. The temperature of the water was 60.5°F. on June 4, 1943.

Yanceyville, the county seat, is an unincorporated town with a population of about 500 to 600 and has been supplied with water by the Yanceyville Sanitary District since 1937. The water is obtained chiefly from a drilled well, number 87 in the table. Prior to 1943 the water was obtained from wells 79, 81, and 82. Because of the low yields and relatively large drawdowns they were rather unsatisfactory. Their location in the town made them subject to contamination, and it was necessary to chlorinate the water from wells 81 and 82. In 1943 the pipe line to the prison camp was extended to well 87 and this is now the main source of supply. This well is 183 feet deep and was tested at 75 gallons a minute for 24 hours, with a drawdown of 150 feet. The water is pumped directly into the system. An 80,000-gallon elevated tank a short distance from the center of town serves as storage and to equalize the pressure, which ranges from 45 to 50 pounds. There are about 140 service taps, and about 30,000 gallons of water is used each day. Except for chlorination of water from some of the wells, the water is not treated. Analyses of water samples from wells 79 and 82 are given in the table of analyses.

RECORDS OF WELLS IN CASWELL COUNTY

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
1	2 miles N of Pelham	T. S. Williamson	J. A. Rich	Dr	95		6¼		3	Gneiss	Flat	
2	Do	Caswell Cottages	Dan. Well Co.	Dr	90		5⅝		4	do	Slope	
3	Do	P. P. Poteat	L. S. Scearce	Dr	102	40	5			do	Hill	Good supply; soft water
4	Do	D. Farthing	do	D-Dr	75		6	25R	3	do	do	Dug 32 feet; soft water.
5	Do	Paul Fitzgerald	Dan. Well Co.	Dr	90		5⅝		4+	do	Flat	Soft water.
6	1 mile NE of Pelham	Dr. J. J. Neal	J. A. Rich	Dr						do	Slope	Satisfactory supply.
7	1½ miles E of Pelham	Dr. W. E. Dickerson	Dan. Well Co.	Dr	160		6			do	Hill	
8	Do	J. L. Cox	Setliff	Dr	60		6	30R		do	Slope	Satisfactory supply.
9	1 mile E of Pelham	Keister Jones	L. S. Scearce	Dr	61	6	6		¼	do	Hill	Moderately soft water, some iron.
10	Pelham	Sam Pryor	Dan. Well Co.	Dr	100+		6		1±	do	do	
11	Do	School	(?)	Dr	100		6		15	Schist	Draw	
12	Do	H. M. Pryor	Dan. Well Co.	Dr	135		6		6+	do	Valley	Soft water.
13	½ mile W of Pelham	R. S. Cooper	do	Dr	117		5⅝		5+	do	Hill	Moderately soft water.
14	2 miles S of Pelham	J. W. Ferguson		Dug	29		60	20½M		do		
15	Do	E. F. McGee	Dan. Well Co.	Dr	105		6		⅛	do		Insufficient supply.
16	Do	Mrs. W. H. Baise	L. S. Scearce	Dr	40		6		1-2	do	Hill	
17	Do	W. A. Baise	Dan. Well Co.	Dr	70		6		5	do	do	Soft water.
18	3½ miles SE of Pelham	C. H. Boyd	do	Dr	101½		6		5	do	Flat	
19	3 miles NW of Providence	George Carter	L. S. Scearce	Dr	100+		6		6	Gneiss	Hill	
20	Do	W. J. Gatewood	Heater Well Co.	Dr	95		6		5-10	do	Slope	
21	Providence	C. J. Fowkes	do	Dr	60		6		3½	do	Draw	
22	1 mile W of Providence	Mrs. H. A. Squires	H. L. Heater	Dr	98		6			do	Hill	Satisfactory supply.
23	Providence	Dave Van Hook		Dr	100+		6			Gneiss & Schist	do	Very small supply. Temperature 61° F.
24	Do	H. Vanhook	Heater Well Co.	Dr	70±		6			do	do	Adequate supply.
25	1 mile S of Providence	School	H. L. Heater	Dr	100		6		15	Schist	Slope	
26	1¼ miles SE of Providence	W. M. Warner	Dan. Well Co.	Dr	85		6			Gneiss	Hill	Water slightly hard. Temperature 60° F.
27	2 miles SE of Providence	John Wood	do	Dr	200		6			Geniss & Schist	do	
28	3 miles SE of Providence	Odd Cooper	do	Dr	108		6			Gneiss		
29	Do	A. D. Swanu	do	Dr	156		6			do	Slope	Adequate supply.
30	3 miles NE of Providence	W. L. Neal & L. A. Goodson, Dairy	do	Dr	140		6		3	do	Hill	Analysis in table.
31	Blanche	B. F. Allen	do	Dr	104		6		3½	do	do	
32	Do	C. S. Walters		Dr	110		6			do	Slope	Satisfactory supply; not in use.
33	Do	Stead Planning Mill		Dr	84		6		1	do	do	Not adequate supply.
34	1 mile E of Blanche	F. G. Powell	Dan. Well Co.	Dr	100		6		6	do	Hill	
35	4½ miles SW of Milton	D. D. Chandler	H. L. Heater	Dr	33		5½		3	do	do	Soft water, no iron.
36	2½ miles SW of Milton	Anna Evans	John Hopkins	Dr	48		6	33R	3	do	Slope	
37	2 miles SW of Milton	E. C. Jones	Dan. Well Co.	Dr	192	60	6		1-2	do	Hill	Soft water.
38	1 mile SW of Milton	D. O. Sunderland	do	Dr	129		6		15	do	Slope	
39	Milton	Town	do	Dr	312		6		75	do	Hill	Analysis in table. Temperature 60½° F.
40	1 mile SE of Milton	J. F. McCain	do	Dr	114		6		7-8	do	do	
41	2 miles SE of Milton	George W. Scott	do	Dr	155	25	6	50R	1½	do	Slope	
42	3 miles SE of Milton	Murphy School	do	Dr	316		6		60	do	do	
43	1 mile NW of Semora	Mr. Smith & Arch Thomas		Dr	60		6		1-2	do	Low Hill	Water contains some iron.
44	Semora	Mrs. Ella Y. McAden	E. A. Ingold	Dr	100		6		16-18	do	Draw	
45	Do	do		Dr	102		6		10-12	do	do	Water contains iron.
46	½ mile E of Semora	C. D. Allen		Dr	87		6		5+	do		
47	Semora	Mrs. P. T. Stevens	E. A. Ingold	Dr	98		6			do	Flat	
48	Do	Tom Barker	Dan. Well Co.	Dr	71		6		8-9	do		
49	½ mile S of Semora	Arch Thomas		Dr	60		6				Flat	Hard Water.
50	1½ miles SW of Semora	W. W. Pointer	Dan. Well Co.	D-Dr	93		6		7-8	Granite	do	Dug 36 feet.
51	3 miles SW of Semora	Walter Rogers	Dan. Well Co.	Dr	113		6	46R	12-16	Gneiss	Draw	Water slightly hard.
52	Do	George Rogers	Heater Well Co.	Dr	258	53	6	45R	2	do	Hill	
53	2 miles S of Semora	C. G. Chandler	Adair	Dr	106		6		10-12	do	Flat	Not in use; casing has rusted out.
54	3 miles S of Semora	C. R. Thomas	do	Dr	84	4½	6		¼-½	Granite	Hill	
55	4 miles SW of Semora	George Tatum	Dan. Well Co.	Dr	80		6		½-1	do	do	Hard water.
56	Do	do		Dr	100	8	6		2-3	do	Slope	Do
57	3½ miles NW of Leasburg	G. M. Wrenn		Dr	72	8?	6		½	do		Do
58	3¼ miles NW of Leasburg	J. B. Stacy		Dr	75?		6			do	Flat	Adequate supply.
59	3 miles NW of Leasburg	Robert Briggs	H. L. Heater	Dr	49		6	30R	5+	do	Slope	Water moderately soft.

[1] Vir. Mach. Co.=Virginia Machinery & Well Co.,; Dan. Well Co.=Danville Well Drilling Co.; Sydnor Well Co.=Sydnor Pump & Well Co.
[2] Dr=Drilled, Br=Bored, Cr-Dr=Core Drilled, B-Dr=Bored and Drilled, D-Dr= Dug and Drilled.
[3] Depth to water from land surface; R=Reported, M=Measured.

RECORDS OF WELLS IN CASWELL COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
60	Leasburg	School		Dr	100		6		8	Greenstone	Flat	
61	2 miles W of Leasburg	J. A. Denny	?	Dr	156		6		3–4	do	Slope	Water slightly hard.
62	3½ miles W of Leasburg	W. P. Lundsford	H. L. Heater	Dr	66		6		2–3	Granite	do	
63	Do	P. P. Willis	do	Dr	62		5½		2±	Greenstone		Water quite hard.
64	Do	L. A. Reynolds		Dr	70		6			do	Slope	Adequate supply, hard water.
65	Do	Benton Stacey	H. L. Heater	Dr	52		5½			do	do	Very satisfactory supply.
66	4 miles SW of Leasburg	S. T. Richmond	L. S. Scearce	Dr	72		6	20R		do	Flat	Adequate supply; hard water.
67	Do	U. S. Defence Plant Corp. Plantation Pipe Line Co.	Vir. Mach. Co.	Dr	485		8	42R	55	do	Draw	Analysis and log in tables. Drawdown 68 feet. Temperature 61° F.
68	2 miles SE of Pleasant Grove	W. B. McCain	H. L. Heater	Dr	66		6		3	do	Slope	Soft water.
69	Do	W. T. Hicks	Dan. Well Co.	Dr	47½		6		¼–½	do	Hill	Supply inadequate.
70	1 mile S of Pleasant Grove	R. P. Fuquay	do	Dr	115		6		5	Gneiss	do	Hard Water.
71	½ mile S of Pleasant Grove	M. T. Pleasant		Dug	37		30	30R		do		Failed in summer of 1942.
72	1 mile NE of Pleasant Grove	J. H. Lunsford	H. L. Heater	Dr	44		6	25R	2–3	do	Slope	
73	Pleasant Grove	G. O. Barts	do	Dr	66	20?	6		2–3	do	Hill	Moderately soft water; inadequate supply.
74	Do	A. J. Fuquay	do	Dr	60+		6		1	do	Slope	
75	1 mile W of Pleasant Grove	U. S. Soil Conservation Service	Dan. Well Co.	Dr	80		6		35	do	Hill	
76	3½ miles NE of Yanceyville	G. W. Davis	H. L. Heater	Dr	65		5½		4–5	Gneiss	Slope	Moderately soft water.
77	4½ miles NE of Yanceyville	Mrs. Ola D. Jiles		Dr			6–4		2–3	do		Water rusty from old casing.
78	Do	J. W. Chaney	?	Dr	58		6		2–3	do	Flat	
79	Yanceyville	C. C. Cole & McSwain	Dan. Well Co.	Dr	103	60	6	30R	15+	do	Slope	Analysis in table. Temperature 61° F.
80	Do	School	?	Dr	200		6		5	do	Flat	
81	Do	Yanceyville Sanitary District	Dan. Well Co.	Dr	180±		6	35R	15	do	do	Temperature 61° F.
82	Do	do		Dr	400		8		12	do	Slope	Analysis in table. Temperature 61° F.
83	Do	County Jail	Dan. Well Co.	Dr	288		6		10	do	Flat	
84	Do	T. D. Boswell	L. S. Scearce	Dr	99		6		2–3	do	Draw	
85	1½ miles SW of Yanceyville	Mrs. W. C. Martin		Dr	90		6	40R		do	Slope	
86	2½ miles SW of Yanceyville	Wilson Chandler	F. L. Smith	Dr	57		6		1–2	do	Hill	Hard water.
87	1 mile N of Yanceyville	C. C. C. Camp	Dan. Well Co.	Dr	183	61	6¼	14R	75	do	Flat	Drawdown 150 feet.
88	1½ miles NW of Yanceyville	Sunderland-Edmunds Lumber Co.	do	Dr	132		6	25R	7	do	Slope	Temperature 61° F.
89	2 miles NW of Yanceyville	Coble Dairy Co.		Dr	109		6		15	do	Draw	
90	Do	H. H. Page	Dan. Well Co.	Dr	94	70	6		10	do	Low Hill	Water slightly hard.
91	Bethel	T. B. Low	Heater Well Co.	Dr	112	60±	6		4–5	do	Flat	
92	1½ miles SW of Bethel	F. M. Low	Dan. Well Co.	Dr	160		6		1	do	Hill	
93	2 miles SW of Bethel	Cobb Memorial School		Dr	200		6		10	do	Low hill	
94	3 miles W of Bethel	W. W. Williamson		Dr	170+		6			do	Hill	
95	4 miles SW of Bethel	Rufus Womak	H. L. Heater	D-Dr	100		6			do	Flat	Dug 65 feet. Large supply of soft water reported.
96	5½ miles SW of Bethel	J. B. Watlington	Well Drillers Inc.	D-Dr	103		6		1–	do	Hill	Dug 65 feet.
97	1½ miles NW of Cherry Grove	Steve Rice	New	Dr	87		6		2–3	do	do	Soft water.
98	1 mile W of Cherry Grove	J. H. Saunders	do	Dr	84		6		1	Schist	do	Water slightly hard.
99	Cherry Grove	Paul Bolden	Odell Garrison	Dr	56	27	6	46R	½±	do	do	Do
100	Do	Cherry Grove School	Heater ?	Dr	100		6		10±	do	Flat	
101	1 mile SW of Cherry Grove	J. H. Saunders		Dug	39		66	33M		Schist		

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN CASWELL COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
102	3½ miles S of Yanceyville	W. A. Totten	F. L. Smith	Dr	55±		5		½	Gneiss	Slope	Soft water.
103	Do	A. J. Garrison	do	Dr	89		5		1–2	do	do	Hard water.
104	5 miles S of Yanceyville	O. M. Dabbs	H. L. Heater	Dr	48		5	40R	1	Diorite	Hill	Do
105	5½ miles S of Yanceyville	L. H. Smith	?	Dr	80		5		1–	do	do	
106	6 miles S of Yanceyville	D. O. Chandler	F. L. Smith	D-Dr	120		6		2–3	do	do	Dug approximately 70 feet.
107	Do	do	do	Dr	30		6		1	do	Draw	Soft water.
108	Do	J. T. Fitch	do	D-Dr	148		6		25	do	Slope	Dug 74 feet.
109	3 miles NW of Anderson	Lawrence Walker	Dan. Well Co.	Dr	60+		6		1–2	do	Flat	Water does not clear.
110	3 miles N of Anderson	W. E. Byrd	do	Dr	117		6		1–2	do	Hill	
111	Do	do	F. L. Smith	D-Dr	99		6		15	do	do	
112	Do	A. C. Byrd	do	D-Dr	66½		6	45R	3½	do	do	Dug 47 feet.
113	2½ miles N of Anderson	Henry Aldridge	do	Dr	63		6	40R	½	do	do	
114	Do	C. P. Aldridge	do	D-Dr	60		6	26R	1	do	Slope	Dug 38 feet.
115	2 miles N of Anderson	A. J. Massey	do	D-Dr	78		6		4–5	Granite	do	Dug 25 feet. Soft water, some iron.
116	Anderson	Anderson School		Dr	99		6		10	Greenstone	Flat	
117	2 miles E of Anderson	J. M. Baynes		Dug	27		24	14R		Granite		Large supply of water. Analysis in table.
118	3 miles NE of Anderson	Dr. C. R. Wharton	?	Dr	101		6	54R	6±	Greenstone	Flat	Hard water
119	4 miles E of Anderson	J. Louis Hooper	Heater Well Co.	Dr	92	28	6		½	Granite	Slope	Soft water.
120	1 mile W of Hightowers	Raymond Cobb	H. L. Heater	Dr	70		6		1½	Greenstone	Hill	Hard water.
121	Do	Henry Meyer	Dan Well Co.	Dr	110		5½		–¼	do	do	Hard water. Insufficient supply.
122	3 miles NE of Hightowers	Alice R. Fuqua		Dr	78½	6	6		3±	do	Slope	
123	2½ miles E of Hightowers	W. D. Blaylock	Muse & Clark	Dr	86		6		10±	Granite		Not used.
124	3 miles E of Hightowers	C. J. Long	do	Dr	76		6	39R	6	do	Hill	Water slightly hard.
125	Do	E. W. Long	W. H. Muse	Dr	86		6		6	do	Slope	
126	2½ miles E of Hightowers	W. D. Blaylock	L. S. Scearce	Dr	84	50	6	46R	5+	Granite		
127	1½ miles E of Hightowers	A. H. Oakley	Muse & Clark	Dr	72		6	66R		do	Hill	
128	1½ miles SE of Hightowers	D. S. Smith	Heater Well Co.	Dr	110	45	6⅝		¾	do	do	Water slightly hard.
129	2 miles SE of Hightowers	W. M. Riggs	Jesse Herb	Dr	114		6		2–3	do	Slope	Hard water.
130	3½ miles N of Propect Hill	R. W. Watson	Dan. Well Co.	Dr	110±		6			do	Flat	Temperature 60° F.
131	Do	W. A. Wilson	Muse & Clark	Dr	58		6			do	Hill	
132	3 miles N of Prospect Hill	Charles Barnwell	do	Dr	48		6		10±	do	do	
133	3 miles NW of Prospect Hill	C. P. Murphy	Heater Well Co.	Dr	68	20	6⅝		2	do	Slope	Soft water.
134	Do	do		Dr	82		6		½	do	Hill	Hard water.
135	2½ miles NW of Prospect Hill	Lester Blaylock	Muse & Clark	Dr	43	38	6	15R	2	do	do	
136	2¼ miles NW of Prospect Hill	H. F. Blaylock		Dr	45		6		2–3	do	do	
137	2¾ miles N of Prospect Hill	W. L. Compton	Dan. Well Co.	Dr	140	120	6	16⅔M	10	do	Flat	Analysis in table.
138	2½ miles NE of Prospect Hill	E. A. Carver		Dr	72		6			do	Hill	
139	1½ miles N of Prospect Hill	W. R. Morgan	Dan. Well Co.	Dr	99		6	20R	10	do	Flat	Hard water, no iron.
140	1¼ miles N of Prospect Hill	F. P. Riggs	do	Dr	42	10	6	12R	20	do	do	Water slightly hard.
141	Do	High School	?	Dr	100		6		12	do	do	
142	1 mile N of Prospect Hill	H. J. Long		Dr	83		6			do	do	
143	2½ miles W of Prospect	C. T. Roberts	C. C. Oakley	Br	28	28	15	15R	½	do		
144	Do	C. P. Murphy		Dr	70		6	30R	1½	do	Hill	

RECORDS OF SPRINGS IN CASWELL COUNTY

	Location	Owner	Name	Yield gallons a minute	Chief aquifer	Topographic location	Remarks
A	2½ miles SW of Providence	Danville Kiwanis Club	Park Springs	½±	Gneiss	Valley	Seepage spring with concrete curbing. Analysis in table. Several other undeveloped seepage springs feed branch.

[1], [2], [3] Footnotes given at beginning of table.

Analyses of Ground Water from Caswell County, North Carolina

(Analysts: E. W. Lohr, William L. Lamar, and Evelyn Holloman, U. S. Geological Survey. Numbers at heads of columns correspond to numbers in table of well data)

(parts per million)

	30	39	67	79	82	117	137	A
Silica (SiO_2)		39	31	43				
Iron (Fe)		.26	1.3	.01				.39
Calcium (Ca)		41	95	14				
Magnesium (Mg)		8.8	40	5.7				
Sodium and Potassium (Na+K)		12	21	9.8				
Carbonate (CO_3)		0	0	0				
Bicarbonate (HCO_3)	146	133	304	54	133	110	54	98
Sulfate (SO_4)	a12	17	76	4.0	a75	a2	a4	a20
Chloride (Cl)	28	26	85	17	15	22	2.5	3
Fluoride (F)	.5	.1	.0		.9		.0	.8
Nitrate (NO_3)	30	.2	.3	9.0	7.8		.0	.2
Dissolved solids		219	544	141				
Total hardness as $CaCO_3$	154	138	402	58	100	92	33	76
Date of collection, 1943	June 1	June 4	June 14	June 1	June 1	June 3	May 31	June 2
Depth (feet)	140	335	485	103	400	27	140	Spring
Chief aquifer	Gneiss	Gneiss	Greenstone schist	Gneiss	Gneiss	Granite	Granite	Gneiss

a By turbidity

Log of Well 67, 2½ Miles Southeast of Pleasant Grove

	Thickness (feet)	Depth (feet)
Greenstone schist:		
Clay	12	12
Sandrock	17	29
Granite, hard	16	45
Flint, white	4	49
Granite, gray	16	65
Rock, soft black	2	67
Granite, gray	38	105
Rock, blue	41	146
Rock, Gray	31	177
Rock, white	92	269
Granite, blue	41	311
Flint, white	8	319
Flint and granite streaks	13	332
Flint, white	25	357
Granite, blue	7	364
Flint, white	6	370
Granite, blue	51	421
Flint, white	10	431
Granite, blue	35	466
Granite, gray	19	485

(Note: the rock exposed at the surface in the vicinity of the well was greenstone schist. The green color is in part caused by weathering, so that cuttings from a well do not have the prominent green color of the rocks at the surface. It is probable that the gray and blue granite and gray and blue rock are phases of the greenstone schist. The white flint undoubtedly is quartz but it is doubtful that the intervals shown as white flint actually are entirely quartz. It is probable that most of the intervals shown as white flint represent several quartz veins separated by schist. The quartz would naturally show up more prominently in the drillings when they were bailed from the well, so that the interval would be logged as white flint.)

FORSYTH COUNTY

(Area, 424 square miles; population, 126,475)

Geography, physiography, and drainage.—Forsyth County, in the southwestern corner of the Greensboro area, is the smallest of the six counties but has the second largest population. There are only one incorporated city and one incorporated town in the county, but there are about six unincorporated towns and villages. Winston-Salem, near the center of the county, is the only large city and is primarily a manufacturing city. The chief products are cigarettes and other tobacco products, textiles, and furniture. The principal occupation in the rest of the county is agricultural. Forsyth County is served by a network of paved highways radiating from Winston-Salem, and by four railway systems.

Forsyth County is near the western edge of the Piedmont physiography province. Its surface is formed by the uplifted and partially dissected peneplane of that province. The topography in Forsyth County is somewhat more rugged than it is in any other county of the Greensboro area except Stokes County. The large flat areas so prominent in parts of Alamance, Caswell, Guilford, and Rockingham Counties are not nearly so prominent in Forsyth County. Probably the largest flat area in Forsyth County is one extending north and south of Kernersville. Other notable areas where dissection is slight are in the vicinities of Walkertown, Lewisville, and Clemmons and south of Rural Hall. Naturally enough, dissection has been much greater near the larger streams and the topography in those areas quite commonly has a relief of 150 to 250 feet. Probably the most rugged areas are along the Yadkin River and in the northeastern corner of the county in the vicinity of Belew Creek. No topographic maps are available for any part of the county. The altitude of the upland surface generally ranges from about 800 to more than 1,000 feet. The lowest altitudes are where the Yadkin River leaves the county at Idols and in the northeastern corner of the county on Belews Creek. The altitude at both places is probably somewhat below 700 feet. The highest recorded altitude is 1,027 feet at Kernersville, although it is probable that there are higher places in the northwest corner of the county.

About 80 per cent of the county is drained by the Yadkin River and its tributaries, the most important of which are Muddy Creek, Salem Creek, South Fork (of Muddy Creek), and Abbots Creek. Most of the remaining 20 percent of the county is in the northeast corner and is drained by several northward-flowing streams that empty into Dan River. The principal streams of that area are Belews Creek and its tributaries, East and West Belews Creeks. A very small area northeast of Kernersville drains into Haw River via Reedy Fork and a similar small area southeast of Kernersville drains into Deep River.

Geology.—Only two of the geologic units of the Greensboro area are exposed in Forsyth County. These are the gneiss unit and the porphyritic granite.

About 85 percent of the county is underlain by gneiss. The gneiss unit consists chiefly of quartz-mica-feldspar gneiss, quartz-mica schist and quartz-feldspar-mica schist. Also included are some feldspar-hornblende gneisses and hornblende schist. The larger part of this unit apparently is of sedimentary origin, although metamorphism has been so great as to alter the rock almost completely from its original character. At many places the bedding is prominent and the structure can be mapped. The bedding strikes generally northeastward and at most places dips southeastward at a moderate angle. The porphyritic granite unit crops out chiefly along the southern boundary and in the southeast corner of the county, although a fairly large area crops out west of Belew Creek and a small area is exposed at Lewisville. The granite is intimately intruded into the gneiss at many places, apophyses and stringers of the granite from a few inches to many feet thick cutting across or following along the structure. At some places the gneiss contains large amounts of large feldspar phenocrysts, which evidently formed from emanations of the granitic magma. At nearly all exposures the granite is a light to medium gray coarse rock with many large feldspar phenocrysts. At only one place, about 1½ miles northwest of Union Cross on U. S. Highway 311, was nonporphyritic granite observed. The granite there is a nearly white moderately fine-grained, equigranular garnetiferous granite.

Ground water.—Nearly all domestic water supplies, most industrial supplies, and one of the three municipal water supplies in Forsyth County are obtained from wells.

Dug wells are used for most domestic supplies. They generally range in depth from about 20 to 60 feet. Because the gneiss is weathered rather deeply at most places, the wells can be dug deep enough to furnish a satisfactory water supply even during periods of drought. Relatively few wells failed in Forsyth County during the drought of 1941-1942.

Bored wells are used to some extent and generally are satisfactory. Because of the deep weathering of the rock, wells can be bored deep enough at most places to obtain adequate yields for domestic purposes.

Almost all wells for industrial purposes and for municipalities and public institutions are drilled, and in most parts of Forsyth County satisfactory yields can be obtained from drilled wells. At a few places underlain by gneiss, particularly Clemmons and Walkertown, some of the wells have not yielded enough water. The porphyritic granite appears to be a much less satisfactory aquifer than the gneiss. Table 15, below, gives a summary of data on drilled wells in Forsyth County.

TABLE 15—SUMMARY OF DATA ON WELLS IN FORSYTH COUNTY
(Drilled wells 3 inches or more in diameter)

ACCORDING TO ROCK TYPE

Type of Rock	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Gneiss	107	232	0—125	20.0	0.090	3.7
Porphyritic granite	9	199	0— 15	7.8	.039	11
All wells	116	224	0—125	19.1	.086	4.3

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Hill	37	214	0—125	11.2	0.052	16.2
Flat	17	195	2— 75	14.0	.072	0
Slope	28	176	2—100	18.1	.103	0
Draw	17	211	6— 85	28.8	.136	0
Valley	17	337	0—100	33.1	.098	5.9

The average yield of wells in gneiss is 20 gallons a minute, more than 2½ times as great as the average yield of wells in granite. However, the average depth of wells in gneiss is also somewhat greater, so that the difference in average yield per foot of well between wells in gneiss and wells in granite is less. In comparison with other counties, Forsyth County ranks second to Guilford County in average yield of wells. However, because of the greater average depth of wells in Forsyth County, both Guilford and Alamance Counties have a greater average yield per foot of well.

As in the other counties, topographic location has an important bearing on the yield of a well. The 37 wells drilled on hills have an average yield less than half that of wells drilled at other locations, and the average yield per foot of well is only slightly more than half as great as it is for wells drilled at other locations. It is apparent from the table that draws are the best location in which to drill wells. Although the average yield of wells in draws is less than the average yield of wells drilled in valleys, the average yield per foot of well is 39 percent greater.

Analyses of water samples from five wells in Forsyth County are given in the table of analyses. Four of these analyses are of water from wells in gneiss and one is of water from a well in granite. The waters range from soft to very hard. The hardness of the water correlates quite closely with the depth of the well; the deeper the well, the greater is the hardness. The iron content of all samples was very low.

Temperatures range from 59 to 60½°F. and average 60°F.

Municipal supplies.—There are three public water supplies in Forsyth County, one obtained from wells and two from streams.

Kernersville, population 2,103, first obtained its water supply from wells. The well supply was abandoned in 1927 because of failure of the wells to supply sufficient water. The town now obtains its water from a small creek about 1 mile west of Kernersville. A dam 10 feet high impounds about 7,500,000 gallons of water in a lake covering 8 acres. The water is pumped to the filter plant at the west edge of town by two electrically driven centrifugal pumps with a total capacity of 900 gallons a minute. Treatment consists of the addition of lime and alum, settling, chlorination, filtration, post-chlorination, and addition of Calgon. The water flows from the filter plant to a 300,000-gallon round concrete clear-water reservoir. It is pumped into the mains by two electrically driven centrifugal pumps with a total capacity of 1,300 gallons a minute. An elevated tank near the center of town serves as additional storage and to equalize the pressure. The capacity of the filter plant is 1,000,000 gallons a day. There are 477 service taps and 64 hydrants. The maximum consumption is about 250,000 gallons a day and the average consumption is about 200,000 gallons a day.

Rural Hall, an unincorporated town with a population of about 425, has had a public water supply since 1940. The water supply, which is owned and operated by the Rural Hall Sanitary District, is obtained from a well 350 feet deep, number 3 in the table of well data. The well was tested at 125 gallons a minute and is pumped by a turbine pump at 65 gallons a minute. The well is on a sharp hill and is drilled in gneiss. The water is pumped directly into the mains without treatment. A 75,000-gallon elevated tank is used for storage and to equalize the water pressure. Maximum pressure is about 70 pounds and the minimum is about 48 pounds. There are 135 service taps. Consumption averages about 35,000 gallons a day.

Winston-Salem, population 79,815, has had a municipal water supply since 1890. The water is obtained from Salem and Walker Creeks and Brushy Fork east of the city. A dam on Salem Creek impounds a lake of 1,000,000,000 gallons on Salem and Walker Creeks and a dam on Brushy Fork impounds a lake of 125,000,000 gallons. The water flows by gravity to the filter plants. Treatment consists of prechlorination, settling with alum and lime, filtration, and break-point chlorination. The two clear-water reservoirs have a total capacity of 4,000,000 gallons and two elevated tanks have a capacity of 1,250,000 gallons. The maximum consumption is about 10,000,000 gallons and the average is about 8,000,000 gallons a day.

RECORDS OF WELLS IN FORSYTH COUNTY

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
1	6 miles NW of Bethania	Gray Petree	R. E. Faw	Dr	167	....	6	64R	3–4	Gneiss	Hill	....
2	3 miles NW of Bethania	Old Rich School	M. A. Holder	Dr	130	....	6	....	10	do	do	Analysis in table.
3	Rural Hall	Rural Hall Sanitary District	Well Drillers Inc.	Dr	350	90	8	70R	125	do	do	Do
4	Do	Rural Hall School	M. A. Holder	Dr	300	....	6	....	40±	do	Flat	Not used since city water available.
5	4 miles E of Rural Hall	Memorial Industrial School	do	Dr	150±	....	6	....	10	do	Slope	....
6	4 miles SE of Rural Hall	R. L. Clayton	Well Drillers Inc.	Dr	90	....	6	....	2–3	do	do	....
7	4½ miles SE of Rural Hall	W. M. Scott	J. R. Cummings	Dr	500	40±	6	....	10	do	Hill	Hard water.
8	5 miles SE of Rural Hall	Alvin Crowder	Well Drillers Inc.	Dr	123	90	6	....	5	Schist	Slope	....
9	5¼ miles SE of Rural Hall	N. E. Brewer	do	Dr	137	....	6	....	10	Gneiss	Hill	....
10	3½ miles N of Walkertown	C. S. Zimmermon	....	Dug	60	60	36	55R	....	do	Flat	....
11	6 miles N of Walkertown	S. N. Johnson & Son	....	Dug	40	40	48	35M	....	do	....	Soft water.
12	3 miles NW of Walkertown	Y.W.C.A. Camp	M. A. Holder	Dr	175	....	5⅝	....	10	Schist	....	....
13	4 miles S of Belew Creek	H. F. VonHoy	J. R. Cummings	Dr	40	20	6	....	2	Gneiss	Slope	Soft water.
14	2½ miles S of Belew Creek	H. T. Lewis	do	Dr	126	35±	6	....	¼	do	Hill	Do

[1] Vir. Mach. Co.=Virginia Machinery & Well Co.,; Dan. Well Co.=Danville Well Drilling Co.; Sydnor Well Co.=Sydnor Pump & Well Co.
[2] Dr=Drilled, Br=Bored, Cr-Dr=Core Drilled, B-Dr=Bored and Drilled, D-Dr= Dug and Drilled.
[3] Depth to water from land surface; R=Reported, M=Measured.

RECORDS OF WELLS IN FORSYTH COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
15	2 miles SE of Walkertown	O. F. Redmond	Bishop	Dr	77	77	5	30R		Gneiss		Not used. Good supply reported.
16	1 mile NE of Walkertown	John H. Clement	do	Dr	82		4			do		Not used. Formerly furnished large amount.
17	Do	do	J. R Cummings	Dr	147	40	6		25	do	Hill	
18	Walkertown	School	M. A. Holder	Dr	200		6		4–5	do	do	
19	Do	do	do	Dr	453		5⅛	40R	15	do	Draw	Drawdown reported 30 feet.
20	2 miles W of Walkertown	Camp Lasater	do	Dr	330		5⅝		6	do	Valley	
21	3 miles SW of Walkertown	White Rock School	do	Dr	140		6		8–10	do	Hill	
22	2 miles SW of Walkertown	J. B. Seivers		Dug	26	26	36	12½M		do		
23	3 miles NE of Winston-Salem	Carver Colored School	M. A. Holder	Dr	702		6		3	do		
24	2½ miles N of Winston-Salem	Smith-Reynolds Airport	Well Drillers Inc.	Dr	200	20	8	14R	50	do	Draw	Water obtained from fracture at 190 feet.
25	Do	Mineral Springs School No. 1	J. R. Cummings	Dr	140		6		8–10		Slope	
26	2 miles N of Winston-Salem	Old Dominion Box Co.		Dr	50±		1¼		15		Valley	Reported to have flowed when drilled.
27	2½ miles N of Winston-Salem	R. J. Reynolds Co.	M. A. Holder	Dr	408		6		40–45	Gneiss	Draw	Water contains much iron
28	Do	do	Bishop	Dr	320?		5		30–35	do	do	
29	2¾ miles N of Winston-Salem	Pilot Freight Carrier	Well Drillers Inc.	Dr			6			do	Flat	
30	3 miles N of Winston-Salem	State Prison Camp 805	J. R. Cummings	Dr	160		6	28R	20	do	Slope	
31	Do	T. W. Garner Food Co.	Well Drillers Inc.	Dr	400		6		6	do	do	
32	Do	do	do	Dr	200		6		7	do	do	
33	3½ miles N of Winston-Salem	T. R. Starr	J. R. Cummings	Dr	305		6		18–20	do	Flat	
34	Do	J. M. Shouse	do	Dr	250		6	40R	13	do	do	
35	4½ miles N of Winston-Salem	Mineral Springs School No. 2	do	Dr	140		6		8–10	do	Slope	
36	5½ miles N of Winston-Salem	Forsyth County Sanitorium	do	Dr	385		8	55R	20	do	Hill	Originally tested at 55 gallons a minute, now yielding 18–20.
37	6½ miles N of Winston-Salem	Forsyth County Home	Clayton & Cummings	Dr	315		8		90	do	Slope	
38	Do	R. M. Cox, Dairy	M. A. Holder	Dr	150		5⅛	3R	16	do	Draw	
39	2¾ miles SE of Bethania	WSJS Broadcasting	Well Drillers Inc.	Dr	70		6	1R	12–15	do	Valley	
40	1¼ miles E of Bethania	Dr. W. N. Walker	do	Dr	81		6		10+	do	Slope	
41	1 mile SE of Bethania	W. H. Yarborough	J. R. Cummings	Dr	90	45	6		?	do		
42	1¼ miles SE of Bethania	J. Lee Keiger	M. A. Holder	Dr	150		5⅛		85	do	Draw	
43	Do	Old Town School	J. R. Cummings	Dr	220		6		12+	do	Hill	
44	½ mile SE of Bethania	Harry P. Taylor	do	Dr	375		6¼		10	do	do	
45	Do	do	do	Dr	252		6	50R	7–8	do	Slope	
46	1½ miles SW of Bethania	O. T. Fowler, Z. B. Gambill	Well Drillers Inc.	Dr	133		6	23R	12–15	do	Draw	
47	2½ miles NW of Vienna	Dr. J. C. Carlton	M. A. Holder	Dr	275		5⅛		6			
48	Vienna	Vienna School	do	Dr	225		6		10–12		Hill	
49	2 miles W of Vienna	H. S. Stokes	do	Dr	200		5⅛		50		Slope	
50	3 miles SW of Lewisville	Frank C. Martel	do	Dr	240		6		½±		do	Water slightly hard.
51	3 miles SW of Lewisville	Frank C. Martel	Heater Well Co.	Dr	100	38	6		10	Gneiss	Draw	Water slightly hard.
52	3½ miles SW of Lewisville	High Point Power Project		Dr	440		10		15	do		
53	1 mile SW of Lewisville	Larry Tucker	Well Drillers Inc.	Dr	120		6		3	do	Hill	Soft water.
54	Lewisville	Mrs. Annie Ogburn	M. A. Holder	Dr	275		5⅝		2	Granite	Flat	
55	Do	Lewisville School	do	Dr	525		6		8	do	Hill	
56	1 mile S of Lewisville	M. A. Braswell	Well Drillers Inc.	Dr	80	30	6		7–8	Gneiss	Valley	Soft water.
57	2¾ miles S of Lewisville	Wm. Harper	M. A. Holder	Dr	190		5⅝		4	do	Slope	
58	2 miles E of Lewisville	Smith Estate	do	Dr	75		5⅝		6	Granite	Hill	

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN FORSYTH COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
59	4 miles E of Lewisville	J. M. Vogler	M. A. Holder	Dr	400		5⅝		½	Gneiss	Hill	
60	Do	C. F. Coble	Well Drillers Inc.	Dr	180	27	6		2½	do	do	
61	3 miles E of Lewisville	Ira Speas	M. A. Holder	Dr	340		5⅝		0	do	Valley	Not used; supply insufficient.
62	5 miles W of Winston-Salem	Mrs. O. E. Holder	do	Dr	175		5⅝		10	do		
63	4½ miles NW of Winston-Salem	Mt. Tabor Church	do	Dr	330		5⅝		6	do	Flat	
64	1½ miles W of Hanes	South Fork School	do	Dr	225		5⅝		8+	do		
65	¾ mile SW of Hanes	Emery Burke	do	Dr	201	125	5⅝	30R	8	do	Hill	Temperature 60½° F.; water slightly hard.
66	Hanes	P. H. Hanes Knitting Co.		?	80	80	2		10	do	Valley	Six other wells, 40 to 80 feet deep; all pumped as a unit yield 54 gallons a minute
67	Do	do		Dr	150–200		5		16	do	do	Pumping level about 30 feet. Soft water.
68	Do	do	M. A. Holder	Dr	102		5⅝	32R	15	do	Ridge	Reported drawdown 30 feet at 10 gallons a minute.
69	Do	do		?	64±	64±	2		24	do	Valley	Combined yield of this and seven similar wells is 24 gallons a minute, Flowed when drilled.
70	Do	Grapette Bottling Plant	Well Drillers Inc.	Dr	323		6		30	do	Slope	
71	Do	Mrs. G. F. Feezor	M. A. Holder	Dr	75		5⅝		9	do	do	Water moderately soft.
72	1 mile NE of Hanes	Selected Dairies Co.	Well Drillers Inc.	Dr	348		6		30	do	do	
73	Do	do	M. A. Holder	Dr	410		6		13	do	do	Tested at 38 gallons a minute, but did not hold up.
74	Do	R. E. Lasater; Smoke House	do	Dr	538		6		50	do	do	Will not hold up to 50 gallons a minute if pumped continuously.
75	2½ miles W of Winston-Salem	C. C. Hauser	do	Dr	350		5⅝		15+	do		
76	Do	Jack Glen	M. A. Holder	Dr	350		5⅝		16	Gneiss	Valley	
77	3 miles NW of Winston-Salem	R. J. Reynolds, Jr.	J. R. Cummings	Dr	400		6		25	do	do	
78	Do	do	do	Dr	425		6		35	do	do	Temperature 59½° F.
79	3½ miles NW of Winston-Salem	John Whitaker	M. A. Holder	Dr	206		5⅝		6	do	Draw	
80	Do	do	do	Dr	134		5⅝		50	do	do	
81	3¼ miles NW of Winston-Salem	J. B. Harper	do	Dr	600		5⅝		7	do		
82	3 miles NW of Winston-Salem	Dan Drummond	do	Dr	125		5⅝		5	do		
83	2¾ miles NW of Winston-Salem	Graylyon Estate	do	Dr	120		6		55	do	Draw	Water slightly hard.
84	Do	R. E. Norfleet Estate	do	Dr	275		4		3	do		
85	3 miles NW of Winston-Salem	Mrs. C. A. Babcock		Dr	45		4		18	do	Valley	Two wells, combined flow 18 gallons a minute (wells are not pumped, but overflow at surface.)
86	2½ miles NW of Winston-Salem	C. W. Myers	Well Drillers Inc.	Dr	140		6		20	do		
87	Winston-Salem	Peerless Ice Cream Co.	W. A. Chambers	Dr	198		10	6R	100	do	Valley	Water enters well at 73 and 150 feet.
88	Do	Crystal Ice & Coal Co.	?	Dr	140±		6		43+	do	do	Temperature 61° F.
89	Do	Taylor Tobacco Co.	Well Drillers Inc.	Dr	420		6		21	do	do	
90	Do	Brown-Williamson Tobacco Co.	do	Dr	401	75	6		100	do	Slope	Water enters well at 375 feet.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN FORSYTH COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
91	Winston-Salem	Southern Dairies Co.	M. A. Holder	Dr	324	118	5⅝		17½	Gneiss	Slope	Water from 118 feet. Not used at present
92	Do	Colonel Stores, Inc.	L. R. Hartsell	Dr	237		4		2–3	do	Hill	
93	Do	R. J. Reynolds Co., Power Plant	Well Drillers Inc.	Dr	714	100±	6		40	do	Valley	Most of water from 200 to 250 feet. Analysis in table.
94	Do	R. J. Reynolds Co., Foil Plant	M. A. Holder	Dr	316		6		35	do	do	
95	Do	Carolina Narrow Fabric Co.	Well Drillers Inc.	Dr	268		6		24	do	Slope	Reported hardness about 75 parts per million.
96	Do	Hanes Hosiery Mills Co., No. 1	R. E. Faw	Dr	241		8	48R		do	Valley	Very poor yield, not used.
97	Do	Hanes Hosiery Mills Co., No. 2	do	Dr	211	32	8	46R	30	do	do	Well is crooked, pump cylinder cannot be set below about 65 feet.
98	Do	Hanes Hosiery Mills Co., No. 2A	do	Dr	405½	35	8		65	do	do	Wells 96, 97, and 98 are less than 50 feet apart. Pumping well 98 lowers water level in well 97.
99	Do	Hanes Hosiery Mills South Well	Hanes Hosiery Co.	Dr	1097		8		35	do	do	
100	Do	Hanes Hosiery Mills North Well	do	Dr	560		8			do	do	Close to well 99 so that pumping well 99 lowers water level in well 100.
101	East edge of Winston-Salem	Winston-Salem Tourist Village	M. A. Holder	Dr	100		5⅝		10	do	Slope	Hard water.
102	Do	J. E. Mecum	Well Drillers Inc.	Dr	104	50	6		3–4	do	Hill	
103	Do	G. D. Purcell	do	Dr	121		6		2–3?	do	Slope	Dug 40 feet. Water slightly hard.
104	Do	Wiley Myer	do	D–Dr	71		6	47R	2–3	do	Hill	Dug 50 feet.
105	3½ miles E of Winston-Salem	City View School	M. A. Holder	Dr	240		6		6–8	do	do	
106	Do	Clyde Shore	Well Drillers Inc.	Dr	300		6		0	do	do	No water.
107	4 miles SE of Winston-Salem	N. L. Reid	do	Dr	98	12	6		4	do	do	Temperature 59° F.
108	Do	W. E. Reid	do	Dr	90		6		5	do	do	
109	Do	C. F. Sapp	J. R. Cummings	Dr	95	15	6		8	do	Flat	Soft water, no iron.
110	Do	W. C. Hine	Well Drillers Inc.	Dr	180		6		4	do	Hill	Drilled most of way in rock.
111	Do	Colonial Furniture Shop	do	Dr	67		6	15R	25–30	do	Slope	Water slightly hard.
112	Do	C. W. Clodfelter, Sr.	J. R. Cummings	Dr	76		6		5±	do	Flat	Water slightly hard, no iron.
113	Do	C. E. Ebert	do	Dr	135		6		4–5	do	do	Soft water.
114	5 miles SE of Winston-Salem	Z. V. Ashe	Well Drillers Inc.	Dr	70	18	6			do	Hill	Adequate supply. No water in another well, 386 feet deep.
115	5½ miles SE of Winston-Salem	A. T. Dize	do	Dr	169	80	6		40	do	Valley	
116	5¾ miles SE of Winston-Salem	L. C. Shugart	do	Dr	98½	30	6	35R	7	do	Hill	
117	6 miles SE of Winston-Salem	C. A. Breudel		Br	39	39	24	33M		do	Flat	
118	5½ miles E of Winston-Salem	R. C. Rights		Dr	315		6			do	Hill	
119	4 miles SW of Kernersville	Sedge Garden School	J. R. Cummings	Dr	75		6		12+	do	Draw	
120	Kernersville	Town	Hudson Well Co.	Dr	580		6		10	Granite	Flat	Not in use.
121	Do	Geo. B. Fulp & S. G. Raiues	J. M. Cummings	Dr	150?		4?			do	do	Abandoned.
122	Do	Town	J. R. Cummings	Dr	150?		8		75?	do	do	Supply failed; abandoned.
123	Do	do	do	Dr	175?		6			do	do	Abandoned.
124	Do	Adams Millis	do	Dr	308		6	65R	18	do	Slope	Analysis in table. Temperature 60½° F.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN FORSYTH COUNTY—*Continued*

Well Number	LOCATION	OWNER	DRILLER[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	REMARKS
125	Kernersville	Vance Knitting Co.	J. R. Cummings	Dr	185		6		9	Granite	Flat	Owner uses a water softener.
125a	2 miles SE of Kernersville	R. J. Reynolds Co. Storage warehouse	M. A. Holder	Dr	335		6		35	do	Draw	
126	2 miles S of Kernersville	C. M. Linville	J. R. Cummings	Dr	106		6	50R		Gneiss?	Slope	
127	Do	J. Edgar Smith	Heater Well Co.	D–Dr	100		6	31R	20	do	do	Dug 35 feet. Water slightly hard.
128	4½ miles SE of Union Cross	F. F. Miller	L. R. Hartsell	Dr	80		6	25R	10±	Gneiss	do	Soft water.
129	Union Cross	Union Cross School	M. A. Holder	Dr	150		6		8–10	Granite	Flat	
130	5½ miles S of Winston-Salem	L. H. Wilson	do	B–Dr	63	23±	6		5	do	Slope	Soft water.
131	6 miles S of Winston-Salem	Henry H. Barnes	McGee	Dr	110		6			do	Flat	
132	4¾ miles S of Winston-Salem	D. S. Lamm & Carl Pope		Dr	100?		6			do	Slope	Adequate supply; water slightly hard.
133	3¾ miles S of Winston-Salem	Paul A. Jones	M. A. Holder	Dr	102¾		6	14R	19	Gneiss	Draw	Reported drawdown 36 feet.
134	4 miles S of Winston-Salem	Griffiith School	do	Dr	160±		6		10+	do	Flat	
135	3½ miles S of Winston-Salem	John Yokeley	do	Dr	50		6		10–15	do	Slope	Soft water.
136	Do	M. C. Rumley	do	Dr	73		6		10	do	do	Do
137	5 miles S of Winston-Salem	W. P. Spach	Well Drillers Inc.	Dr	138		6		11	Granite	Flat	
138	Do	L. B. Spach	do	Dr	70	20	6	30R	14	do	Draw	Water moderately soft.
139	Do	F. L. Gobble	Sam Miller	Dr	99		6	54R	10–20?	do	Hill	Large yield reported.
140	Do	R. O. Fultz	M. A. Holder	Dr	75	75	5⅝		6	do		Well screened in granite "sand".
141	Do	F. A. Martin		Dr	92		6	20R		do	Slope	Adequate supply. Soft water.
142	2 miles SW of Hanes	O. W. Butner	M. A. Holder	Dr	104		5⅝		20	Gneiss	Flat	
143	3 miles NE of Clemmons	W. L. Thomas	do	Dr	400		5⅝		0	Granite	Hill	Hit rock about 6 feet below surface.
144	2½ miles NE of Clemmons	Warners Store	do	Dr	75		5⅝		3	do		
145	2 miles E of Clemmons	Mrs. W. B. Edison	?	Dr	190		2½		13?	Gneiss	Hill	
146	1½ miles E of Clemmons	J. C. Goodman	Bishop	Dr	172		4			do	do	Adequate yield.
147	Clemmons	H. A. Cumby	M. A. Holder	Dr	103		5⅝		8	do	Flat	
148	Do	H. B. Stimpson	do	Dr	160		5⅝		15	do	do	
149	Do	Clemmons School	do	Dr	120		5		12½+	do	do	Tested at 12½ gallons a minute.
150	2 miles N of Clemmons	N. W. Beck	Bishop	Dr	87		4		7	Geniss	Slope	Hard water.
151	Do	M. A. Holder	M. A. Holder	Dr	28	20	5⅝		7	do	Draw	
152	1½ miles NW of Clemmons	Edgar Tesh	do	Dr	62		5⅝		10	do	Hill	
153	Clemmons	Mrs. J. M. Brower	do	Dr	64		5⅝		6	do	do	
154	Do	Dr. J. C. Casstevens	do	Dr	500	40	5⅝		0	do	Ridge	
155	Do	J. E. Swain & Mrs. Strupe	Bishop	Dr	285		5		0	do	do	
156	Do	C. H. Wiles	M. A. Holder	Dr	52	48	5⅝		10		Draw	
157	Do	Mrs. Eva Hinshaw	do	Dr	125		5⅝		10		do	
158	Do	Dr. J. C. Casstevens	do	Dr	75		5⅝		9		do	Water slightly hard.
159	Do	R. E. Lasater	do	Dr	130		5⅝	18R	30+			
160	Do	John Mechum	do	Dr	146		5⅝	42R	3		Hill	
161	2 miles SW of Clemmons	Tanglewood Farms	Clayton	Dr	105		6	20R	20		Draw	
162	Do	do	Bishop	Dr	103		5		1–2		Hill	Not used.
163	Do	W. N. Reynolds	do	Dr	54		5		20		Draw	
164	3 miles S of Clemmons	Duke Power Co.	M. A. Holder	Dr	110		5⅝		10–12	Gneiss	Hill	Analysis in table. Temperature 60° F.

RECORDS OF SPRINGS IN FORSYTH COUNTY

	LOCATION	OWNER	NAME	Yield gallons a minute	Chief aquifer	Topographic location	REMARKS
A	1½ miles SE of Kernersville	Pilgrim Holiness Church	Bethel Springs	1.5	Gneiss	Valley	Depression-contact spring. Flows into large square concrete pit.

[1], [2], [3] Footnotes given at beginning of table.

ANALYSES OF GROUND WATER FROM FORSYTH COUNTY, NORTH CAROLINA

(Analysts: E. W. Lohr and M. S. Berry, U. S. Geological Survey. Numbers at heads of columns correspond to numbers in table of well data)

(parts per million)

	2	3	93	124	164
Silicia (SiO_2)	31	28	22	31	29
Iron (Fe)	.02	.02	.03	.03	.03
Calcium (Ca)	5.7	22	64	23	6.7
Magnesium (Mg)	3.1	8.0	24	7.4	3.0
Sodium and Potassium (Na+K)	14	7.2	67	7.0	1.3
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	63	112	46	92	30
Sulfate (SO_4)	3.2	9.1	10	17	3.7
Chloride (Cl)	1.2	1.5	225	5	1.2
Fluoride (F)	----------	----------	.0	.5	----------
Nitrate (NO_3)	.0	.0	47	2.0	2.2
Dissolved solids	89	130	603	143	71
Total hardness as $CaCO_3$	27	88	258	88	29
Date of collection	May 21, 1943	May 20, 1943	Oct. 16, 1942	Oct. 13, 1942	May 19, 1943
Depth (feet)	130	350	714	308	110
Chief aquifer	Gneiss	Gneiss	Gneiss	Granite	Granite

GUILFORD COUNTY

(Area, 651 square miles; population, 153,916)

Geography, physiography, and drainage.—Guilford County, in the south-central part of the Greensboro area, is the largest of the six counties and has the largest population. It has four incorporated cities and towns and about 14 unincorporated towns and villages. Greensboro, located in the center of the county, is the largest city and county seat. High Point, the only other city, is in the extreme southwestern corner of the county. Greensboro is an important center of textile manufacturing and High Point also has a number of textile factories, although it is better known as a center of furniture manufacturing. There are a few factories in the smaller towns and villages, but the remainder of the county is dominantly agricultural. Guilford County has a good system of paved roads and railroads, most of which radiate from Greensboro.

Guilford County is in the Piedmont physiographic province. Its surface is formed by the uplifted and partially dissected peneplane of that province. The land surface near the larger streams is gently rolling, with a relief of 100 to 150 feet. The interstream areas are broad and generally quite flat. No large trunk streams flow through or near Guilford County and therefore there are no deep valleys. Because the base-level is higher, dissection has generally been less extensive than in other counties of the Greensboro area. Guilford County is underlain by rocks of several different types. Because some of these differ considerably in resistance to erosion, both the topography and the drainage pattern are greatly influenced by the geology. However, topographic maps have not been made of any part of the county, and the geology is complex and at many places obscure, so that the exact relation of the topography and drainage to the geology cannot always be ascertained. The outstanding feature is the northeastward trend of the ridges and streams. Apparently some of the streams flow along or near the contact between different kinds of rocks, whereas others flow in weaker rocks, the more resistant rocks forming interstream divides. The major exception to the northeastward trend of the streams is Deep River, which flows southeastward chiefly across diorite and granite, which are uniformly resistant.

Practically all of Guilford County is drained by the two main branches of the Cape Fear River system, Haw River and Deep River. About 75 percent of the county is drained by Haw River and its tributaries, the most important of which are Reedy Fork, Buffalo Creek, and Alamance Creek. Practically all of the remaining 25 percent is drained by Deep River, only a few square miles of the southwest corner of the county draining southward into Yadkin River.

Geology.—The geology of Guilford County apparently is more complex than that of any other county of the Greensboro area. Seven of the nine geologic units crop out in Guilford County and the areal distribution of most of them is quite irregular.

The gneiss unit crops out in several irregular belts extending northeastward across the northwestern corner of the county. These belts are separated by areas of porphyritic granite, which was intruded into the gneiss. The principal rocks of the gneiss unit are banded quartz-mica-feldspar gneiss and quartz-mica schist. They are chiefly of sedimentary origin, and although the rocks have been greatly changed by metamorphism at many places the bedding planes can still be distinguished. The granite has intimately intruded the gneiss so that the boundaries between the two units necessarily are greatly generalized.

The greenstone schist crops out in large, irregularly shaped areas in the southeastern two-thirds of the county. These areas are separated by areas of sheared granite. The greenstone schist consists of a green fine- to medium-grained basic schistose rocks, chiefly of volcanic origin. At most places the rock is highly schistose but at a few places it is coarser and fairly massive.

The sericite schist crops out in a belt extending northeastward across the county from a point near Guilford College. It is closely associated with the greenstone schist and may be a metamorphosed tuff or possibly a metamorphosed clay. The rock is greatly weathered, and usually the only recognizable minerals are quartz, sericite and iron oxide, the latter apparently an oxidation product of chlorite and hornblende.

The slate unit is limited to a narrow, highly irregular belt extending across the southeastern corner of the county and to a small patch in the south edge of High Point. The rocks are mostly tuffaceous slates but include some clay slates.

The sheared granite is exposed over about 50 percent of the southeastern half of the county, where it forms a fairly continuous area interrupted by large patches of greenstone and slate. The granite is generally a moderately coarse pink schistose and gneissic rock consisting chiefly of quartz, biotite, and feldspar. The granite has been considerably metamorphosed and intensely sheared. The outstanding feature of the granite is the schistose and slaty dikes, which are green in color and greatly resemble the greenstone schists.

Diorite crops out at a number of places but was mapped separately at only two places. The outcrops otherwise are too small or not well enough exposed to map separately. Places where diorite crops out but is not shown on the map include the vicinity of Sedgefield, Pleasant Garden, along State highway 62 between Climax and High Point, and an area about 6 miles north of High Point. The diorite is a medium- to coarse-grained, dark-gray to greenish-gray rock consisting chiefly of plagioclase and hornblende. It generally is massive but at a few places is somewhat schistose.

The porphyritic granite outcrops in irregular, elongated patches across the northwestern corner of the county, where it is closely associated with the gneiss. In places the gneiss has been completely assimilated by the granite but in other places the gneiss has only been impregnated by emenations from the granitic magma. Because the granite has so intimately intruded the gneiss and because every gradation between true granite and true gneiss can be found, the map is necessarily greatly generalized.

The porphyritic granite is generally coarse-grained and medium gray, with large phenocrysts of feldspar. The ground mass consists of quartz, biotite, and feldspar. At most places the granite is entirely massive, but at some places the granite has some of the schistosity of the gneiss.

Ground water.—Nearly all domestic water supplies, many industrial supplies, and one of the three municipal water supplies are obtained from wells.

Dug wells are extensively used for domestic supplies in rural districts. Generally they are from about 15 to 50 feet deep and 2½ to 4 feet in diameter. Wells can generally be dug deep enough in gneiss and schist that they will not go dry even during a drought. However, at some places in granite, diorite, greenstone schist, and slate, the rock is so close to the surface that dug wells frequently go dry.

Bored wells are used considerably in suburban areas and are cheaply and easily constructed. They are bored by power-driven earth augers and cannot go below the completely weathered zone. For this reason, they are not always successful in rocks such as granite and diorite, where the water table at times declines below the weathered zone. Most bored wells are cased, and where they are properly constructed and of sufficient depth that they will not go dry, they are a satisfactory source of supply. Dug and bored wells obtain their water from the weathered rock material at and just below the water table. For this reason, extra precautions must be observed to prevent contamination.

There are a large number of drilled wells in Guilford County. Records of more than 350 drilled wells are given in the tables of well data. Many of these were core-drilled with chilled shot and are 2 or 3 inches in diameter. There are many other core-drilled wells in Guilford County which do not appear in the table. Core-drilled wells have the advantages of all drilled wells and are cheaper than the larger percussion-drilled wells. However, although they are satisfactory for domestic wells, their small size makes them unsatisfactory for most industrial plants. About 7 or 8 gallons a minute is the maximum rate at which water can be removed from a 2-inch well by a deep-well pump. The average yield of 157 wells 2 inches in diameter in Guilford County is 6 gallons a minute and the average yield of 20 wells 3 inches in diameter is 10½ gallons a minute. These quantities are near the maximum amount that can be pumped from wells of that diameter and suggest that many of the wells would yield more than can be withdrawn from the well.

Most industrial, and public-supply wells are drilled with a percussion drill and are from 4 to 8 inches in diameter. The 6-inch well is by far the commonest. The larger-diameter wells encounter more fractures and cracks than small-diameter wells. Also, because a larger pump can be used, more water can be pumped from a large-diameter well than from a small-diameter well.

Drilled wells, both core-drilled and churn-drilled, have certain advantages over dug or bored wells. Because they are generally tightly cased and the water is obtained from crevices in the rock, they are much less liable to contamination. The depth of water in the well is generally large in comparison with the fluctuation of the water level, so that the yield decreases only slightly during a drought.

A summary of data on drilled wells 3 inches or more in diameter is given below:

TABLE 16—SUMMARY OF DATA ON WELLS IN GUILFORD COUNTY
(Drilled wells 3 inches or more in diameter)

ACCORDING TO ROCK TYPE

Type of Rock	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Gneiss	20	123	1—50	15.6	0.126	5.0
Greenstone schist	67	163	1—200	36.5	.223	3.0
Sericite schist	8	116	5—20	11.1	.105	0
Slate	4	273	5—15	10.5	.039	0
Sheared granite	54	175	0—70	14.4	.093	13.0
Porphyritic granite	26	137	½—30	10.9	.079	3.8
All wells	179	158	0—200	22.0	.139	6.1

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Hill	41	203	0—100	15.5	0.076	24.4
Flat	44	170	0—200	22.2	.131	2.3
Slope	55	130	2—120	21.8	.168	0
Draw	16	125	2½—75	22.8	.182	0
Valley	22	158	10—100	34.4	.218	0

According to this table, wells in greenstone schist have by far the greatest average yield and average yield per foot of well. Wells in the gneiss unit rank second both in average yield and average yield per foot of well. Wells in sheared granite rank third in average yield but are fourth in average yield per foot of well, being exceeded in that respect by wells in sericite schist. Wells in the porphyritic granite rank fifth in both respects and wells in slate are sixth and lowest. However, data on only four wells in slate are included, one of which was very deep and had a low yield. If this one well were omitted, the record for the slate would be more than twice as good. It is obvious that not much importance can be given the position of the slates in table 16. The relative rank of wells in slate is given more accurately in table 1.

Although the greenstone schist is generally an excellent aquifer, at some places it is not. In the vicinity of Whitset and southwestward it apparently yields rather meagerly. Wells in the greenstone schist between Greensboro and Browns Summit and in the vicinity of Sedgefield have not been uniformly successful. Fortunately, at most places where water is needed for industrial purposes, excellent wells have usually been obtained.

More wells are drilled in granite (including together the sheared granite and porphyritic granite) than in any other rock. Results have generally been quite uncertain. No particular area can be designated as unusually poor, except possibly the vicinity of the County Home just east of Greensboro, and no areas can be designated as exceptionally good. At a number of places where a well several hundred feet deep was drilled and only a few gallons a minute was obtained, a second well drilled a few hundred feet away obtained several times as much water. It is apparent that the success or failure of a well depends on encountering fractures and joints in the rock. The second part of table 16, showing the average yields of wells in different topographic location, is significant in that connection. Wells drilled on hills have by far the lowest average yield and average yield per foot of well. Wells in valleys have much the highest average yield and average yield per foot of well. Wells in draws are second, on slopes third, and in flat areas fourth. Wells on hills have an average yield 30 percent less and an average yield per foot of well 42 percent less than wells drilled on flat areas. A hill is a poor location for a well because it is quite commonly underlain by rock which is more resistant to erosion. In many places the rock in hills is resistant to erosion because it has few fractures, joints, and similar openings facilitating the movement of ground water, which promote weathering and thus make the rock easily susceptible to erosion. Naturally if the avenues of movement of ground water are limited, the amount of water yielded by a well drilled there will be small.

In some of the other counties it was observed that wells drilled in draws had a greater average yield and average yield per foot of well than wells drilled in valleys. This was attributed to the relative large width of the valley in comparison with the width of the fracture or joint zone which originally determined the location of the valley. Draws, on the other hand, may be either wider or narrower than the zone of weakness which localized them. That wells in the valleys of Guilford County have a higher average yield and average yield per foot of well than wells in draws may be partly attributed to the small size of the Guilford County valleys.

Analyses of eight samples of water from wells in Guilford County are given in the table of analyses. Seven of the samples are from wells in granite and one is from a well in greenstone schist.

The seven samples from the granite ranged from soft to very hard and from 0.0 to 0.04 part per million in iron content. There is evidence of considerable contamination in some of the samples and in these there is little correlation between depth and hardness. However, in the samples from wells 22, 43, and 111, which appear to be free from contamination, increasing hardness correlates with increasing well depth.

The water from the well in greenstone, well 328, which has a relatively large amount of chloride, sulfate, and nitrate and therefore appears to be somewhat contaminated, is moderately hard.

Temperatures range from 59 to 63° F. and average 61° F.

Municipal supplies.—Gibsonville, population 1,753, has had a public supply since 1822, obtaining its water from two deep wells, one in Guilford County and the other in Alamance County. Well 234, Guilford County, is 201 feet deep and yields 100 gallons a minute. Well 139, Alamance County, is 335½ feet deep and was tested at 112 gallons a minute but is now being pumped at about 45 gallons per minute. Well 233, Guilford County, is only a short distance from well 234. The pumping of the one causes a large drawdown in the other, so well 233 was abandoned. Logs of wells 233 and 234 are given following the table of well data.

The turbine pump on well 234 discharges into a 154,000-gallon concrete reservoir. Centrifugal pumps force the water into the mains. A 75,000-gallon elevated tank gives additional storage. Well 139 in Alamance County pumps directly into the mains. The water from neither well is treated. Consumption of water averages about 55,000 gallons a day.

Greensboro, population 59,319, obtains its water from an impounded lake on Reedy Fork and Horsepen Creek, about 7 miles north of the city. The lake covers an area of 450 acres and has a capacity of 1,000,000,000 gallons. An auxiliary reservoir a mile south of the lake and 120 feet higher gives additional raw-water storage of 20,000,000 gallons. The water is pumped to the treatment plant in the city through a 24-inch line by three steam-driven centrifugal pumps and one water wheel. Water treatment consists of coagulation with alum, filtration, chlorination, and final adjustment of pH with lime. There are two concrete clear-water reservoirs with capacities of 3,000,000 and 18,000,000 gallons, respectively, and two elevated tanks with capacities of 250,000 and 500,000 gallons, respectively. The capacity of the treatment plant is 12,000,000 gallons a day. The maximum consumption is about 7,000,000 gallons a day and the average is about 5,500,000 gallons a day. About 25 percent of the water is used by industries.

In addition to the municipal water plant in Greensboro is the Buffalo Water Works, owned by the Proximity Manufacturing Company. Water is obtained from Buffalo and Richland Creeks. The total capacity of the storage lakes on these creeks is about 1,000,000,000 gallons. The water is treated by coagulation with alum and lime, filtration, final adjustment of pH with lime, and chlorination. The filter plant has a capacity of about 4,500,000 gallons a day but filter plants at some of the mills increase the capacity to about 8,500,000 gallons a day. The total consumption is about 8,000,000 gallons a day, most of which is used by the mills. Nearly 7,000 people in the mill villages are also supplied with water.

High Point, population 38,495, obtains its supply from an impounded lake on Deep River 5 miles northeast of the city. The dam is 45 feet high and the lake has an area of 350 acres. The water flows by gravity 4,000 feet through a 30-inch pipe to the raw-water pumping station. Four electrically driven centrifugal pumps with a total capacity of 8,000,000 gallons a day and one gasoline-driven pump with a capacity of 3,500,000 gallons a day pump the water to the treatment plant through parallel 24-inch and 12-inch lines. Treatment consists of coagulation with alum, the addition of ammonia and chlorine, filtration, secondary chlorination, and final adjustment of pH with lime. The clear-water reservoir has a capacity of 3,200,000 gallons and a 1,000,000-gallon elevated tank furnishes additional storage. The pumps on the distribution system exactly duplicate the raw-water pumping system. The capacity of the source is reported to be 15,000,000 gallons a day and the capacity of the treatment plant is 6,000,000 gallons a day. The maximum consumption is about 4,000,000 gallons a day and the average is about 3,500,000 gallons a day.

RECORDS OF WELLS IN GUILFORD COUNTY

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
1	1½ miles W of Stokesdale	W. R. Hutchins	Well Drillers Inc.	Dr	222	....	6	60R	1±	Gneiss	Hill	Soft water.
2	3½ miles SW of Stokesdale	C. S. Linville	do	Dr	100+	....	6	....	5	Granite	Slope	Hard water.
3	Stokesdale	Geo B. Jones	Z. V. Jones	Cr-Dr	99	50	2	....	4	Gneiss	Flat	Soft water, no iron.
4	Do	Jim Knight	do	Cr-Dr	112	....	3	....	5	do	do	Used by 3 families, Water slightly hard.
5	Do	Dr. V. E. Edwards	do	Cr-Dr	95	....	2	....	6	do	do	....
6	Do	Carl Lemon	Well Drillers Inc.	Dr	188	57	6	20R	15	do	Valley	Soft water. Drawdown reported 65 feet.
7	Do	Paul Knight	Z. V. Jones	Cr-Dr	110	....	2	....	4	do	Flat	Soft water.
8	Do	Stokesdale School	....	Dr	140	....	6	....	15	do	do	....
9	3 miles N of Summerfield	Mrs. Blanche Robinson	J. Stafford	Cr-Dr	125	....	2	....	5	do	do	No water in a 300-foot well at same location
10	2 miles N of Summerfield	C. C. Winfree	Frank Gardner	Cr-Dr	117	....	3	....	3-4	Granite	do	Water slightly hard.
11	2 miles NW of Summerfield	Miss Elizabeth Ogburn	F. L. Smith	Dr	131½	120	6	....	15-20	do	do	....

[1] Vir Mach. Co.=Virginia Machinery & Well Co.,; Dan. Well Co.=Danville Well Drilling Co.; Sydnor Well Co.=Sydnor Pump & Well Co.
[2] Dr=Drilled, Br=Bored, Cr-Dr=Core Drilled, B-Dr=Bored and Drilled, D-Dr= Dug and Drilled.
[3] Depth to water from land surface; R=Reported, M=Measured.

RECORDS OF WELLS IN GUILFORD COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
12	1 mile NW of Summerfield	J. W. Winfree	Frank Gardner	Cr-Dr	90	80	2		5+	Granite	Flat	
13	Do.	Miss Elizabeth Ogburn	F. L. Smith	Dr	53½	36	6		18-20	do	do	Soft water.
14	1 mile N of Summerfield	M. V. Winfree	Frank Gardner	Cr-Dr	90		2		4	do	do	
15	1 mile NW of Summerfield	S. J. Ellington	do	Cr-Dr	102	67	2	40R	6+	do	do	
16	¾ mile N of Summerfield	C. L. Scarlett	do	Cr-Dr	60		2		4	do	do	
17	Summerfield	L. W. Tilley	do	Cr-Dr	118½		2		6	do	Slope	Soft water, no iron
18	Do.	Summerfield School	J. R. Cummings	Dr	225		6		12-15	do	Flat	
19	Do.	S. S. Blackburn	Frank Gardner	Cr-Dr	102		2	25R	5	do	do	Soft water, no iron.
20	Do.	J. B. Thorp	W. B. Mayhew	Cr-Dr	100±		2	25R	5±	do	do	
21	Do.	L. A. Stafford	J. R. Cummings	Dr	90?		6	35R	15	do	do	
22	Do.	G. S. Miles (T. E. Case)	Walter Stafford	Cr-Dr	271½	40	2	40R	16	do	do	Analysis in table.
23	Do.	R. O. Gamble	W. B. Mayhew	Cr-Dr	94		2		5	do	do	
24	Do.	do	Z. V. Jones	Cr-Dr	76		2		1±	do	Hill	
25	Do.	W. Parrish	W. B. Mayhew	Cr-Dr	97		2		5	do	Flat	Soft water, no iron.
26	Do.	Mrs. O. E. Shields	W. B. Mayhew	Cr-Dr	110		2		5-6	do	Flat	
27	Do.	L. A. Stafford (Hammer Mill)	do	Cr-Dr	100±		3		10	do	Draw	
28	Do.	W. B. Stafford	J. Stafford	Cr-Dr	168	69	4	21R	7	do	Flat	Soft water, no iron.
29	Do.	Methodist Parsonage	W. B. Mayhew	Cr-Dr	90		3		5-6	do	do	Soft water.
30	¾ mile N of Summerfield	A. C. Metz	Frank Gardner	Cr-Dr	198		2	28R	15	do	do	Soft water, no iron.
31	Do.	Mrs. L. H. Taylor	W. B. Mayhew	Cr-Dr	96		2		4-5	do	do	
32	Summerfield	B. H. Hoskins	do	Cr-Dr	93		2		6-7	do	do	
33	¾ mile N of Summerfield	Mrs. D. T. Todd	do	Cr-Dr	86		2		5-6	do	do	Water slightly hard.
34	1 mile N of Summerfield	J. H. Barhan	J. Stafford	Cr-Dr	297		2		3	do	do	Hardness about 70 parts per million.
35	2 miles NE of Summerfield	R. L. Stigall	Fank Gardner	Cr-Dr	93		3			do	do	Soft water.
36	1 mile SE of Summerfield	C. O. Martin	J. Stafford	Cr-Dr	126		2		7?	do	Draw	Not used.
37	3 miles NE of Summerfield	G. T. Wilson	Frank Gardner	Cr-Dr	140		2		5	Gneiss		Water moderately soft.
38	Do.	J. W. Dixon	do	Cr-Dr	100		2		10	do	Slope	
39	3¼ miles NE of Summerfield	Mrs. J. Alice Wilson	do	Cr-Dr	100		2		4-5	Granite		Water contains some iron.
40	4 miles NE of Summerfield	W. T. Clayton	W. B. Mayhew	Cr-Dr	82⅓		2		4-5	do		Soft water.
41	4½ miles NE of Summerfield	R. J. Clayton	Frank Gardner	Cr-Dr	97		2		4-5?	do		
42	2 miles E of Summerfield	Hubert Walker	W. B. Mayhew	Cr-Dr	114		2		5-6	do	Draw	Water moderately soft, no iron.
43	3 miles E of Summerfield	J. F. Mathews	do	Cr-Dr	130	90	2	35R	5	do	Flat	Analysis in table.
44	Do.	R. F. Shaw	Z. V. Jones	Cr-Dr	100		2		2	do		
45	Do.	J. F. Mathews	W. B. Mayhew	Cr-Dr	100		2		6	do	Flat	
46	Do.	W. L. Moton	do	Cr-Dr	157	100	2		5	do	do	Soft water, no iron.
47	4½ miles SW of Browns Summit	Dr. Wesley Taylor	Well Drillers Inc.	D-Dr	186		6		3	do	Hill	Dug 50 feet.
48	Do.	do	J. R. Cummings	Dr	80		6		3	do	Slope	
49	Do.	do	do	Dr	144		6		5	do	do	
50	4½ miles W of Browns Summit	Joe D. Whitt (W. D. Sharp)	J. Stafford	Cr-Dr	259	40	2		3¾	do	Draw	
51	1½ miles NW of Browns Summit	E. A. Spencer	J. L. Hopkins	Dr	103⅓		6	35R	8	Gneiss		Moderately soft water
52	Browns Summit	Mrs Salley E. Troxler	W. P. Phillippi	Cr-Dr	96	88	2		8	do		Hard water.
53	Do.	C. R. Hopkins	do	Cr-Dr	66½	33	2		8	do	Hill	Moderately hard water.
54	¾ mile SE of Browns Summit	Browns Summit Negro School	F. L. Smith	Dr	68		6		30	do	Flat	
55	2 miles E of Browns Summit	Monticello School		Dr	90		6		30	Granite	do	
56	2½ miles SE of Osceola	Willie Andrews	W. B. Mayhew	Cr-Dr	70	40	2		½±	do	Hill	Not used; insufficient water.
57	2 miles SE of Osceola	Busick School		Dr	80		6		15	Greenstone		Water contains some iron.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN GUILFORD COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
58	4½ miles SE of Osceola	Avery Brown	W. B. Mayhew	Cr-Dr	90		2		6-7	Granite	Slope	Soft water
59	3 miles N of Gibsonville	County Farm	F. L. Smith	Dr	48		6		7	Greenstone		
60	3¼ miles S of Osceola	P. L. Michael	W. P. Phillippi	Dr	131		2		2-3	do	Slope	Soft water.
61	6 miles SW of Osceola	D. R. Huffine, Dairy	J. R. Cummings	Dr	119	25±	6	40R	10+	do		Soft water, no iron.
62	3¼ miles E of Busick	Madison School		Dr	80		6		12-15	do	Hill	
63	2 miles SE of Browns Summit	Proximity Mfg. Co. Farm	W. B. Mayhew	Cr-Dr	250		2		0	Granite	do	
64	Do.	do.	do.	Cr-Dr	60		2		3	do	do	
65	2½ miles S of Browns Summit	U. S. Army Rifle Range	Vir. Mach. Co.	Dr	300		8		15	Greenstone	Slope	
66	3 miles S of Browns Summit	do.	do.	Dr	236		8	30R	25	do	do	Reported drawdown 50 feet.
67	¾ mile E of Busick	H. H. Horner	W. B. Mayhew	Cr-Dr	60		2		6-7	Granite		
68	Do.	Carl Gregory	do.	Cr-Dr	97		2		7	do	Ridge	
69	1¼ miles E of Busick	W. W. Parish	do.	Cr-Dr	97		2		7	Greenstone	Slope	Soft water.
70	½ mile S of Busick	Southern Webbing Mills	Heater Well Co.	Dr	185	40?	8		40	do	Valley	
71	¼ mile W of Busick	R. A. Hawkins	Frank Gardner	Cr-Dr	140	90	2		5	do	Ridge	Water contains some iron.
72	1½ miles SW of Busick	A. C. Hillard	Paul Greggerson	Cr-Dr	242	60	2		4	do		
73	Do.	R. B. Carroll	Carter	Cr-Dr	100	58	2		5	Schist	Valley	Water contains much iron.
74	2½ miles SW of Busick	Charlie Pulliam	W. B. Mayhew	Cr-Dr	90		2		7-8	do	Flat	
75	Do.	Jesse Wharton School		Dr	80		6		15	do	Draw	
76	2 miles W of Busick	W. M. Moore	W. B. Mayhew	Cr-Dr	112½	85	2		5	Schist	Slope	
77	Do.	Mrs. W. S. Moore, Dairy	do.	Cr-Dr	150	100	2		5-6	do	Valley	
78	Do.	Mrs. W. S. Moore	do.	Cr-Dr	112		2		5-6	do	do	Water contains some iron.
79	3 miles NE of Battleground	Negro Scout Camp	do.	Cr-Dr	230		2		4	Granite?		
80	3 miles N of Battleground	Greensboro Pumping Station	Z. V. Jones	Cr-Dr	125		2		4	Gneiss	Valley	
81	3½ miles N of Battleground	L. Richardson	W. B. Mayhew	Cr-Dr	200	200	3		7	do	Hill	
82	Do.	do.		Cr-Dr	130	80	3		8	do	Slope	Water moderately hard.
83	2 miles NE of Battleground	R. G. Trosper	Heater Well Co.	Dr	105		6⅝		10	Granite	Valley	Soft water.
84	1½ miles NE of Battleground	City of Greensboro	W. B. Mayhew	Cr-Dr	125	25	2		5	Gneiss	Flat	
85	1 mile N of Battleground	Robert Woodward	Heater Well Co.	Dr	104	40	8		25	do	Valley	
86	Do.	C. W. Causey, Jr.	do.	Dr	80	58	6		10	do	Slope	
87	Battleground	Greensboro Park		Cr-Dr	110		2		5	Schist	Valley	
88	¾ mile W of Battleground	L. F. Barnard	J. Stafford	Cr-Dr	126		2		7	do	Slope	
89	1 mile W of Battleground	Dr. R. B. Davis	Heater Well Co.	Dr	90		6		½	Granite	Hill	
90	1½ miles NW of Battleground	Harry Hoffman	Danville Well Co.	Dr	109	20	6	8R	15+	Gneiss	Valley	Drawdown 40 feet at 10 gallons a minute. Hardness 210 parts per million.
91	Do.	J. G. Crutchfield	do.	Dr	74		6		10	do	do	
92	2 miles NW of Battleground	M. W. Lewis	Frank Gardner	Cr-Dr	53		2		5	Granite		
93	2½ miles NW of Battleground	J. P. Huskins	Danville Well Co.	Dr	65	35	6	30R	5	do	Hill	Water slightly hard.
94	Do.	Shady Oak Dairy	W. B. Mayhew	Cr-Dr	160		2		5	Gneiss	do	Not in use.
95	Do.	do.		Cr-Dr	88		2½		8	do	Slope	
96	Do.	do.	Heater Well Co.	Dr	94	44	8		33	do	do	
97	1½ miles SE of Summerfield	Oscar Peedon	Mackintyre	Dr	105	95	4	50R	7½	Granite	do	
98	2½ miles N of Friendship	R. B. Miller	W. B. Mayhew	Cr-Dr	102		2		5-10	Gneiss	Draw	Soft water.
99	3 miles N of Friendship	D. C. Dettor	do.	Cr-Dr	143	122+	2		6	do	Flat	Water slightly hard.
100	Do.	R. L. Edwards	J. R. Cummings	Dr	85		6	30R	10+			
101	2½ miles N of Friendship	W. R. Beeson	W. B. Mayhew	Cr-Dr	141	51	2		4½	Granite	Hill	Water slightly hard, no iron.
102	Do.	W. D. Warren	Well Drillers Inc.	Dr	156	61	6	48M	5-6	do	do	Water moderately soft.
103	2 miles N of Friendship	Robert H Cain	W. B. Mayhew	Cr-Dr	204		2		5	do		Soft water.
104	Oak Ridge	Maj. Z. L. Whitaker & Maj. E. A. Green	J. R. Cummings	Dr	45		6		15	Gneiss		
105	Do.	Maj. Z. L. Whitaker	do.	Dr	62		6	30R	6	do	Slope	

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN GUILFORD COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
106	Oak Ridge	Oak Ridge Military Ins.	J. R. Cummings	Dr	78	35-40	6	30R	50	Gneiss	Draw	
107	Do.	do.	do.	Dr	66	35-40	6	30R	16	do	Slope	Yield diminishes if pumped continuously.
108	Do.	do.	do.	Dr	65		6		20	do	do	Do
109	Do.	Maj. Z. L. Whitaker.	do.	Dr	42		6		15	Granite	do	
110	Do.	Oak Ridge Military Ins.	do.	Dr	200		6		10	do	do	Not used because of fine sand with water.
111	Do.	do.	do.	Dr	63		6	30R		do	Hill	Analysis in table. Temperature 59½° F.
112	Do.	do.	do.	Dr	700		6		7	do	do	Not used. Entire yield obtained at 60 feet.
113	½ mile SE of Oak Ridge.	T. J. Pegram, Estate	do.	Dr	200		6		1½	Gneiss	do	Water hard, contains considerable iron.
114	Oak Ridge	Oak Ridge School		Dr	110?		6		15	do		
115	Colfax	Methodist Church.	Well Drillers Inc.	Dr	163		6		10	Granite	Flat	
116	¾ mile SE of Colfax	Colfax School	J. R. Cummings	Dr	225		6		20	Gneiss	do	
117	1 mile SE of Colfax	J. E. Gray	do.	D-Dr	70		6			do	Ridge	Dug 37 feet. Soft water, no iron.
118	1½ miles SE of Colfax	O. G Brown	do.	D-Dr	43		6	27R	2½	Granite	Draw	Dug 30 feet.
119	3 miles S. of Colfax	Z. P. Campbell	Well Drillers Inc.	Dr	67	60	6		14	do	Hill	Soft water, no iron.
120	Do.	Prison Camp 505	Vir. Mach. Co.	Dr	80		6		16	do	Slope	Soft water.
121	Do.	do.	Heater Well Co.	Dr	141	99	6		20	do	Flat	
122	¼ mile N of Friendship	Methodist Parsonage	W. B. Mayhew	Cr-Dr	80		2		8	Greenstone	do	
123	½ mile E of Friendship	Greensboro-High Point Airport	Danville Well Co.	Dr	123		6	21R	52+	do	Hill	Pumped 24 hours with 44 feet of drawdown at 52 gallons a minute.
124	2 miles NE of Friendship	Motsinger Bros. Dairy	Well Drillers Inc.	Dr	136		6		20	Granite?	do	
125	2 miles NW of Guilford College	Clarence Knight Dairy	J. R. Cummings	Dr	75		6			do	Slope	Water slightly hard, no iron.
126	2 miles NW of Guilford College	W. A. Coble	W. B. Mayhew	Cr-Dr	32	28	3		12	Greenstone	Slope	At 28 feet entered 4 feet of quartz veins.
127	Do.	State Dairy Farm	J. R. Cummings	Dr	88		6		40	do	Hill	
128	1½ miles W of Guilford College	C. C. Cummings	W. B. Mayhew	Cr-Dr	135	100	2		6	do	Slope	
129	2 miles SE of Friendship	Standard Oil Co.	Heater Well Co.	Dr	143	60	8		20	do	Draw	
130	Do.	Shell Oil Co.	do.	Dr	200		6		12	do	Slope	
131	Do.	The Maples	J. Stafford	Cr-Dr	199¾		2		5	do	Flat	
132	Do.	Miller Motor Co.	Well Drillers Inc.	Dr	300		6		0	Greenstone?		No water.
133	Do.	Plantation Pipeline	Vir. Mach. Co.	Dr	204		8	20R	71	Greenstone	Slope	Drawdown 147 feet after 24 hours at 71 gallons a minute. Log in table.
134	2 miles SW of Guilford College	D. E. Petty		Cr-Dr	114		3	16R	16	do	Flat	
135	1½ miles SW of Guilford College	W. H. Blaylock	W. B. Mayhew	Cr-Dr	125		2		4	do	Slope	Water slightly hard, no iron.
136	Do.	Wesley Ferrell	do.	Cr-Dr	70+		2		5	do		
137	½ mile SW of Guilford College	J. O. Lindley	do.	Cr-Dr	120		2		5	do	Hill	
138	½ mile W of Guilford College	Lindley Dairy	do.	Cr-Dr	65	50	2		4½	do	Slope	Water slightly hard, no iron.
139	Do.	do.	do.	Cr-Dr	90		3		10	do	Valley	
140	Do.	S. E. Coble	do.	Cr-Dr	87		2		5-6	do	Hill	
141	Do.	A. J Hollowell	do.	Cr-Dr	110	75	2		5	do		
142	Guilford College	Guilford College	Sydnor Well Co.	Dr	304		8		20	do	Flat	Not used.
143	Do.	Jule Coltrane	W. B. Mayhew	Cr-Dr	167		2		4	do	do	
144	Do.	A. J. Marshburn	do.	Cr-Dr	112½	100	2		8	do	do	Water slightly hard, no iron.
145	½ mile W of Guilford College	J. H. Henshaw	do.	Cr-Dr	95		2	20M	5-6	do	Hill	Soft water, no iron.
146	½ mile S of Guilford College	School	J. R. Cummings	Dr	110		6		30	do	Slope	

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN GUILFORD COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
147	¾ mile S of Guilford College	Dr. John D. Williams	W. B. Mayhew	Cr-Dr	63	60	2		7+	Greenstone		
148	Do.	H. M. Crutchfield	do.	Cr-Dr	75		2		7	do		
149	Do.	O. R. Stout	do.	Cr-Dr	87		2		7	do		Soft water, no iron.
150	Do.	A. S. Long	do.	Cr-Dr	65		2	16R	6	do	Slope	Water contains a little iron
151	Do.	J. W. Simpson & R. G. Simmons	Danville Well Co.	Dr	99	68	6	40R	39	Greenstone	Valley	Drawdown 20 feet.
152	1½ mile S of Guilford College	R. C. Smith		Cr-Dr	70		2		5-6	do	Hill	Water contains some iron.
153	4 miles W of Greensboro	Pomona Terra Cotta Co., No. 2 plant	W. B. Mayhew	Cr-Dr	120	80	3		18	do	Slope	
154	Do.	Pomona Terra Cotta Co., No. 3 plant	do.	Cr-Dr	65-70		3		15	do	do	
155	Do.	Pomona Terra Cotta Co., No. 4 plant	do.	Cr-Dr	120	100	3	12R	20	do	do	
156	Do.	Pomona Mills Co.	Vir. Mach. Co.	Dr	302½		8		60	do	Flat	Temperature 60° F.
157	2½ miles N of Guilford College	E. R. Bond	Heater Well Co.	Dr	150	105	6		3	Granite	Hill	Water obtained at 127 feet.
158	1 mile N of Guilford College	Miss Ada Field	J. Stafford	Cr-Dr	224	70	2		6+	Schist	Slope	Moderately soft water.
159	1½ miles N of Guilford College	Dave Hodgins	Frank Gardner	Cr-Dr	97		2		7	do	Hill	Do
160	Do.	Jefferson Std. Life Ins. Co., farm	Heater Well Co.	Dr	78		6		20	do	Slope	
161	1 mile E of Guilford College	J. M. Crutchfield	do.	Dr	102		6			Greenstone	Hill	Hard water.
162	Do.	S. P. Bryant	do.	Dr	110	105	6		20	do	do	
163	1¼ miles E of Guilford College	J. P. Dillard	W. B. Mayhew	Cr-Dr	115	95	2		6-7	do	do	Water slightly hard.
164	1 mile SW of Battleground	H. G Armfield	Heater Well Co.	Dr	95		6		15	do	Valley	Log in table.
165	1 mile S of Battleground	C. W. Holshouser	G. G. Clayton	Br	50		24	40R		Schist	Flat	Water somewhat hard.
166	½ mile S of Battleground	Hobbs Store	W. B. Mayhew	Cr-Dr	98		2		5	do	do	
167	Do.	Mrs. Mary Lou Woods	J. Stafford	Cr-Dr	70	47	2	40R	8	do	do	
168	1 mile S of Battleground	State Prison Camp	W. B. Mayhew	Cr-Dr	185		2		6-7	do	Valley	
169	1½ miles SE of Battleground	WBTG Radio Station		Dr	118		6	15R	57	do	Draw	Water slightly hard.
170	1¾ miles SE of Battleground	Miss Annie Stratford	W. B. Mayhew	Cr-Dr	93		2		5-6	do	Slope	
171	2 miles SE of Battleground	J. C. Jones	Heater Well Co.	Dr	102		6			do	Ridge	Water fairly soft.
172	Do.	G. P. Rose	W. B. Mayhew	Cr-Dr	104		2		5	do	do	Water fairly soft, no iron.
173	2 miles E of Guilford College	W. T. Dowd	Heater Well Co.	Dr	85	81	6		7	Greenstone	Slope	
174	Greensboro	Southern R. R. Co. Roundhouse	?	Dr	300		6			do	Flat	Very large yield reported.
175	Greensboro?	Southern R. R., Section foreman's house	Southern R. R. Co.	Dr	120±		6		10+	do	do	
176	Greensboro	Mock, Judson, Voehringer Co.	Sydnor Well Co.	Dr	438		8	50R	200	Greenstone	Slope	Drawdown 200 feet. Temperature 60° F.
177	Do.	Vick Chemical Co.	do.	Dr	203		8	28R		do	do	
178	Do.	Geo. C. Brown & Co.	Well Drillers Inc.	Dr	120		6		15	do	Draw	Two other wells 20 and 40 feet deep, 6 inches in diameter, yield 8-10 gallons a minute each Soft. water.
179	Do.	Buffalo Rock Inc.	F. L. Smith?	Dr	126½		6	17R		do	Flat	Satisfactory yield. Soft water.
180	Do.	Piedmont Ice & Coal Co.	Heater Well Co.	Dr	125		8		40	Granite	do	Well abandoned.
181	Do.	do.	do.	Dr	187		8		4	do	do	Do
182	Do.	Colonial Stores Inc.	L. R. Hartsell	Cr-Dr	55		4		10	do	Hill	
183	3 miles NW of Greensboro	Floyd H. Craft	Heater Well Co.	Dr	101	83	6⅝		4	Schist	Slope	Log in table.
184	Do.	Lewis A Raulston	do.	D-Dr	58	54	6⅝	8R	20	do	do	Dug 24 feet. Soft water
185	Do.	A. Stern	do.	Dr	110	68	6⅝		5	do	Flat	
186	Do.	G. R. Cates	Carl Greggerson	Cr-Dr	165		2		3-5	do		

[1, 2, 3] Footnotes given at beginning of table.

RECORDS OF WELLS IN GUILFORD COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
187	3 miles NW of Greensboro	E. G. Rawlins	?	Cr-Dr	95		2		5-6	Schist	Slope	
188	2 miles NW of Greensboro	R. G. Hardin	F. L. Smith	Dr	290±?		6		14	do	Flat	Soft water, no iron.
189	3½ miles NE of Greensboro	Rankin School	?	Dr	120		6		15	Greenstone		
190	4 miles NE of Greensboro	Mrs. C. A. McNealy	W. B. Mayhew	Cr-Dr	132		2	23R	5	do	Flat	Hard water.
191	Do	H. B. Powell	do	Cr-Dr	80		2	25R	7½	Granite?	Slope	Water is not hard.
192	Do	G. D. Wyrick	Carl Greggerson	Cr-Dr	215		2		3½	Greenstone	Flat	Moderately soft water.
193	Do	O. H. Graham	do	Cr-Dr	170		2		6½	do	do	Do
194	Do	R. E. Fittchett	W. B. Mayhew	Cr-Dr	80		2		7¾	do	Slope	Soft water.
195	Do	Joe Walters	do	Cr-Dr	120		2		7	do	do	
196	Do	do	do	Cr-Dr	70		2		6	do		
197	Greensboro	Proximity Mfg. Co., White Oak Mill		Dr	322		8?		55	do	Valley	
198	Do	Proximity Mfg. Co., (Revolution Mill)	Sydnor Well Co.	Dr	437		8		100	do	do	Not in use at present.
199	Do	do	do	Dr	402	60±	8		100	do	do	
200	Do	Proximity Mfg. Co., Print Works	do	Dr	100		8		100	do	do	
201	Do	Proximity Mfg. Co., Hubbard St.	Sydnor Well Co.	Dr	282		8	17R	180	do	Slope	Log in table Analysis in table. Temperature 61° F.
202	Do	Proximity Mfg. Co., at Standpipe	do	Dr	487		8		70	Granite?	do	Not in use.
203	Do	Proximity Mfg. Co., Revolution Mill	do	Dr	858		8		5	Granite	Flat	Do
204	East edge of Greensboro	Mrs. George Smith	J. Stafford	Cr-Dr	126		2		8	do		Soft water, no iron.
205	Do	Bessemer School	J. R. Cummings	Dr	110		6		10-12	do		
206	3 miles E of Greensboro	County Home	W. B. Mayhew	Cr-Dr	78	60	3		6	do		Analysis in table.
207	Do	do	do	Cr-Dr	78	60	3		6	do		
208	Do	do	Heater Well Co.	Dr	250	35	8		4	do		
209	Do	do	do	Dr	100		8		6	do	Slope	
210	Do	County Dairy	J. R. Cummings	Dr	700		6		2	do	do	
211	Do	do	do	Dr	700		6	165R	7	do	Hill	Hard water.
212	Do	Prison Camp	W. B. Mayhew	Cr-Dr	120		2	30R	7	do	Slope	Soft water, no iron.
213	3½ miles E of Greensboro	Tabor Hudson	Heater well Co.	Dr	72		6	20R	5	do	Flat	Soft water.
214	Greensboro	D. D. Stout, Home Ice Plant	do	Dr	200	74	6	10R	24	do	do	Soft water; pH 6.5; Chloride 6 parts per million. Log in table.
215	2 miles SE of Greensboro	J. V. Hunt, Woodland Dairy Farm	Danville Well Co.	Dr	256		6	20R	30	Greenstone	Valley	Drawdown 100 feet.
216	5½ miles E of Greensboro	P. C. Clapp	Well Drillers Inc.	Dr	123½		6	21R	20±	Granite	Flat	Soft water.
217	6 miles E of Greensboro	Miss Hazel Teague	do	Dr	104		6		10-15	do	do	Soft water, no iron.
218	Do	A. W. Higgins	do	Dr	160		6		26	do	do	Soft water.
219	6 miles W of Gibsonville	McLeansville School	J. R. Cummings	Dr	120		6		12	do		Water contains some iron.
220	Do	A. B. Holt	?	Br	27	27	24	16M		do	Flat	
221	5 miles NW of Gibsonville	Robah C. LaMarr	Heater Well Co.	Dr	49	42	6	20R	1	do	Hill	
222	5 miles W of Gibsonville	L. L. Bolick	do	Dr	42		6	8R	20	do	Draw	Soft water, no iron.
223	3 miles NW of Gibsonville	P. E. Lowe	W. P. Phillippi	Cr-Dr	50½	45	2	25R	9½	Greenstone	Slope	Water from quartz vein at 45 to 50 feet.
224	2½ miles NW of Gibsonville	L. G. Loy	do	Cr-Dr	53	30	2		5	do	do	Hardness 35 to 40 parts per million.
225	2 miles NW of Gibsonville	Friedens Lutheran Church	do	Cr-Dr	148		2		4	do	Flat	
226	1½ miles NW of Gibsonville	Mrs. Eric Summers	W. P. Phillippi	Cr-Dr	48		2			Greenstone	Slope	Water moderately hard, some iron.
227	1¼ miles NW of Gibsonville	W. J. Sockwell	F. L. Smith	Dr	67		6	25R	9	do		Water slightly hard, some iron.
228	1 mile NW of Gibsonville	R. C. Apple	W. P. Phillippi	Dr	137	18	2		5	do	Hill	
229	Gibsonville	Minneola Mfg. Co.	Sydnor Well Co.	Dr	557	207	8	70R	65	do	Draw	Pumping level reported to be 90 feet below surface.
230	Do	do	do	Dr	436	80	10	50R	50	do	Flat	Water reported to be coming from above 200 feet. Temperature 63° F.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN GUILFORD COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
231	Gibsonville	Minneola Mfg. Co.	F. L Smith	Dr	204	41	6		30	Greenstone	Flat	Most of water from above 125 feet.
232	Do	do	do	Dr	300	65	6		40	do	Draw	
233	Do	City	Sydnor Well Co.	Dr	201	201	8			do	Hill	Tested at 110 gallons a minute, failed in service. Log in table.
234	Do	do	do	Dr	201	201	8	37R	100	do	do	Log similar to log of well 133.
235	1¾ miles S of Gibsonville	A. M. Shepard, estate	F. L. Smith	D-Dr	80		6		1	do	do	Dug 45 feet.
236	Do	Mrs. Hattie Shepard	do	Dr	65		6			do	Flat	Very small yield.
237	2¼ miles SW of Gibsonville	J. L. Dick	do	Dr	121	11	6	30R	1±	do	Hill	Water comes in at 46 feet.
238	Do	Lee H Ingle	Heater Well Co.	Dr	36		6	9R	10	do	Draw	
239	Do	J. C. Cowan, Sinclair Station	F. L. Smith	Dr	56		6		16–18	do	Valley	
240	3 miles SW of Gibsonville	Whitsett School	do	Dr	165		6		5±	do	Flat	
241	Do	C. E. Edgerton	do	D-Dr	65		6		3	do	Slope	Dug 40 feet.
242	5 miles SW of Gibsonville	Rock Creek Dairy	J. R. Cummings	Dr	120		6		5	do	do	
243	Do	do	F. L. Smith	Dr	160	50	6		25	do	do	Hard water.
243a	5½ miles SW of Gibsonville	do	do	Dr	54	44	6		20	do	Hill	
244	5 miles SW of Gibsonville	Palmer Memorial Institute	Vir. Mach. Co.	Dr	380		8	37R	90+	do	do	Drawdown 90 feet.
245	6 miles SW of Gibsonville	Girl Scout Camp	J. Stafford	Cr-Dr	80		2		3-4	do		
246	6 miles NE of Julian	J. L. Neese	W. P. Phillippi	Cr-Dr	74		2		5	Slate		Moderately soft water.
247	Do	O. G. Priddle	do	Cr-Dr	103	40	2		¼	do		
248	7 miles NE of Julian	J. B. Apple	do	Cr-Dr	100+		2			do	Hill	Small yield.
249	5½ miles NE of Julian	J. B. Corsbie	do	Cr-Dr	65		2		2½	Granite	do	Moderately soft water, some iron.
250	6 miles N of Julian	C. P. Phillips	F. L. Smith	Dr	159	9	6	12R	20	do	Valley	
251	6½ miles N of Julian	Geo. H. Lynch	W. P. Phillippi	Cr-Dr	138		2		1±	Granite		
252	5½ miles N of Julian	G. W. Shoffner	F. L. Smith	Dr	57	48	6		2½	do	Hill	
253	7½ miles SE of Greensboro	R. V. Andrews	Carl Greggerson	Cr-Dr	178		3	20R	3	do	Slope	Drawdown 25 feet.
254	6 miles SE of Greensboro	Charles Wade	F. L. Smith	Dr	87		6		25	do	do	
255	Do	Alamance School	J. R. Cummings	Dr	140		6		10	do	do	
256	Do	W. F. Brower	Well Drillers Inc.	Dr	80		6		15	do		
257	Do	Alamance Presbyterian Church	Carl Greggerson	Cr-Dr	190	46	2	28R	10	do	Hill	Hard water.
258	4½ miles SE of Greensboro	Frank Allred	Well Drillers Inc.	Dr	87		6		6	Greenstone	do	Soft water.
259	5½ miles SE of Greensboro	Robert Forsyth	Frank Gardner	Cr-Dr	69	17	2		5-6	do	Valley	
260	4 miles SE of Greensboro	Neese Country Sausage Co.	T. A. Leadbetter	Dr	48		6	18R	12	do	Slope	
261	Do	do	W. B. Mayhew	Cr-Dr	54	20	2	18R	9	do	do	Not used.
262	Do	do	do	Cr-Dr	185		3		2½	do	Hill	Never used, insufficient water.
263	Do	Charles T. Sharpe	do	Cr-Dr	108	68	2		6	do	Flat	
264	3 miles SE of Greensboro	Robert Sharp	do	Cr-Dr	70		2		6	do		
265	2½ miles SE of Greensboro	Tom Pemberton	Auman	Dr	42		6	22R	25	do	Draw	Soft water.
266	3 miles SE of Greensboro	A. Hoyle Hinkle	F. L. Smith	Dr	132	36	6	28R	25–30	do	Hill	Moderately soft water.
267	3½ miles SE of Greensboro	C. F. Swain	W. B. Mayhew	Cr-Dr	158	52	2		5–6	do		
268	Do	Henry Sharpe	do	Cr-Dr	38	30	2		6	do	Valley	
269	4 miles SE of Greensboro	C. A. Scott	do	Cr-Dr	72	60	2		7+	do	do	
270	2 miles N of Pleasant Garden	Mr. Kemp	do	Cr-Dr	75±	10+	2		4+	Granite		
271	2 miles NW of Pleasant Garden	J. Nickols	do	Cr-Dr	108		2		6	do		
272	Do	T. W. Ritter Ritter's Lake	do	Cr-Dr	52		2		1½	do	Valley	Well flows 1½ gallons a minute
273	Do	T. W. Ritter	Heater Well Co.	Dr	142		6	10R	20	do	do	
274	Do	do	W. B. Mayhew	Cr-Dr	46		3		20	do	do	Not in use.
275	Do	do	do	Cr-Dr	100		2		4	do	do	Do
276	2 miles NW of Pleasant Garden	H. L. Clodfelter	W. B. Mayhew	Cr-Dr	134		2		9	do	Draw	Soft water.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN GUILFORD COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
277	2¼ miles NW of Pleasant Garden	Alvin T. Haley	W. B. Mayhew?	Cr–Dr	72	68	2	35R	5–6	Granite	Hill	Water not hard, no iron.
278	3 miles N of Pleasant Garden	D. F. Engle	Carl Greggerson	Cr–Dr	117	32	2	35R	5–6	Greenstone	Slope	
279	4 miles S of Greensboro	C. E. Mosier	W. B. Mayhew	Cr–Dr	114	46	2	30R	4½	do		
280	Do.	N L. Biggs	do	Cr–Dr	110	85±	2	30R	5–6	Granite		
281	Do.	Kirby Kirtman	do	Cr–Dr	90	70	2		5–6	Greenstone		
282	3½ miles S of Greensboro	Mrs Sherril	do	Cr–Dr	60	50	2		8+	do	Slope	
283	Do.	H A. Lane	do	Cr–Dr	55±		2		4	do	Hill	
284	Do.	Mrs. D. W. Romsuer	do	Cr–Dr	98	80	2		5	do	Flat	
285	3 miles S of Greensboro	Charles B. Routh	Heater Well Co.	D–Dr	62	26	6	25R	3	do	Slope	Water somewhat hard.
286	2 miles S of Greensboro	American Agriculture Chemical Co.	Sydnor Well Co.	Dr	433	90	8	30R	35	do	Hill	Quartz vein at 400 feet.
287	Do.	Carolina By-Products Co.	do	Dr	521		8		100+	do		
288	Do.	do	do	Dr	299	50	8		13	do	Draw	Temperature 61° F. Water comes in at 176 feet.
289	1½ miles S of Greensboro	G. S. Miles, Stables	J. Stafford	Cr–Dr	198		2		5	do		
290	2 miles S of Greensboro	Armour Fertilizer Plant	Danville Well Co.	Dr	271	75	6	10R	60	do	Valley	Drawdown 35 feet. Temperature 61° F.
291	2½ miles SW of Greensboro	G. W. Crouse	W. B. Mayhew	Cr–Dr	80		2		7	Granite	do	
292	2¼ miles S of Greensboro	WGBG Radio Station	Heater Well Co.	Dr	58	43	6		20	Greenstone	do	Water from quartz veins.
293	3 miles SW of Greensboro	J. C. Inmon	W. B. Mayhew	Cr–Dr	90	60	2		5	Granite	Hill	Soft water, no iron.
294	3 miles S of Greensboro	O. D. Park	Danville Well Co.	Dr	85		6		15	Granite?		
295	4 miles SE of Sedgefield	Summer School		Dr	80		6		8–10	Granite	Flat	Water contains much iron.
296	2½ miles E of Sedgefield	W. R. Johnson	W. B. Mayhew	Cr–Dr	105	80	2		0–7	do	Hill	
297	2 miles NE of Sedgefield	R. H. Swiggart	Well Drillers Inc.	Dr	123		6		0	do	Flat	
298	1¼ miles NE of Sedgefield	H. A. McNary	W. B. Mayhew	Cr–Dr	60		2		6	Greenstone	Valley	
299	Do.	Mrs. Jewel Smith	Heater Well Co.	Dr	87	76	6	30 R	20	do	Flat	Drawdown 12 feet. Log in table.
300	½ mile E of Sedgefield	Mrs. J. H. Adams	Sydnor Well Co.	Dr	900		6		0	Granite	Hill	
301	Sedgefield	Pilot Life Insurance Co.	Sydnor Well Co.	Dr	308		8		65	Greenstone	Slope	Water slightly hard
302	Do.	Dr. A. T. Smith	J. Stafford	Cr–Dr	80		2		5–6	Granite	Hill	Soft water.
303	Do.	R. E. Bowman, Dairy	J. R. Cummings	Dr	375		4		30–40	Greenstone		
304	½ mile SW of Sedgefield	Dr. R. F. Wakefield	J. Stafford	Cr–Dr	102		2		16	Granite	Flat	
305	1 mile W of Sedgefield	Mrs. J. H. Adams, Farm	Heater Well Co.	Dr	110		6		20	Greenstone?	Valley	Water somewhat hard. Temperature 59° F.
306	1½ miles N of Jamestown	Edward Armstrong John Aldred	do	Dr	51		6		8–10	Granite	Slope	
307	1¼ miles N of Jamestown	Edward Armstrong	F. L. Smith	Dr	146½		6		15–20	do	do	Water moderately hard.
308	Jamestown	Mrs. Lucie C. Ragsdale	Courson	Dr	150		4			do	Hill	Water slightly hard.
309	Do.	R. E. Buody	W. B. Mayhew	Cr–Dr	45		2		6	do	Slope	
310	Do.	O. M. Bundy	do	Cr–Dr	90		2		6–7	do		
311	3 miles NE of High Point	Lindale Dairy Farm	F. L. Smith	Dr	240	32	6	10R	30±	Granite?	Valley	
312	4½ miles NE of High Point	Hortence White	Heater Well Co.	D–Dr	76		6		½	Granite	Hill	Dug 39 feet.
313	4½ miles NW of High Point	F. L. Warford	do	Dr	125	46	6		20	Gneiss	do	
314	3 miles N of High Point	Sherwood Forrest	Well Drillers Inc.	Dr	276	100+	6			Granite	Flat	Large yield.
315	Do.	Mrs. Lena Thacker	L. R. Hartsell	Cr–Dr	80	40	4		15	do	Hill	
316	Do.	O. W. Butner	M. A. Holder	Dr	164		5⅝		20	Granite?	Slope	Hardness 56 parts per million, some iron.
317	Do.	Oak View School		Dr	90		6		20	Granite	do	
318	2¾ miles NW of High Point	J. C. Currie	L. C. Hartsell	Cr–Dr	57	50	4		30	do	do	Soft water.
319	Do.	J. M. Young	do	Cr–Dr	58	54	4			do	Draw	Large yield. Hard water.
320	High Point	Adams Millis		Dr	120		4	40R	50	Greenstone	do	Hard water. Temperature 61° F.
321	Do.	Adams Millis Corp. (Hosiery Mills)		Dr	124		6	35R	75	do	do	Temperature 62½° F.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN GUILFORD COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
322	High Point	J. N. Wright	L. R. Hartsell	Dr	113	100	6	36½M	7	Greenstone	Flat	Used for air conditioning.
323	Do.	Cloverbrand Creamery	J. R. Cummings	Dr	96		6		13	do	do	
324	Do.	Powell & Headen		Dr	175		4			do	do	Large yield, hard water. Not used.
325	Do.	Highlands Cotton Mills, Inc.		Dr	190	100	6		12	Slate?	Slope	Hard water.
326	Do.	Cloverdale Dye Plant	Sydnor Well Co.	Dr	750		6		5	Slate	Hill	Insufficient water, never used.
327	Do.	Colonial Stores, Inc.	L. R. Hartsell	Cr-Dr	68		4		15+	Greenstone	Flat	Drawdown reported negligible.
328	Do.	Logan Porter Mirror Co.	do.	Cr-Dr	75		6	25R	100	do	do	Analysis in table. Temperature 62° F.
329	Do.	Slane Hosiery Mill	Heater Well Co.	Dr	160		6		120	do	Slope	Water from quartz veins at 90 and 120 feet. Drawdown 3 feet at 120 gallons a minute.
330	Do.	Crown Hosiery Mill		Dr	240		8	20R	200	do	Flat	Water moderately hard; owner uses a softener.
331	Do.	High Point Weavieg Co.		Dr	900		8			Slate		Not used.
332	3 miles SE of High Point	S. O. Peebles	L. R. Hartsell	Cr-Dr	64		6		10+	Granite	Slope	
333	Do.	N. J. McCuiston		Cr-Dr	92	80	4		10+	do	do	
334	Do.	Mrs. L. J. Marshall	L. R. Hartsell	Cr-Dr	68		4	16R	10±	do		
335	Do.	S. W. Horn	do.	Cr-Dr	84	65	4		10±	do	Slope	Large yield, soft water.
336	Do.	Lonnie Dickens	do.	Cr-Dr	54	45	4		10+	do		
337	Do.	D. W. Beck	do.	Cr-Dr	62		4			do	Slope	Adequate yield.
338	Do.	S. W. Horn	do.	Cr-Dr	52	45	4		10+	do	do	
339	3¾ miles SE of High Point	J. A. Pope	do.	Cr-Dr	49	47	4		5	do		Soft water.
340	4 miles SE of High Point	Allen Jay School	F. L. Smith	Dr	60		6		5±	do	Flat	Owner also has a second well, same depth and yield.
340a	Do.	do.	Well Drillers Inc.	Dr	?		6		9?	do	do	
341	3 miles E of High Point	P. W. Helms	M. A. Holder	Dr	90		5⅝		12	do		
342	Do.	Union Hill School		Dr	90		6		20	do	Slope	
343	Oakdale	Oakdale Cotton Mills	W. B. Mayhew	Cr-Dr	45		2		10	do	Valley	Analysis in table.
344	Do.	do.	do.	Cr-Dr	45		2		10±	do	Slope	Three wells in village with this depth and yield.
344a	Do.	do.	Courson	Cr-Dr	100		2		10±	do	do	Four wells in village with this depth and yield.
345	Do.	do.		Dug	30		24	25¼M		do	do	Analysis in table.
346	1½ miles SE of Jamestown	Dr. H. L. Brockman	Heater Well Co.	D-Dr	74	68	6		15	Greenstone	do	Dug 44 feet. Soft water.
347	6 miles SE of High Point	J. E. Millis	?	Dr	380		8		25-30	Granite	Hill	Hard water.
348	8 miles E of High Point	R. Morgan	J. R. Cummings	Dr	117	16	6	46R	1/6	do	do	
349	2½ miles NW of Pleasant Garden	S. B. Tye	W. B. Mayhew	Cr-Dr	106		2		5-6	Granite	Hill	
350	Do.	S. J. Lasley	do.	Cr-Dr	112		2		6	do	do	Soft water.
351	2 miles NW of Pleasant Garden	Cone Country Club	do.	Cr-Dr	65	6	3		15	do	Valley	Water contains iron
352	2 miles W of Pleasant Garden	J. A. Vaughn	Heater Well Co.	Dr	125	25	6		1	do	Hill	Soft water, contains iron.
353	2 miles SE of Pleasant Garden	W. B. Ross, Dairy	W. B. Mayhew	Cr-Dr	110	80	3		12	Greenstone		
354	Pleasant Garden	Pleasant Garden School	do.	Dr	120	80	2		5-6	do		
355	Do.	Robbins Mill Works	do.	Cr-Dr	85±		2½		10	do	Valley	
356	Do.	P. F. Reddick	do.	Cr-Dr	80		2		7-8	Granite		
357	Do.	S. Reddick	do.	Cr-Dr	80	70	2		8	do		
358	¾ mile NW of Pleasant Garden	Walter Wright	C. R. Overman	Cr-Dr	190		2		5-6	do		
359	Pleasant Garden	W. B. Kerns	E. C. Younts	Cr-Dr	82		2		7	do		
360	Do.	E. L. Rummage	W. B. Mayhew	Cr-Dr	109		2	38R	7-8	Greenstone?		Hard water.
361	2½ miles NW of Climax	W. B. Kerns	C. R. Overman	Cr-Dr	312		2			Granite	Hill	Very small yield
362	1¾ miles NW of Climax	E. B. Hockett	Carl Greggerson	Cr-Dr	150	39	2	22R	2	do	do	Log in table.
363	2½ miles N of Climax	A. T. Jones	do.	Cr-Dr	123½	44	2		4	Greenstone	do	Hard water contains much iron.
364	Climax	W. T. Parrish		Cr-Dr	70	63	2		12-15	Slate	Flat	

1, 2, 3 Footnotes given at beginning of table.

RECORDS OF WELLS IN GUILFORD COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
365	Climax	J. W. Moore	Carl Greggerson	Cr-Dr	42	67	2		6	Slate	Valley	Soft water.
366	Do	R. S. Donnell	do	Cr-Dr	100		2		9	do	Flat	Do
367	Do	M. L. Allred	do	Cr-Dr	85½	80?	2		12	do	do	
368	Do	Climax Corp.	W. B. Mayhew	Cr-Dr	120	100	3		15	do		
369	¾ mile E of Climax	M. T. Parish	Parish & Younts	Cr-Dr	97	57	2		15	do		
370	½ mile NW of Julian	D. F. McClintock	W. B. Mayhew	Cr-Dr	118		2		5-6	do		Soft water with a little iron.
371	Julian	T. B. Reynolds	do	Cr-Dr	170		2	20R	6	do		Soft water.
372	Do	S. R. Stafford	Z. V. Jones	Cr-Dr	99?		2			Granite		Moderately soft water, with a little iron.
373	4½ miles N of Julian	Lutheran Church	T. A. Leadbetter	Dr	90	30+	6		3½	Greenstone	Hill	Moderately soft water.
374	4 miles NE of Julian	Nathanael Greene School	?	Dr	140		6		10+	Slate?	Hill	Water contains some iron.
375	6 miles NE of Julian	Mrs. Pearl Bailey	W. B. Mayhew	Cr-Dr	95		2		5	Slate	Flat	
376	7½ miles NE of Julian	Dan Bowman	F. L. Smith	D-Dr	63½		6	33½M		Granite	Hill	Dug 49 feet.
377	7 miles NE of Julian	L. G. Clapp	do	Dr	41		6	21R	½	do	do	

RECORDS OF SPRINGS IN GUILFORD COUNTY

Location	Name	Yield gallons a minute	Chief aquifer	Topographic location	Remarks
A—5 miles NE of High Point	C. M. Borum	½	Granite	Valley	Spring issues from contact of overburden and solid rock. Has never failed.
B—2½ miles S of Gibsonville	J. H. Joyner and others	5-10	Greenstone	Flat	Water issues from fractures or cleavages in the greenstone schist. Supplies 7 homes. Water slightly hard.

[1], [2], [3] Footnotes given at beginning of table.

ANALYSES OF GROUND WATER FROM GUILFORD COUNTY, NORTH CAROLINA
(Analysts: E. W. Lohr, M. D. Foster, and M. S. Berry, U. S. Geological Survey. Numbers at heads of columns correspond to numbers in table of well data)
(parts per million)

	22	43	111	201	206	328	343	345
Silica (SiO_2)	32		22	32			38	48
Iron (Fe)	.02		.01	.0			.02	.04
Calcium (Ca)	23		4.0	59			21	53
Magnesium (Mg)	4.1		1.6	13			6.7	29
Sodium and Potassium (Na+K)	12		6.6	21			18	25
Carbonate (CO_3)	0		0	0			0	0
Bicarbonate (HCO_3)	116	23	22	181	48	48	50	148
Sulfate (SO_4)	2	a2	2	48	a8	a18	21	55
Chloride (Cl)	2	2	6	30	29	30	35	64
Fluoride (F)		.0		.3	.0	.0		
Nitrate (NO_3)	.5	3.2	2.9	5.1	19	31	7.6	45
Dissolved solids	138		63	311			188	422
Total hardness as $CaCO_3$	74	21	17	201	86	111	80	252
Date of collection, 1942	Aug. 14	Aug. 14	Sept. 17	June 5	Aug. 12	Nov. 12	Sept. 18	Sept. 18
Depth (feet)	271	130	63	274	78	75	45	30
Chief aquifer	Granite	Granite	Granite	Granite (?)	Granite	Greenstone schist	Granite	Granite

a By turbidity

LOG OF WELL 133, 2 MILES SE OF FRIENDSHIP
(Driller's log)

	Thickness (feet)	Depth (feet)
Greenstone schist (?):		
Clay, red	65	65
Sand	5	70
Shale	6	76
Granite, gray	28	104
Granite, bluish	52	156
Granite, very fine-grained, blue	48	204

LOG OF WELL 164, 1 MILE SW OF BATTLEGROUND
(Driller's log, with comments by the writer)

	Thickness (feet)	Depth (feet)
Greenstone schist (?):		
Shale, yellow	51	51
Flint, blue (silicified schist?)	9	62
Flint, dark gray (silicified schist?)	8	70
Granite, gray	8	78
Varied blue stone and quartz	12	90
Rock, green, blue, yellow	5	95

LOG OF WELL 183, 3 MILES NW OF GREENSBORO
(Driller's log)

	Thickness (feet)	Depth (feet)
Sericite schist (?):		
(Old well)	28	28
Clay	30	58
Mud	15	73
Shale, blue	28	101

LOG OF WELL 201 AT GREENSBORO
(Driller's log)

	Thickness (feet)	Depth (feet)
Greenstone schist:		
Soil	3	3
Sandstone, becoming harder	17	20
Blue granite	30	50
Hard gray granite	78	128
Black granite (crevice struck at 144 feet and had to fill in 2 or 3 times to turn tools)	18	146
Dark blue granite, hard	128	274
Blue granite	7	281
Gray granite	1	282

Completion test: Static level 17 feet. Pump setting 218 feet. Pumped 2¼ hours at 225 gallons a minute, 19 hours at 180 gallons a minute. (Well originally 274 feet deep. Deepened to 282 feet in 1944. Samples examined from the last 8 feet of drilling were greenstone schist.)

LOG OF WELL 214, AT EAST EDGE OF GREENSBORO
(Driller's log, with comments by the writer)

	Thickness (feet)	Depth (feet)
Granite:		
Granite, weathered	42	42
Granite, weathered, yellow	29	71
Granite, gray	19	90
Granite, light gray	12	102
Rock, hard, blue (salty dike?)	51	153
Granite, gray	29	182
Granite, light gray	18	200

LOG OF WELL 233, GIBSONVILLE
(Driller's log)

	Thickness (feet)	Depth (feet)
Greenstone schist:		
Clay, red and gray	133	133
Rock, soft, rotten	18	151
Rock, white flint	9	160
Rock, white flint, and blue-green rock	20	180
Rock, soft blue, caving	21	201

LOG OF WELL 299, 1¼ MILES NE OF SEDGEFIELD
(Driller's log)

	Thickness (feet)	Depth (feet)
Greenstone schist:		
Clay, red	22	22
Clay, yellow and sand	23	45
Sand, yellow and blue	7	52
Sand, white	16	68
Sand, white and white flint rock	5	73
Shale, blue	14	87

LOG OF WELL 362, 1¾ MILES NW OF CLIMAX
(Driller's log)

	Thickness (feet)	Depth (feet)
Granite:		
Clay	22	22
Quicksand	5	27
Sandrock	12	39
Granite, gray, hard	111	150

ROCKINGHAM COUNTY

(Area, 572 square miles; population, 57,898)

Geography, physiography, and drainage.—Rockingham County, in the north-central part of the Greensboro area, is the second largest county in the area. There are five incorporated cities and towns in the county and four unincorporated towns and villages. Reidsville is the largest incorporated city, but the combined population of Leaksville-Spray is considerably more, although most of the area is not incorporated. Reidsville has an important cigarette manufacturing industry and Leaksville-Spray has a number of large textile mills. Textile mills and furniture factories are located in the other, smaller towns. Agriculture is the chief occupation outside these towns. Rockingham County has an excellent system of improved highways and is served by three railroad systems.

Rockingham County is in the Piedmont physiographic province, which is characterized by a dissected upland plateau-like surface formed by uplift and partial dissection of a peneplane. Large areas between the larger streams are relatively flat, but near these streams the upland has been dissected and the topography has reached approximate maturity, most of the surface consisting of slopes with little flat upland or lowland. The surface is particularly rugged in a strip several miles wide along the southeast side of the Dan River basin. In this area even the smaller streams tributary to the Dan have cut down several hundred feet below the upland surface. The basin of Dan River, formed in Triassic rocks, possibly should be considered as a separate division of the Piedmont province, because it is much lower and has had a different physiographic history. The peneplane has been entirely removed by lateral planation of Dan River and its tributaries and has been replaced by a strath extending parallel to the river and sloping southeastward from the northwestern contact of the gneiss and the Triassic. The southeastward slope of this strath terminates abruptly against the wall of crystalline rocks forming the southeastern bank of Dan River.

Slightly more than 80 percent of Rockingham County is drained by Dan River and its tributaries, the most important of which are Mayo River, Smith River, Hogans Creek (in the west part of county), Wolf Island Creek and Hogans Creek (in the east part of county). The remaining 20 percent of the county is drained by Haw River and its tributaries, the most important of which is Troublesome Creek. Structural control of the drainage is quite apparent, showing prominently not only in aerial photographs but also in maps showing the drainage. Dan River is of course the most outstanding example, flowing northeastward along the southeastern edge of the Triassic rocks. The slope of the Piedmont province is quite uniformly to the southeast but the course of Dan River is deflected many miles to the northeast before it breaks across the structure to turn southeastward again in the lower reaches of the river. Most of the smaller streams in Rockingham County likewise show the effects of structural control. It is not certain, however, whether they follow beds of weaker rocks striking northeastward or whether their courses are determined by strike faults. It is probable that both of these structural features control some stream-courses at different places.

Topographic maps have been made only of a strip about 3 miles wide along the northern boundary of the county. However, these probably illustrate fairly well the topographic features of the county. The maximum local relief is nearly 300 feet, although the difference in elevation of the highest and lowest points in the county is more than 595 feet. The lowest point is on Dan River at the Rockingham-Caswell County line and is about 445 feet. The highest points shown on the topographic maps, which probably are the highest points in the county, are in the northeastern corner of the county and rise above 1,040 feet.

Geology.—Five of the nine geologic units mapped in the Greensboro area crop out in Rockingham County. The geology, in terms of the broad units used in mapping, is relatively simple.

Most of the county is underlain by the gneiss unit. The rocks consist principally of quartz-mica-feldspar gneiss and quartz-mica schist. At many places the schist is garnetiferous and at some places the gneiss is also. At a few places the gneiss contains so much quartz as properly to be classed as a gneissic quartzite. The bedding of these rocks is apparent at many places and folding has been only moderate. Generally dips are from 30° to 50°. Although the rocks dip to the northwest in a few places, the most common direction of dip is to the southeast.

Greenstone schist underlies about 1 square mile in the extreme southeastern corner of the county. These rocks consist of metamorphosed fine- to medium-grained green basic volcanic rocks. Generally they are extensively sheared and are quite schistose.

The sericite schists underlie 8 or 10 square miles immediately to the northwest of the greenstone schists in a belt about 2 miles wide extending northeastward across the county. The rocks are deeply weathered, forming a bright red soil and subsoil. The rock presumably is chlorite-sericite schist.

Granite underlies several small areas along the southern boundary of the county, only two of which are shown. It is intrusive into the gneiss and the effects of the emanations from the granite magma are seen at many places where no true granite is exposed. At other places small pods, bosses, and other masses occur in the gneiss that are too small to map. The granite is nowhere well exposed, but it is evidently the typical coarse gray porphyritic granite so characteristically exposed in Forsyth and Guilford Counties.

The Triassic rocks are exposed in a belt 2½ to 6 miles wide across the northwestern corner of the county. It occupies a total area of about 105 square miles. Along the southeastern edge of the belt the Triassic rocks lie unconformably upon the gneisses and dip northwest at an average angle of about 35°. The dip is fairly uniform across the entire belt, and it is apparent that the northwestern margin of the Triassic is marked by a fault, the Triassic having been downdropped several thousand feet. The thickness of the Triassic ranges from a feather edge where it overlies the gneiss along the southeast side of Dan River to 7,000 or 8,000 feet where it has been faulted downward against the gneiss. The Triassic rocks consist of arkosic sandstone, shale, mudstone, and conglomerate. They are usually red in color and are often cross-bedded. Most of the beds are lenticular so that individual beds can be traced only for a short distance. Certain horizons, however, are quite persistent, and mapping in detail would permit separating the Triassic rocks into several formations. The arkosic conglomerate is particularly outstanding. It forms a ridge for at least half the length of the Triassic belt. The ridge extends N. 58° E. from approximately the Stokes County line, passing about a mile northeast of Mayodan, nearly to the bridge over the Mayo River on U. S. highway 220, midway between Mayodan and Stoneville. The ridge here appears to be offset by a fault, commencing again at the eastern edge of Mayodan, extending about N. 60°. E. for about 3 miles, then gradually veering northward to strike about N. 40° E. and crossing State highway 770 about 3 miles east of Stoneville, after which it dies out. A ridge of the same rock extends about N. 60° E. into Virginia from the eastern edge of Spray. The fault offsetting the ridge at Mayodan apparently strikes about N. 45° E. and the Mayo River follows this fault for about 2 miles. There probably are many other faults in the Triassic which would be revealed by detailed mapping.

Ground water.—Practically all domestic water supplies, many industrial supplies, and two public water supplies are obtained from wells in Rockingham County. A few domestic supplies are obtained from springs but the other ground-water supplies are obtained from wells. Dug wells are used extensively in rural areas. Because the gneiss generally is deeply weathered, they can be dug deep enough that few of them go dry, except in periods of extreme drought. Dug wells in the gneiss range from about 20 feet to 80 feet deep, and the depth to water ranges from about 15 feet to 75 feet. The water level in the Triassic rocks at most places is considerably closer to the surface and, even though the Triassic rocks are not deeply weathered, wells can usually be dug deep enough in the shales and sandstones to obtain satisfactory supplies.

A few bored wells are used in rural sections and a considerable number are used in suburban areas. These furnish satisfactory amounts of water at most places. Both dug and bored wells obtain their water from the weathered and disintegrated rock and are in greater danger of becoming contaminated than drilled wells.

Drilled wells are used for many domestic water supplies and practically all industrial and public ground-water supplies. Advantages of drilled wells are greater safety from contamination or pollution, less chance of going dry, and a generally much greater yield. Because most of the county is underlain by two geologic units, the gneiss and the Triassic rocks, nearly all drilled wells are in these two rock units. Table 17, below, gives a summary of the data on drilled wells in Rockingham County.

TABLE 17—SUMMARY OF DATA ON WELLS IN ROCKINGHAM COUNTY
(Drilled wells 3 inches or more in diameter)

ACCORDING TO ROCK TYPE

Type of Rock	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Gneiss	112	134	0—38	6.7	0.049	9.0
Porphyritic granite	2	162	0—3	1.5	.009	50
Triassic	41	163	1—75	15.6	.096	2.4
Sericite shcist	2	95	4—25	15.5	.152	0
All wells	157	141	0—75	9.0	.064	7.6

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Hill	62	142	0—30	4.4	0.031	32.2
Flat	26	139	1—75	15.0	.108	3.8
Slope	48	124	0—25	7.8	.063	10.4
Draw	6	244	7½—75	25.5	.104	0
Valley	16	160	3—75	15.4	.096	0

Only two wells each are listed for granite and for sericite schist and these are too few on which to base any conclusions regarding their respective water-bearing properties. Data regarding these geologic units are given in the section entitled "Rock Units and their water-bearing properties."

The 112 wells in gneiss have an average yield considerably less than half that of wells drilled in Triassic rocks, and the average yield per foot of well is only slightly more than half as great. It appears probable, therefore, that the Triassic is a better aquifer than the gneiss in Rockingham County. However, the difference probably is not nearly so great as the above figures seem to indicate, because many of the wells in the Triassic rocks were drilled for industries and municipalities, whereas most wells in the gneiss were drilled for domestic supplies.

At a few places wells in the gneiss have been somewhat unsuccessful. The average yield of wells drilled on the Dibrell farms, 2 miles north of Ruffin, was less than 5 gallons a minute, although the average depth is 239 feet. The average yield per foot of well is only 0.021 gallon a minute, less than half the average for the entire county. The gneiss and schist at this place are not materially different than elsewhere. However, the dip of the beds is quite low, and it may be that this lessens the opportunity for entrance of water into the rock. Wells at Sadler School and most of the other wells in the vicinity of Sadler also yield small amounts of water. As Sadler is southwest of the Dibrell farm, in the direction of the strike of the gneisses, it is quite possible that the same strata are encountered at both places.

Table 17 also shows the relation of the yield of wells to the topography. Wells on hills yield less than half as much as wells at other locations, and wells in valleys and draws have an average yield per foot of well more than 3 times as great as that of wells drilled on hills.

According to table 17, wells in Triassic rocks yield an average of 15.6 gallons a minute, which is much higher than the yield of the other wells in Rockingham County but is only slightly higher than the average for all wells in the Greensboro area. One characteristic of wells in the Triassic is that many of them fail to hold up to the capacity indicated by the test made at the time the well is drilled. This tendency towards decreasing yields with continuous pumping has been noticed in many municipal and industrial wells in Triassic rocks, not only in the Dan River area but also in the Deep River area.

In order to determine more accurately the rate at which a well will yield over a long period of time, pumping tests of wells in the Triassic should be of long duration and the well should be pumped at several different rates, accurate measurements being made of the drawdown at the different rates. The water level also should be measured for several hours after pumping ceases in order to determine the rate of recovery.

Analyses of water from five wells in Rockingham County are given in the table of analyses. Two of the samples were of water from wells in gneiss and three were from wells in Triassic rocks. The water from the gneiss is moderately soft to moderately hard. The hardest water is from the deepest well. Both wells yield water with a low iron content. Water from either well is satisfactory for almost any use. The water from the Triassic rocks ranges from soft to extremely hard, and there is no correlation between depth and hardness. The iron content of the soft water is only 0.06 part per million, but the iron content of one of the hard waters is 0.36 part per million. The iron content of the other hard water was not determined.

Temperatures range from 58 to 65½° F. and average 60° F.

Municipal supplies.—Five incorporated cities and towns and three unincorporated cities and towns have public water supplies. Only two of these are obtained from wells, the remaining six being obtained from streams.

Draper, an unincorporated town of about 3,500 people, is supplied with water from Smith River at Spray, by Marshall Field and Company. The plant is described under the town of Spray. There are about 340 service taps in Draper and the average consumption is about 25,000 gallons a day.

Leaksville, population 1,886, obtains its water from the Dan River at a point about 2 miles southwest of the center of town. The water is pumped to the raw-water reservoir at the treatment plant by two centrifugal pumps with a capacity of 750 gallons a minute each. The raw-water reservoir has a capacity of 1,000,000 gallons. The water flows through the treatment plant by gravity. Treatment consists of coagulation with alum and sodium hydroxide, settling, filtration, and chlorination. The clear-water reservoir has a capacity of 500,000 gallons. Two centrifugal pumps with a capacity of 750 gallons a minute each are used to distribute the water. A 150,000-gallon elevated tank furnishes additional storage. The capacity of the filter plant is about 1,000,000 gallons a day. There are 1,185 service taps and consumption averages about 400,000 gallons a day, about 20 percent being used by industries.

Madison, population 1,683, obtained its water supply from wells 159, 160, 161, and 162 until 1937. The yield became inadequate at that time, and the town has since purchased treated water from the Washington Mills Company at Mayodan. The water is delivered into a 200,000-gallon underground concrete reservoir in Madison. Two electrically driven centrifugal pumps with a capacity of 500 gallons a minute each are used to distribute the water. A 100,000-gallon elevated tank furnishes additional storage. There are about 350 service taps and average consumption is about 55,000 gallons per day, 10 percent of which is used by industries.

Mayodan, population 2,323, is supplied with water from Mayo River by the Washington Mills Company. The intake is at the dam about half a mile north of town. Centrifugal pumps are used to pump the water to the treatment plant. Treatment consists of prechlorination, coagulation with alum and sodium carbonate, settling, filtration, and post-chlorination. The capacity of the plant is 600,000 gallons a day and average consumption is about 450,000 gallons a day, of which about 70 percent is used by the mills, 12 percent is sold to Madison, and the remainder, about 80,000 gallons a day, is used by the inhabitants of Mayodan.

Reidsville, population 10,387, has had a public water supply since about 1900. The city obtains its water from Troublesome Creek about 5½ miles southwest of the city. Three centrifugal pumps with a combined capacity of 2,100 gallons a minute pump the water from the intake, above a wooden diversion dam, to the treatment plant in the city. Treatment consists of coagulation, settling, filtration, and chlorination. The plant capacity is about 1,500,000 gallons a day. There are about 2,500 service taps. Maximum consumption is about 1,000,000 gallons a day and the average is about 500,000 gallons a day, of which about 40 percent is used by industries. The clear-water reservoir has a capacity of 900,000 gallons, a standpipe has a capacity of 976,000 gallons, and two elevated tanks have capacities of 75,000 and 500,000 gallons, respectively.

Spray, an unincorporated town of about 7,500 people, is partially supplied with water by Marshall Field and Company from Smith River. Two centrifugal pumps with a capacity of 2,800 gallons a minute each are used at the intake. Treatment consists of prechlorination, addition of ammonia, coagulation with lime and alum, settling in an 850,000-gallon basin, filtration, and post-chlorination. The clear well has a capacity of 150,000 gallons. The water is distributed by five centrifugal pumps with a total capacity of 6,000 gallons a minute. The capacity of the plant is 4,000,000 gallons a day. Maximum consumption is about 3,500,000 gallons a day and the average is about 2,500,000 gallons a day. About 98 percent is used by the mills in Spray and Draper and 2 percent is used by the inhabitants of Spray and Draper. Some of the inhabitants of Spray and Draper use wells of which there are reported to be about 100 in Spray alone (see number 38 in well table).

Stoneville, population 615, has had a public water supply since 1938, obtaining its water from two drilled wells, 6 and 7. The wells are 190 and 189 feet deep, respectively, 8 inches in diameter, and yield 40 and 75 gallons a minute, respectively, from Triassic shales. The wells are pumped by electrically driven turbine pumps which discharge directly into the mains. A 100,000-gallon elevated tank serves for storage. Well 7 is used regularly, well 6 only during emergencies. There are about 120 service connections. Maximum consumption is about 25,000 gallons a day and the average is about 17,000 gallons a day. The water is not treated. An analysis of water from well 7 is given in the table of analyses.

Wentworth, a small unincorporated town of a few hundred people, is the county seat. About 150 people and the courthouse and other county buildings are supplied with water from a drilled well. The well, no. 142 in the table, is 588 feet deep, 6 inches in diameter, and yields 30 gallons a minute. The well is drilled in gneiss. It is pumped by a plunger pump at a rate of about 20 gallons a minute. A 5,000-gallon elevated tank serves for storage. Consumption averages about 10,000 gallons a day. The water is not treated. An analysis of the water is given in the table of analyses. The temperature of the water is 61° F.

RECORDS OF WELLS IN ROCKINGHAM COUNTY

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
1	4 miles W of Stoneville	Lee Webb	Piner & Beasley	Dr	63		6		3–4	Gneiss	Slope	Soft water. Temperature 59½° F.
2	5 miles N of Stoneville	Curtis Martin		D-Dr	100		6		1–2	do	Hill	Soft water.
3	4½ miles N of Stoneville	J. W. Price	M. H. Jones	Dr	81		6			do	do	Do
3a	Do	do		Dug	60			48R		do	Slope	Dry in 1941.
4	Stoneville	Town	M. H. Jones	Dr	101		6		20	Shale (Triassic)	Flat	
5	Do	Stoneville Grocery	Danville Well Co.	Dr	116½		6		20	do	do	
6	Do	Town	Carolina Drill. Co.	Dr	190+		8		40	do	do	Auxiliary well.
7	Do	do	do	Dr	189		8		75	do	do	Analysis in table. Temperature 61½° F.
8	Do	Stoneville Furniture Co.	do	Dr	216		8		40	do		
9	2½ miles SE of Stoneville	Roy Carter	R. E. Faw	Dr	212		6			do	Flat	Large yield.
10	Do	Roger Baughn	Jerome Clark	Dr	342		6	70R	0	Dike	do	
11	3½ miles E of Stoneville	Miss Emma Carter	M. A. Holder	Dr	80		5⅝		4	Shale (Triassic)	do	Moderately soft water.
12	Do	W. R. Carter	do	Dr	77		5⅝		12	do	do	Soft water.
13	Do	L. M. Moore	Danville Well Co.	D-Dr	110		6	20R	10+	Triassic	Draw	Dug 22 feet. Water slightly hard.
14	Do	Virgil Hall	do	D-Dr	87		6	25R		do	Flat	Dug 30 feet. Adequate yield. Water slightly hard.
15	3 miles E of Stoneville	J. H Roberts	do	D-Dr	50		6		20±	do		Dug 30 feet. Soft water.
16	3¼ miles NE of Stoneville	T. S. Joins	do	D-Dr	50		6	20¾M	25	do	Slope	Dug 34 feet.
17	4 miles W of Leaksville	R. L. Simpson		Dr	75		6	25R		do	do	Soft water.
18	3½ miles NW of Leaksville	Y. T. Joyce		Dr	120		6		10	Gneiss	do	Soft water. Temperature 59° F.
19	3 miles W of Leaksville	Will Owens	M. H. Jones	Dr	100		6		3	Triassic		
20	Do	R. Holman; Sunset Dairy	do	Dr	122		6		2	do	Hill	Moderately soft water.
21	3 miles SW of Leaksville	Tom Watkins	Danville Well Co.	Dr	94		6	20R	8–10	do	Flat	Slightly hard.
22	Do	P. W. Minter	do	Dr	157		6		7	do	do	Soft water.
23	Do	do	do	Dr	103		6		15+	do		Do
24	3¼ miles SW of Leaksville	Jim Wilson	do	Dr	80	20	6	34R	7	do	Slope	Soft water. Temperature 59° F.
25	2 miles SW of Leaksville	P. W. Zigloer	Danville Well Co.	Dr	119		6		15	Shale (Triassic)		Water moderately soft.
26	Do	F. P. Newman		Dr	90		6		10–15	Triassic		Water slightly hard contains some iron.
27	1¾ miles NW of Leaksville	Oscar Field	John Hopkins	D-Dr	115	110	6	65R	5–6	Gneiss	Slope	Dug 65 feet. Soft water.
28	2 miles N of Spray	Pete Mabe	M A. Holder	Dr	120		5⅝		6–7	Conglomerate (Triassic)	do	Soft water.
29	Do	Tony Newman	M. H. Jones	Dr	104		6	65R	5+	do	Flat	Soft water. Adequate yield.
30	1½ miles NE of Spray	C. A. Light and T. A. James	Danville Well Co.	Dr	105		6		8–10	do	Hill	
31	Spray	Marshall-Field & Co., Woolen Mill		Dr	195		6		9	Triassic	Valley	Abandoned.
32	Do	Marshall-Field & Co., Suiting Mill		Dr	150		6		9	do		Do
33	Do	Marshall-Field & Co., General Office		Dr	113		5⅝	64½R	2?	do	Slope	
34	Do	Marshall-Field & Co., American Warehouse		Dr	152		5⅝	67R	3?	do	Valley	
35	Leaksville	Marshall-Field & Co., Bedspread Mill		Dr	80		6		10+	Shale (Triassic)	do	Not used.
36	Do	Marshall-Field & Co., Karastan Mill		Dr	100		6		?	do	do	Do
37	Do	J. G. Halsey	Danville Well Co.	Dr	163		6		15–20	do		Driller reports 2 feet of coal at 105 feet.
38	Spray	Marshall-Field & Co.	M. H. Jones	Dr	35 to 150		6			do		About 100 wells from 35 to 150 feet deep in mill village. Adequate yield from all wells.

[1] Vir. Mach. Co.=Virginia Machinery & Well Co.; Dan. Well Co.=Danville Well Drilling Co.; Sydnor Well Co.=Sydnor Pump & Well Co.
[2] Dr=Drilled, Br=Bored, Cr-Dr=Core Drilled, B-Dr=Bored and Drilled, D-Dr= Dug and Drilled.
[3] Depth to water from land surface; R=Reported, M=Measured.

RECORDS OF WELLS IN ROCKINGHAM COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
39	Spray	Spray Cotton Mills		Dr	100+		8		15	Shale (Triassic)	Valley	Temperature 65½° F.
40	Do	Leaksville Woolen Mill	M. H. Jones	Dr	80		6		8	do	do	
41	Do	G. M. Lamar	Danville Well Co.	D-Dr	125	75	6	70R	5-6	Triassic	Hill	Soft water.
42	Do	Morehead Mills Co.		Dr	205		6			Shale (Triassic)	Valley	Analysis in table. Temperature 61½° F.
43	1½ miles S of Leaksville	Ben H. Holmes		Dr	120±		6		4-5	Gneiss	Hill	Soft water.
44	Do	J. Frank King	M. H. Jones	Dr	177	100	6		6	do	do	Water slightly hard.
45	1¾ miles S of Leaksville	Miss Lily Hill	Danville Well Co.	Dr	84		6		5-6	do	Ridge	Water moderately soft.
46	1½ miles S of Leaksville	E. E. Early (Turner)	do	Dr	270		6		3-4	do	Hill	
47	1¾ miles S of Leaksville	R. O. Dietz		D-Dr	130±		6		1/16	do	do	Dug 70 feet.
48	2 miles S of Leaksville	Walker Roberts	Rogers	Dr	48		6	24R	4-5	do	Slope	Soft water.
49	2½ miles S of Leaksville	Dave L. Cudle	do	Dr	150	20	6		8±	do	do	
50	2¾ miles S of Leaksville	W. R. Roberts	John Hopkins	D-Dr	130+	80±	6		1-2	do	Hill	Dug 80 feet. Soft water.
51	2¾ miles S of Leaksville	S. P. Thomas		Dr	180		6		2±	Gneiss	Flat	Soft water, contains iron.
52	3 miles S of Leaksville	Jessie Saunders		Dug	45		36	42R	3	do		Soft water.
53	Do	George Rice	M. H. Jones	Dr	95		6		3-4	do		Do
54	4 miles SE of Leaksville	Edgar Thomas	Danville Well Co.	Dr	225		6		1½	do	Hill	Moderately soft water.
55	Do	Dewey Robinson	?	Dr	130±		6	50R	2±	do	Ridge	
56	2¾ miles SE of Leaksville	F. L. Anderson	John Hopkins	Dr	68		6	54R	10	do		Soft water.
57	3 miles SE of Leaksville	E. G. Jarrell	do	D-Dr	68		6		13	do	Slope	Dug 60 feet. Soft water.
58	2¾ miles SE of Leaksville	J. K. Williams	do	Dr	94½		6	72R	1½±	do	Hill	Soft water.
59	2¼ miles SE of Leaksville	Martin Smith	do	D-Dr	95		6	75R	2	do	Slope	Dug 75 feet.
60	1¼ miles E of Spray	Frank Eggleston	M. H. Jones	Dr	73		6		6-7	Triassic	do	Not in use.
61	½ mile W of Draper	J. M. Law	Danville Well Co.	Dr	125		6		10	Shale (Triassic)	do	Hard water.
62	Draper	Mrs. Hope Flinchum	do	Dr	105		6		20-30	do	do	Analysis in table. Temperature 58° F.
63	1 mile N of Draper	Mr. Coleman	do	Dr	101±		6		18-20		Flat	
64	Draper	Marshall-Field & Co.	Carolina Drill Co.	Dr	150		6		50	Shale (Triassic)	Valley	Two other wells, about 300 feet deep, yield about 30 gallons a minute.
65	Do	R. P. Roy Esso Station	Danville Well Co.	Dr	186		6		10-12	Shale	Slope	
66	½ mile S of Draper	Ben Eggleston Pure Oil Station	M. H. Jones	Dr	145		?		7-8	Shale (Triassic)		
67	¾ mile S of Draper	L. J. Hopkins	Danville Well Co.	Dr	74		6		8-10	do		
68	1 mile S of Draper	E. C. Stophel	do	Dr	79	50	6		10	do		Water moderately soft, no iron.
69	1¼ miles S of Draper	George Meade	do	D-Dr	78		6			do	Slope	Dug 53 feet. Adequate yield.
70	Do	S. G. Hopkins	do	Dr	80		6		10	do	Hill	Hard water, contains iron.
71	3½ miles W of Oregon Hill	Tom Moore	John Hopkins	D-Dr	90±		6		15	Gneiss	Slope	Dug about 50 feet.
72	3 miles SW of Oregon Hill	W. F. Jackson	F. L. Smith	D-Dr	175		6		¼	do	Hill	
73	2 miles SW of Oregon Hill	J. W. Strader	do	D-Dr	98		6	49R	1	do	do	Dug 54 feet.
74	2¼ miles SW of Oregon Hill	T. J. Forbes	do	D-Dr	100		6	46R	1	do	do	Dug 49 feet.
75	1 mile SW of Oregon Hill	E. M. Gunn	John Hopkins	Br-Dr	117		6		9	do	Flat	Bored 47 feet.
76	1 mile S of Oregon Hill	Floyd Evans	F. L. Smith	Dr	40±		6		6	Gneiss	Hill	Dug 25 feet.
77	Oregon Hill	Pure Oil Station	C. H. Davis	Dr	170		6		4+	do	Slope	Soft water.
78	3 miles SE of Draper	J. H. Schoolfield, Jr.	J. A. Rich	Dr	180?		6			Conglomerate (Triassic)	Hill	Adequate yield.
79	3½ miles SE of Draper	Happy Home School	Danville Well Co.	Dr	200		6		38	Gneiss	Flat	
80	3½ miles NE of Draper	John W. Wilson	M. A. Holder	Dr	105		5⅝		5	Shale (Triassic)		
81	5 miles NE of Draper	T. R. Perkinson		Dug	20		24	14R		Triassic		Good yield.
82	7 miles E of Draper	R. N. Williams	Danville Well Co.	Dr	140		6		10	Gneiss	Hill	Soft water.
83	6 miles E of Draper	J. M. Davis	J. A. Rich	Dr	?		6			do	Flat	Adequate yield. Soft water. Temperature 59½° F.
84	4½ miles SE of Draper	R. A. Hill	do	Dr	160		6		2-3	do	Slope	
85	1¼ miles SW of Ruffin	Chandler Estate	Moss	Dr	90		6		3-4	do	Flat	Water slightly hard.
86	Do	Dr. Charles Wharton		Dr	80		6			do		
87	1 mile SE of Ruffin	Mrs. Alice Chandler	F. L. Smith	D-Dr	100		6		10+	do	Hill	Dug 70 feet.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN ROCKINGHAM COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
88	Ruffin	High School	Danville Well Co.	Dr	200±		6			Gneiss	Draw	
89	Do	Chandler Estate	John Hopkins	D-Dr	120		6		1¼	do	Hill	Dug 60 feet.
90	2 miles N of Ruffin	L. N. Dibrell	Danville Well Co.	Dr	337		6		2½	do	Slope	Pumped by windmill.
91	Do	L. N. Dibrell, at pool	do	Dr	252		8		16	do	Valley	
92	Do	do	do	Dr	250		8		3	do	do	Capped; not in use.
93	Do	do	do	Dr	90		6		3	do	do	
94	2¼ miles N of Ruffin	L. N. Dibrell	do	Dr	95		6		3	do	Slope	
95	2½ miles N of Ruffin	do	do	Dr	809		6		12	do	Hill	Most of water from above 300 feet.
96	Do	do	do	Dr	115		6		1½		do	
97	2¾ miles N of Ruffin	do	do	Dr	110		6		1	Gneiss	do	
98	3 miles N of Ruffin	do	G. S. Rich	D-Dr	103		6	63R	1	do	do	
99	1 mile SE of Reidsville	J. L. Butler	Danville Well Co.	Dr	112		6		6-8	do	do	Dug 68 feet. Temperature 58½° F.
100	1 mile S of Lawsonville	do		Dug	60		?		½-1	do	do	Inadequate yield.
101	¾ mile S of Lawsonville	J. W. Butler	Danville Well Co.	Dr	123		6		6-8	do	Hill	
102	¼ mile N of Lawsonville	R. H. Blackwell	F. L. Smith	D-Dr	85		6			do	Slope	Adequate yield; soft water.
103	1½ miles NE of Sadler	Mrs. Nora Canady	?	Dr	60±		6			do	do	Good yield; hard water.
104	1¼ miles NE of Sadler	R. M. Durham	Setliff	Dr	86		6	60R	¼-½	do	Hill	Soft water.
105	½ mile NE of Sadler	W. M. Travis	Rogers	Dr	60		6	30R	½	do	do	
106	Do	H. I. McAlister	do	Dr	34		6	30R	1	do	Slope	
107	Do	W. W. McAlister	do	Dr	60		6	38R	7-8	do	Hill	Hard water, contains iron.
108	Sadler	Sadler School	F. L. Smith	Dr	175	20	6		3	do	Slope	Inadequate yield. All water from about 75 feet.
109	Do	do	Danville Well Co.	Dr	76		6		1	do	do	
110	1 mile NW of Sadler	Whit Brown	F. L. Smith	D-Dr	105		6	50R	15	do	do	Dug 50 feet. Soft water.
111	3 miles N of Reidsville	G. T. Gordon	do	D-Dr	68		6		20	do	do	Do
112	1¼ miles N of Reidsville	S. B. Mace	C. H. Davis	Dr	96		6	40R	15-20	do		Supplies four families.
113	1¾ miles NE of Reidsville	Mrs. C. A. Penn	?	Dr	250		6		15+	do	Slope	
114	2 miles NE of Reidsville	do	?	Dr	80		6		15±	do	Hill	
115	2½ miles NE of Reidsville	Joe Woods	F. L. Smith	D-Dr	80		6		5-7	do		Dug 50 feet. Water slightly hard.
116	2¾ miles NE of Reidsville	J. F. Daniels	Warrick	Dr	97	30	6	67R		do	Hill	Good yield; water slightly hard.
117	3 miles NE of Reidsville	Mrs. R. L. Watt	F. L. Smith	Dr	109		6		0	do	do	
118	Do	W. H. Foy	Muse	Dr	90		6		½	do	do	Inadequate yield; hard water.
119	1¼ miles SW of Lawsonville	Bernis Walker	?	Dr	165		6	55R	2-3	do		Moderately soft water.
120	3½ miles NE of Reidsville	Dr. S. Hurdle	Frank Gardner	Cr-Dr	70		3		8	do		
121	3¼ miles NE of Reidsville	J. W. Bullock	C. H. Davis	Dr	120		6			do	Hill	Adequate yield; soft water.
122	4 miles E of Reidsville	Roy Harris	?	Dr	140	40	6		2-3	do	Slope	Water slightly hard.
123	2½ miles E of Reidsville	Mrs. Ava Phillips	Danville Well Co.	D-Dr	123		6			do	do	Dug 35 feet.
124	2¼ miles E of Reidsville	Mrs. M. E. Roberts	F. L. Smith	D-Dr	160		6		1±	do	do	Dug 45 feet. Small yield. Soft water.
125	1¾ miles E of Reidsville	H. R. Scott	Frank Gardner	Cr-Dr	150		3		4-5	do	Flat	Soft water.
126	1¾ miles NE of Reidsville	W. H. Foy	Moss	D-Dr	99		6		1¼	do	Hill	
127	1¾ miles E of Reidsville	Wm. Smith	C. H. Davis	D-Dr	165	37½	6		0	do	Slope	Not used.
128	1½ miles E of Reidsville	Herbert Mace	John Hopkins	Dr	218		6	37¼M	1½	do		
129	Do	G. S. Woodall	Well Drillers Inc.	Dr	100		6		3-4	do	Slope	Water slightly hard.
130	Do	L. E. King	C. H. Davis	Dr	200		6			do	do	Water moderately soft.
131	Do	W. E. King	H. L. Heater	Dr	74		6		10+	do	do	Do
132	1¼ miles E of Reidsville	Ethel Strader & Eugene Rice	Well Drillers Inc.	Dr	98½	30	6			do	do	Soft water.
133	Reidsville	Edna Mills, Corp.		Dr	160+		6	15R	30	do	Valley	
134	2½ miles NW of Reidsville	Chinqua-Penn Farms		Dr	200?		6			do	Draw	Large yield. Pump has 3 h.p. motor. Temperature 61° F.
135	Do	do		Dr	250±		6			do	do	Large yield. Pump has 3 h.p. motor.
136	Do	do		Dr	200		6			do	do	Do
137	2¾ miles NW of Reidsville	do		Dr	200±		?			do	Valley	
138	Do	R. R. Saunders	John Hopkins	Br-Dr	80	34+	6		10	do	Slope	Bored 34 feet. Soft water.
139	4½ miles W of Reidsville	Marion McMichael	J. Stafford	Cr-Dr	70		2		2	do	Flat	Soft water.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN ROCKINGHAM COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
140	1½ miles SE of Wentworth	Prison Camp		Dug	44		42	40R	25	Gneiss	Flat	
141	1 mile E of Wentworth	Wentworth School	Danville Well Co.	Dr	?		6			do	Slope	
142	Wentworth	County	D. M. Hanlon	Dr	588		6	40R	30	do	Hill	Analysis in table. Temperature 61° F.
143	¾ mile S of Wentworth	Mrs. Hugh Scott	John Hopkins	D-Dr	110		6		3±	do	Slope	Dug 53 feet.
144	2½ miles NE of Intelligence	J. C. Peay	Walker	Dr	125		6	80R	1½	do	Hill	Temperature 58½° F.
145	4¼ miles SE of Stoneville	Mulberry Island Farm		Dr	290		6		15	Shale (Triassic)	Slope	Water is not hard.
146	4 miles SE of Stoneville	David Lindsey		Dr	60		6		½-1	do	Flat	
147	Do	do	C. H. Davis	Dr	65		6	40R	5	do	do	Soft water.
148	4 miles SE of Reidsville	do	do	Dr	120		6		5	do		
149	4½ miles SE of Stoneville	do	do	D-Dr	130		6		5	do		Dug 65 feet. Water moderately soft.
150	Do	do		Dr	97		6	70R	6+	do	Valley	Water rather hard.
151	1½ miles N of Intelligence	W. E. Puckett	John Hopkins	Dr	78		6		8	Gneiss	Hill	Soft water.
152	1 mile N of Intelligence	C. H. H. Martin	?	Dr	62		6	30R	3-4	do	Slope	Do
153	Do	C. W. Bailey	John Hopkins	D-Dr	140		6		0	do	Hill	Dug 40 feet.
154	1 mile NE of Intelligence	Mrs. G. T. W. Carter	Walker	Dr	160		6			do	Ridge	Soft water.
155	Intelligence	Intelligence School	Danville Well Co.	Dr	150		6		18	do	Hill	
156	Do	A. A. Sharpe	Hopkins & Williams	D-Dr	137		6	69R	10	do		Soft water.
157	1 mile W of Intelligence	Upton G. Wilson	Heater Well Co.	Dr	130	45	6	45R	2	do	Flat	Do
158	1¼ miles SW of Intelligience	J. L. Wilson	J. Stafford	D-Cr-Dr	192		2	80R	4+	do	Slope	Dug 45 feet.
159	Madison	Town	Vir. Mach. Co.	Dr	310		8		75±	Shale (Triassic)	Valley	Tested originally at 140 gallons a minute for 48 hours, but would not hold up to 90 gallons a minute after prolonged pumping.
160	Do	do	Heater Well Co.	Dr	300+		8		75±	do	Draw	
161	Do	do	do	Dr	500		8		15	do	Slope	Originally yielded 50 gallons a minute.
162	Do	do	Vir. Mach. Co.	Dr	700		8		15	do	Draw	Do
163	1 mile NW of Madison	Walter Bailey	Well Drillers Inc.?	Dr	75		6		2-3	do	Slope	Soft water
164	Mayodan	Washington Mills Co.	Heater Well Co.	Dr	300		6		15-20	do		Hard water. Not in use.
165	Do	do	Sydnor Well Co.	Dr	700		8		15	do		Do
166	1 mile NW of Mayodan	H. Roy Martin	Z. V. Jones	Cr-Dr	99		2		3	Arkose (Triassic)	Hill	Soft water. Reported to have encountered coal seam.
167	1¾ miles W of Mayodan	H. G. Grogan	?	Dr	200		6	35R	12	Triassic	Slope	
168	Do	do	J. Stafford	Cr-Dr	177		2	18R	6+	Shale (Triassic)		Moderately soft water. Reported to have encountered coal seam.
169	2 miles W of Madison	Y. L. Carter	do	Cr-Dr	340		2		3	do	Hill	Water slighty hard.
170	2¾ miles W of Madison	H. R. Closson	do	Cr-Dr	334		2		5	Arkose (Triassic)	Valley	Moderately hard water. Temperature 60° F.
171	Do	Y. L. Carter	Frank Gardner	Cr-Dr	150		2		5	do	do	
172	4 miles S of Ellisboro	T. L. Knight	J. Stafford	Cr-Dr	93		2		7½	Gneiss	Draw	
173	Do	Huntsville School	Danville Well Co.	Dr	350		8		7	do	Flat	Soft water, no iron.
174	2¾ miles NW of Stokesdale	Abe Neal	Frank Gardner	Dr	100		2		0	do	Hill	
175	2 miles NW of Stokesdale	W. T. Fulp	Well Drillers Inc.	D-Dr	175		6		1/10	do	do	
176	5 miles SW of Bethany	C. B. Pegram	J. Stafford	Cr-Dr	125	15	2	7R	3	Granite?	Valley	Soft water.
177	4¼ miles SW of Bethany	Kenneth McCollum	Well Drillers Inc.	Dr	199		6		0	do	Hill	
178	3½ miles SW of Bethany	Harvey Albert	J. Stafford	Cr-Dr	147		2		0	Quartzite?	do	
179	Do	do	do	Cr-Dr	115		2		0	Quartzite	do	
180	4¼ miles SW of Bethany	Lawrence Bennett	Heater Well Co.	Dr	33		6	13R	5	Gneiss	Valley	Soft water.
181	2¾ miles SW of Bethany	P. A. McCollum	J. Stafford	Cr-Dr	126	26	2		5+	do	Flat	
182	2¼ miles SW of Bethany	M. M. Joyner	?	Dug	23		24	17R	5+	do	Hill	Soft water.
183	2½ miles W of Bethany	do	Jones	Cr-Dr	120		2		2½	do	do	Do
184	1¾ miles W of Bethany	Mrs. Stella Tyson	J. Stafford	Cr-Dr	148		2		1	do	do	Do
185	1½ miles N of Bethany	Mrs. J. L. Sharp	do	Cr-Dr	198		2		3	do	do	Do

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN ROCKINGHAM COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
186	Bethany	School	?	Dr	300?		8		8±	Gneiss	Flat	Adequate yield for 650 students.
187	1½ miles NE of Bethany	T. F. Humphrey	John Hopkins	Br–Dr	85		6	49R	6–8	do	Slope	Bored 53 feet. Soft water.
188	2½ miles NE of Bethany	W. O. Overby	do	D–Dr	70		6	50R	⅛	do	Hill	Dug 56 feet. Soft water.
189	2¾ miles NE of Bethany	T. W. Sharp	do	D–Dr	62		6		½	do		Dug 41 feet. Soft water.
190	3½ miles NE of Bethany	J. W. Jones	do	D–Dr	86		6		4–5	do	Ridge	Dug 62 feet. Soft water.
191	4¾ miles NE of Bethany	D. E. Purcell	J. Stafford	Cr–Dr	58		2		7–8	do	Slope	Hard water.
192	3½ miles NE of Bethany	A. L. Wall	do	D-Cr-Dr	198	58	2		1	do	Hill	Dug 58 feet.
193	3 miles E of Bethany	Robert Brown	John Hopkins	D–Dr	100		6		10+	do	Flat	Dug 40 feet. Soft water.
194	2½ miles SE of Bethany	Robert Bradshaw	Heater Well Co.	Dr	78		6		5	do	Hill	Dug 42 feet.
195	3 miles SE of Bethany	Melrose Stock Farms	Danville Well Co.	Dr	170		6		1½	do	do	
196	3¾ miles SE of Bethany	Melrose Stock Farm (barn)	do	Dr	74½		6		10	do	Slope	Soft water.
197	1¾ miles SW of Monroeton	J. E. Small	John Hopkins	D–Dr	94		6	45R	6	do	Hill	Do
198	Monroeton	James Apple	do	D–Dr	140		6		15	do	Slope	Dug 40 feet. Water is not hard.
199	Do	Elementary School	Danville Well Co.	Dr	165		8		15+	do	Flat	Very good yield.
200	2 miles N of Monroeton	Paul Lemon		Dug	39		48	31½M			Hill	Adequate yield, soft water.
201	2 miles S of Reidsville	M. M. Trent & L. A. Trent	H. L. Heater	Dr	62		6	32R	6	Gneiss	Slope	
202	Do	Pine Hill Dairy	C. H. Davis	Dr	228		6		1–2	do	Hill	Insufficient yield, not used.
203	Do	W. E. Trent (home)	F. L. Smith	D–Dr	130		6		2½	do	do	Dug 40 feet.
204	Do	Pine Hill Dairy	do	Dr	165		6	30R	35	do	Draw	Drawdown 10 feet. Analysis in table.
205	2½ miles S of Reidsville	Otis Collins	Well Drillers Inc.	Dr	300	12	6		0	do	Hill	
206	3¼ miles S of Reidsville	T. B. McCollum	F. L. Smith	Dr	59	32	6	26R	10	do	Slope	Soft water.
207	Do	R. W. McCollum	do	Dr	100	40	6		5+	do		Large yield, soft water.
208	3½ miles S of Reidsville	A. L. Styres	C. H. Davis	Dr	158		6	38R	10+	do	Hill	Soft water.
209	5 miles S of Reidsville	Lawrence Martin	do	Dr	97		6	14R	10±	do	Draw	Do
210	7½ miles S of Reidsville	S. T. Price	Heater Well Co.	Dr	106	85	6		3	do	Hill	
211	4¼ miles SE of Reidsvlle	Marvin Comer	Hopkins or Davis	Dr	80±		6			do	do	Adequate supply.
212	4 miles SE of Reidsville	P. L. Ferguson	John Hopkins	Br	52½		20	45R		do	do	Do
213	Do	P. W. Tysinger	Hopkins or Davis	Dr	79	25	6	40R	2–3	do	Slope	Soft water.
214	3 miles SE of Reidsville	W. K. Knowles	C. H. Davis	Dr	140		6	100R	10	do	Hill	Do
215	Do	P. S. Knowles	Danville Well Co.	Dr	150		6		2–3	do	do	Hard water; Temperature 60° F.
216	4 miles SE of Reidsville	John Lovelace	John Hopkins	D–Dr	120		6	70R	10±	do	do	Dug 80 feet. Soft water.
217	4½ miles SE of Reidsville	W. A. Cook		Dr	110		6		¼	do	Slope	
218	Do	T. E. Massey	John Hopkins	D–Dr	126		6	80R	5	do	Hill	Dug 71 feet. Soft water.
219	Do	George Robertson		Dug	79	79	24	77R		do	Ridge	Soft water.
220	5 miles SE of Reidsville	W. A. Cook	Danville Well Co.	Dr	76		6		10+	do	Slope	Do
221	5¼ miles SE of Reidsville	do		Dr	106		6		1±	do	Hill	
222	1 mile NW of Thompsonville	G. C. Collins		Dr	75		6			do	Slope	Soft water.
223	Thompsonville	Williamsburg School	Danville Well Co.	Dr	210		6		35?	do	Flat	
224	1¾ miles E of Thompsonville	W. H. Matkin	C. R. Heater	Dr	40		6		4	Schist	Hill	Not in use.
225	2¼ miles SE of Thompsonville	Mrs. S. A. Harris	F. L. Smith	D–Dr	150	60	6		25	do	Flat	Soft water.
226	2 miles S of Thompsonville	H. E. Pritchett	C. R. Heater	Dr	94	20	6	45R	-1	Gneiss	Hill	Do

RECORDS OF SPRINGS IN ROCKINGHAM COUNTY

Location	Owner	Yield gallons a minute	Chief aquifer	Topographic Location	Remarks
A—1½ miles SE of Wentworth	County Home	10±	Gneiss, coarse	Draw	About 40 springs. Water issues from crevices in gneiss, which dips about 10° down the draw.

[1], [2], [3] Footnotes given at beginning of table.

ANALYSES OF GROUND WATER FROM ROCKINGHAM COUNTY, NORTH CAROLINA

(Analysts: William L. Lamar, Evelyn Holloman, and E. W. Lohr, U. S. Geological Survey. Numbers at heads of columns correspond to numbers in table of well data)

(parts per million)

	7	42	62	142	204
Silica (SiO_2)				19	
Iron (Fe)	0.06	0.36		.02	0.04
Calcium (Ca)				22	
Magnesium (Mg)				2.9	
Sodium and Potassium (Na+K)				17	
Carbonate (CO_3)				0	
Bicarbonate (HCO_3)	53	214	440	104	55
Sulfate (SO_4)	a1	a48	a96	11	a3
Chloride (Cl)	4	16	32	5.0	2
Fluoride (F)					
Nitrate (NO_3)				.3	
Dissolved solids				135	
Total hardness as $CaCO_3$	34	202	480	67	40
Date of collection, 1943	June 17	July 7	July 8	June 16	June 29
Depth (feet)	189	205	105	588	165
Chief aquifer	Triassic rocks	Triassic rocks	Triassic rocks	Gneiss	Gneiss

a By turbidity

STOKES COUNTY

(Area, 459 square miles; population, 22,656)

Geography, physiography, and drainage.—Stokes County is in the northwestern corner of the Greensboro area. There are only two incorporated towns in the county, but there are several small unincorporated towns and villages. The county is crossed by several paved roads, and railroads cross the southeastern and southwestern corners. Stokes County is dominantly agricultural, having only a few relatively small industries.

Stokes County is in the Piedmont physiographic province, near its western edge. The surface of the county is a maturely dissected plateau formed by uplift and dissection of a peneplane. Sauratown Mountain, rising about 1,500 feet above the dissected plateau or upland surface, was left as a monadnock on the peneplane. Stokes County is the most rugged of the six counties in the Greensboro area. Flat areas on the upland are relatively small, generally being narrow flat-topped ridges between drainage basins. Local relief of 150 to 200 feet is the rule and at places is much more. Dan River has cut down into the plateau from 200 to about 400 feet. The Sauratown range of mountains rises as much as 1,500 feet above the plateau surface and a number of other hills rise more than 400 feet above the upland surface. Moore Knob, elevation 2,572 feet, is probably the highest point in the county. The lowest point is on Dan River where it enters Rockingham County and is probably about 550 feet.

The plateau surface slopes to the southeast from an altitude of about 1,300 feet in the northwestern corner to about 1,000 feet in the southeastern corner. The slope of the upland surface is interrupted by two major structures, both of which trend northeastward. The Sauratown range of mountains, extending from the Surry County line near Pinnacle most of the way across the county, is capped by several hundred feet of quartzite. There are a number of individual peaks in this range, several of which have an altitude of more than 2,000 feet. The quartzite forms steep cliffs, most of which face southward or southeastward, the quartzite generally dipping gently to the north and northwest. The second structure interrupting the southeastward slope of the upland is the Triassic basin, generally 3 to 4 miles wide, in the southeastern corner of the county. The deepest part of the basin is near its southeastern edge, where it is at least 400 feet lower than the general level of the upland.

Drainage of Stokes County goes into two main drainage systems, the Dan River and Yadkin River systems. About 90 percent of the drainage goes into Dan River. Dan River enters from Virginia near the northwestern corner of the county and flows generally southeastward to a point within about 4 miles of the southeastern corner of the county. At this point it is deflected sharply to the northeast by the gneisses forming the southeastern wall of the Triassic basin. The most important tributaries of the Dan in Stokes County are Big Creek, Snow Creek, and Town Fork. Drainage to the Yadkin is by way of Little Yadkin River.

Geology.—Four of the nine geologic units of the Greensboro area are exposed in Stokes County. These are the gneiss, the quartzite, the porphyritic granite, and the Triassic rocks. The distribution of these rocks is shown on plate 1.

The gneiss unit underlies about half of the county. The rocks of this unit are chiefly quartz-biotite-plagioclase gneiss, garnetiferous mica schist, and quartz-mica schist. Some plagioclase-hornblende gneiss is also included. These gneisses and schists are mostly of sedimentary origin and the original bedding is apparent at many places. Although the strike and dip differ considerably from place to place, the strike is generally northeastward. The dip in the southeastern half of the county is generally to the southeast and in the northwest part of the county it is to the northwest. The structure of the county appears to be that of an anticlinorium with many minor structures.

The quartzite unit extends northeastward, in a belt about 6 miles wide, about two-thirds of the way across the county from near the southern end of the Stokes-Surry County line. It forms the Sauratown Mountain range and minor hills. The rocks consist chiefly of quartzites and mica schists but also include quartz-chlorite schists and quartz-mica schists. Some of the quartzites contain considerable mica, which gives them a banded appearance. The upper part of the unit consists almost entirely of quartzite occurring in massive beds capping the mountains, but a number of quartzite strata also are interbedded with the schists, occurring at irregular intervals throughout the unit. No attempt was made to measure the thickness of the quartzite and the schists but undoubtedly it is more than a thousand feet. The thickness of the quartzites capping the mountains alone is probably more than 500 feet.

The upper quartzites have been only moderately folded, dips usually being from about 10° to 25°. Sauratown Mountain, beginning at a point about 2½ miles east of Pinnacle, is a hogback ridge that extends due north for about 2 miles and then turns northeast. The quartzite generally dips to the west and northwest and there is a cliff along the eastern and southeastern side of the ridge. The ridge plunges to the northeast and thus becomes lower towards Gap. The mountains east of Gap apparently are essentially a syncline, Cooks Wall and Hanging Rock forming a part of the southern limb and Moores Knob part of the northern.

The granite in Stokes County is included with the porphyritic granite unit although some of it is nonporphyritic. However, it is probably of approximately the same age and has similar water-bearing properties. It crops out chiefly along the northern boundary of the county, the largest areas being in the northeast corner, in the vicinity of Sandy Ridge, and near the center, north of Francisco and in the northwest corner near Asbury. It crops out in another area northeast of Pinnacle. At this place the granite is quite coarse and very gneissic and may be of a different age. The granite crops out at a few other places but the areas are too small and the granite too complexly intruded into the gneisses and schists to be mapped separately. At some exposures in all the granite areas the granite is gneissic but at other places the granite is relatively massive. The gneissic structure is particularly noticeable near the contact with the schist and gneiss into which the granite was intruded, and the structure of these rocks apparently is preserved because of the failure of the granite to assimilate the gneiss and schist completely. At most places the granite is a light- to medium-gray, medium- to coarse-grained rock consisting chiefly of feldspar, quartz, and biotite. In some exposures the granite is highly porphyritic.

The Triassic rocks occur in a belt extending northeastward from Germanton into Rockingham County. The belt widens from a point at Germanton to about 4 miles at Walnut Cove and maintains that width beyond the county line. The Triassic rocks are chiefly lenticular red, brown, and yellow arkosic and argillaceous sandstones, sandy shales, and arkosic conglomerates. They also include some mudstone which is calcareous at places. The Triassic sedimentary rocks unconformably overlie the rocks of the gneiss unit. The unconformable contact between these two units can be traced along the southeastern side of the Triassic belt from Germanton through the south edge of Walnut Cove, through Pine Hall, and into Rockingham County. The Triassic rocks dip to the northwest at an average angle of about 30°. The dip of the beds is to the northwest entirely across the Triassic belt, except for a belt of border conglomerate along the northwest margin. The thickness of the Triassic is about 8,000 feet along the northwest margin of the belt; and it is obvious that the Triassic must have been faulted down, relative to the gneiss, 8,000 feet or more.

Ground water.—All water supplies in Stokes County, including domestic, industrial, and municipal supplies, are obtained from wells or springs. Springs are used to a greater extent in Stokes County than in the other counties, probably because, owing to the more rugged topography, they are more plentiful, and also because the population is thinner, there is less danger of their being contaminated. Most domestic supplies are obtained from dug wells which range in depth from about 10 to 100 feet. The shallowest dug wells are in the Triassic basin and the deepest are in the mountains and in the dissected plateau adjacent to Dan River. Generally dug wells yield satisfactory supplies for domestic use, except where bedrock is too close to the surface to permit digging to sufficient depth.

Dug wells have two principal disadvantages. First, there is the danger of pollution of the water supply. Most frequently this pollution results from entrance of the contamination directly into the well from the surface or from surface water running down the outside of the curbing and entering at some point below the surface. Danger of pollution of dug wells can be held to a minimum by proper location of the well so that there is no source of contamination near the well, by using a curb or casing that completely prevents the possibility of entrance of any water above the aquifer, and by adequately covering the top of the well. The second disadvantage is that dug wells are much more apt to go dry during a period of drought. This disadvantage can be overcome to a large extent by selecting favorable sites and digging the well to an adequate depth at the start.

Very few bored wells have been used in Stokes County. These wells are similar to dug wells except in method of construction and the discussion of dug wells also applies generally to bored wells.

Drilled wells are used to a considerable extent in Stokes County and are becoming increasingly important. Drilled wells have several advantages. In the first place, because they are usually tightly cased to bedrock and the mouth of the well is kept tightly covered, there is little danger of pollution. Secondly, they are much less affected by drought and rarely go dry. At places where water is available at shallow depths, drilled wells are considerably more expensive than dug wells, but in areas where the water table is 50 feet or more below the surface the dug well may be nearly as expensive as a drilled well. This is true of a considerable part of Stokes County, where the water table at many places is 50 to 70 feet below the surface.

Records were obtained of approximately 120 drilled wells in Stokes County, 100 of which had sufficiently complete records to be summarized in table 18, below.

A number of interesting facts are revealed by this table. In the first place, drilled wells in Stokes County have the lowest average yield and lowest average yield per foot of well of the six counties in the Greensboro area. Probably the chief reason for this is that nearly all drilled wells in Stokes County are used for domestic purposes and only small yields are needed. Another reason may possibly be that drilled wells in Stokes County are used chiefly at places where water has been difficult to obtain from dug wells, and therefore most of the wells have been drilled in areas which are poor water producers.

The average depth of wells in Stokes County is 123 feet, 13 feet more than the average depth of wells in Caswell County, which has the lowest average depth of wells in any county in the area. Stokes County has a larger proportion of domestic wells than Caswell County, and therefore the wells should have a smaller average depth. However, Stokes County is much more rugged than Caswell County and the depth to the water table is considerably greater; thus the average depth of well is greater.

Slightly more than half the wells tabulated were drilled in gneiss and slightly more than one-fourth were drilled in the quartzite unit. The average yield of wells in the quartzite unit is slightly greater than in the gneiss unit, but the average yield per foot of well is identical. This fact is significant because it suggests that the quartzite unit is just as good an aquifer as the gneiss, in Stokes County. This is interesting in view of the fact that, as shown in table 1, wells in gneiss in the entire area have an average yield more than twice as great as those in quartzite and an average yield per foot of well 76 percent greater. As the quartzite crops out only in Stokes County, the data on wells in that unit in table 1 is based entirely on

TABLE 18—SUMMARY OF DATA ON WELLS IN STOKES COUNTY
(Drilled wells 3 inches or more in diameter)

ACCORDING TO ROCK TYPE

Type of Rock	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Gneiss	53	112	1/6— 20	4.7	0.042	26.4
Quartzite and schist	27	126	0— 20	5.3	.042	14.8
Porphyritic granite	12	104	½— 10	4.3	.041	16.7
Triassic	8	210	5—150	24.6	.117	0
All wells	100	123	0—150	6.4	.052	20

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Hill	49	123	0— 18	3.3	0.027	36.8
Flat	4	127	2½—7½	4.5	.035	0
Slope	34	108	½— 20	5.7	.053	5.9
Draw	5	144	½— 15	6.8	.046	0
Valley	5	275	5—150	39.8	.146	0

wells in Stokes County. Therefore it is obvious that the yield of wells in gneiss in the other counties is much higher than in Stokes County and it seems reasonable to assume that the yield of wells in quartzite likewise might be greater in other counties, where larger supplies are more frequently sought. It is possible, therefore, that the quartzite unit is approximately as satisfactory an aquifer as the gneiss unit. The 12 wells drilled in granite in Stokes County have a slightly lower average yield than wells drilled in the gneiss or in the quartzite unit, but because the average depth is less, the average yield per foot of well is nearly as great.

Wells drilled in Triassic rocks in Stokes County have an exceptionally high average yield and average yield per foot of well, actually higher than in the other counties of the Greensboro area. However, this is entirely due to one well in the Triassic at Walnut Cove. If this well is disregarded, the average depth of wells in the Triassic is 94 feet, the average yield of wells is only 6.7 gallons a minute, and the average yield per foot of well is only 0.072 gallon a minute. Such an average yield and average yield per foot of well are more nearly in line with the results in the other units of Stokes County and probably come closer to giving a true comparison of the relative merits of the Triassic and the other units.

The part of table 18 showing the relation of average yield and average yield per foot of well to the topography is highly significant. Wells located on hills have by far the smallest average yield and average yield per foot of well and nearly 37 percent of these wells yield less than 1 gallon a minute. Wells located in valleys have much the highest average yield and average yield per foot of well. Even disregarding well 113 at Walnut Cove, which yields 150 gallons a minute, the average yield is 12.2 gallons a minute. The average yield per foot of well is 0.143 gallon a minute, which is nearly as great as when well 113 is included. It is obvious that almost any location is to be preferred to a hill and that, in Stokes County at least, slopes, draws, and valleys are the most favorable sites for drilling wells.

Table 3, showing the average yield and average yield per foot of well according to topographic location in the entire Greensboro area indicates the same thing.

Selection of favorable locations for drilling wells should be based upon the following considerations: type of rock, topography, jointing and fracturing, cleavage and schistosity, veins, dikes, thickness of mantle, and depth to the water table. These factors are discussed in some detail in this report under the subheading "Utilization of ground water."

Analyses were made of seven samples of ground water collected in Stokes County. Six of these water samples were from wells and one was from a spring. Only one of these is a complete analysis, but the others give a good indication of the most important characteristics of the water. Three samples were from wells in the gneiss unit, two were from wells in the quartzite unit, and one was from the Triassic. The spring from which the other sample was collected issues from gneiss. The water from wells in the gneiss ranges from soft to very hard, without much relation to depth of well. All these waters are predominantly bicarbonate waters. It seems probable that the degree of hardness of these waters is determined chiefly by the character of the rock through which the water percolates. It is probable that there is considerable limestone or marble in close proximity to well 89, the water from which has a hardness of 342 parts per million, although the well is only 125 feet deep. As would be expected, the water from spring A, issuing from mica gneiss, is very soft. The water from well 61, which is 80 feet deep and is in schist of the quartzite unit, is soft; but the water from well 50, which is 700 feet deep and also in the quartzite unit, is very hard. The only water sample from the Triassic rocks was collected from well 113 at Walnut Cove. Although this well is 1,027 feet deep, the water has a hardness of only 90 parts per million. Practically all of this is bicarbonate hardness, the chloride and sulfate contents being unusually low, especially for a well of that depth. The iron content of five of the seven samples was determined and ranged from 0.04 to 0.22 part per million, which is below the maximum considered permissible for a satisfactory supply. Objectionable amounts of iron were reported in water from several wells, but it is probable that it is usually caused by corrosion of the casing.

The average temperature of ground water in Stokes County is about 59° F.

Municipal supplies.—Danbury, the county seat, is an unincorporated town of about 300 people. The water supply is owned by W. G. Petree and the water is obtained from three springs northwest of town. The water is pumped into two concrete reservoirs with a combined capacity of about 25,000 gallons. Distribution from the reservoirs is entirely by gravity. The water is not treated.

Walnut Cove, population 1,084, has had a public water supply since about 1926. The water is obtained from well 113, which is 1,027 feet deep and 10 inches in diameter. The well is drilled in Triassic rocks and is reported to have yielded 150 gallons a minute when drilled. It is pumped with a deep-well turbine pump driven by a 15 horsepower electric motor. The pump discharges directly into the mains. A 100,000-gallon elevated tank located on a hill at the north edge of town furnishes storage. Maximum pressure is about 82 pounds and the minimum is about 42 pounds per square inch. There are about 175 service taps. Maximum consumption is about 40,000 gallons a day and the average is about 30,000 gallons a day. The water is not treated.

RECORDS OF WELLS IN STOKES COUNTY

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
1	Ashbury	S. P. Joyce	Frank Christian	Dr	213	....	6	53M	5	Granite	Flat	Soft water.
2	1¼ miles E of Ashbury	Benton Joyce		Dug	93	....	48	91R	1–2	do	Hill	
3	1 mile S of Ashbury	Bill Simmons	Oliver France	Dr	101	....	6	....	3–4	do	Slope	Soft water.
4	2¼ miles S of Ashbury	Reed Tilley	R. W. George	D–Dr	130	....	6	....	5	do	Hill	
5	3 miles S of Ashbury	F. V. Dearmin	J. R. Cummings	Dr	95	....	6	....	3	Gneiss	Slope	Soft water.
6	Do	R. M. Simmons	do	Dr	63	....	6	....		do	Hill	Soft water; contains some iron.
7	Do	R. A. France	Will Lovell	Dr	114	....	6	70R	½	do	do	Soft water.
8	3 miles SE of Ashbury	J. C. France	J. R. Cummings	Dr	70	....	6	....	....	do	do	Adequate yield.
9	2¾ miles SE of Ashbury	R. L. Collins	Will Lovell	D–Dr	103	....	6	....	3	do	do	Dug 63 feet. Soft water
10	¾ mile W of Francisco	Union School		Dr	100±	....	6	....	?	do	Slope	
11	Francisco	Sam Moir	Will Lovell	D–Dr	90½	....	6	48R	2	do	Hill	Dug 50 feet. Soft water.

[1] Vir. Mach. Co.=Virginia Machinery & Well Co.,; Dan. Well Co.=Danville Well Drilling Co.; Sydnor Well Co.=Sydnor Pump & Well Co.
[2] Dr=Drilled, Br=Bored, Cr–Dr=Core Drilled, B–Dr=Bored and Drilled, D–Dr= Dug and Drilled.
[3] Depth to water from land surface; R=Reported, M=Measured.

RECORDS OF WELLS IN STOKES COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
12	¼ mile N of Francisco	Abe Goin	Will Lovell	Dr	160		5	60R	1	Gneiss	Hill	
13	¾ mile SE of Francisco	E. E. Shelton	Grover Beasley	Dr	101		6	57R	1	do	do	Soft water.
14	1 mile SE of Francisco	Mrs. F. A. Christian	R. W. George	Dr	203		6		4–5	do	do	Water contains much iron.
15	1¼ miles SE of Francisco	do	Well Drillers Inc.	Dr	70±		6			do	do	Dug about 30 feet. Adequate yield.
16	2 miles NE of Francisco	J. L. Moore	J. R. Cummings	Dr	63		6	40½M	1±	Granite	Slope	Soft water.
17	2¼ miles NE of Francisco	J. O. Overby	do	Dr	89	8	6		½	do	Hill	Do.
18	2½ miles E of Francisco	W. S. Hart	R. W. George	D–Dr	84		6		5	Gneiss	Slope	Do.
19	Do	W. S. Teacher	do	Dr	89		6	83R	3	Granite	do	Do.
20	1½ miles W of Lawsonville	J. C. Mabe	C. H. Davis	Dr	121½		6		½	Schist	do	Do.
21	1¼ miles W of Lawsonville	Eulice Rogers	J. R. Cummings	Dr	90		6	40R	15	do		
22	3½ miles N of Lawsonville	C. S. Simmons	?	Dr	100		6			Granite		Adequate yield. Water contains iron.
23	3½ miles NW of Sandy Ridge	Banner Mills		Dr	63		6	41¾M	5±	Schist		Large yield. Water contains iron.
24	3 miles W of Sandy Ridge	A. Schurman	Well Drillers Inc.	Dr	97		6		14	do	Valley	Analysis in table.
25	Do	do	do	Dr	86		6		15	do	Draw	
26	Sandy Ridge	Union School		Dug	45		48		6–8	Schist	Flat	Adequate yield. Soft water, contains iron.
27	1¼ miles NE of Sandy Ridge	Methodist Parsonage	R. W. Clayton	Br	37		20	32R		Granite gneiss	Draw	
28	4 miles NE of Sandy Ridge	Edgar Dodson	Well Drillers Inc.	Dr	65		6	30R	10	do	do	Soft water.
29	Do	J. S. Richardson	C. H. Davis	D–Dr	85		6	40R		do	Slope	Water somewhat hard.
30	4¼ miles NE of Sandy Ridge	Sam Martin	Well Drillers Inc.	Dr	100		6		½	do	Draw	
31	4½ miles NE of Sandy Ridge	J. J. Amos	C. H. Davis	Dr	101		6		5±	do	Slope	Adequate yield. Soft water.
32	Do	D. B. Nance	Well Drillers Inc.	Dr	110		6	48M	10	do	do	Soft water.
33	4¾ miles NE of Sandy Ridge	Otis Amos	C. H. Davis		95		6		5±	do	Hill	Adequate yield. Soft water.
34	2 miles SE of Sandy Ridge	J. W. Dodson	Well Drillers Inc.	Dr	80		6	65R	2	Schist	Slope	
35	3 miles E of Dillard	W. G. Young	do	Dr	100		6	20R	1–2	Arkose (Triassic)		Soft water. Temperature 59° F.
36	1½ miles NE of Dillard	Manley Dunlap		Dug	67		42	61R		Schist	Hill	Adequate yield. Soft water.
37	1¼ miles SW of Prestonville	J. R. Carter	Well Drillers Inc.	Dr	71		6		½	do	do	Soft water.
38	1½ miles SW of Prestonville	H. P. Steele	Jasper Waldren	Dr	75		6		½	do	do	Do.
39	2 miles SW of Prestonville	J. T. Oakley	Well Drillers Inc.	Dr	100		6	43¼M	½–1	do	do	Do.
40	2¼ miles SW of Prestonville	C. H. Sheppard	Jasper Waldren	Dr	52		6		2–3	do		Water moderately hard.
41	1¾ miles W of Prestonville	W. A. Steele	do	Dr	72		6		1½	do	Hill	Soft water.
42	4½ miles E of Lawsonville	Earl Moore	Well Drillers Inc.	Dr	98		6	40R	½	do	do	Do.
43	3½ miles SE of Lawsonville	R. L. Wilson	Jasper Waldren	Dr	60		6			do	Slope	Adequate yield.
44	Do	John Priddy	do	Dr	114		6			do	Hill	Adequate yield. Moderately soft water.
45	3¾ miles SE of Lawsonville	Mrs. W. R. Priddy	C. H Davis	Dr	150		6		3±	do	do	Moderately hard water.
46	4 miles SE of Lawsonville	D. S. Priddy	Jasper Waldren	Dr	191		5⅝	20R	1/6	do	do	
47	3¼ miles SE of Lawsonville	Jess Priddy	C. H. Davis	Dr	75		6		10±	do	do	Hard water.
48	3 miles NE of Danbury	S. M. Nelson	do	Dr	81		6		2–3	do	do	Soft water.
49	2½ miles NE of Danbury	Mrs. R. I. Dalton	Well Drillers Inc.	Dr	101	31	6	40R	8	do	Slope	Do.
50	3½ miles NW of Danbury	J. H. Nelson	C. H. Davis	Dr	700		5⅝	161M	⅓	Schist & quartzite	Hill	Analysis in table.
51	3½ miles N of Gap	S. E. Willard	R. W. George	Dr	150		6		2–3	Gneiss	Draw	Water very hard.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN STOKES COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
52	3½ miles N of Gap	Gaston Coffer	?	Dr	84		4	60R	5	Gneiss	Draw	Soft water.
53	1¾ miles N of Gap	John Bowles	Bill Bishop	Dr	110		4	50R	2-3	Schist	Slope	Do.
54	4¾ miles S of Francisco	J. R. Nunn	Will Lovell	Dr	113		6	60R	3-4	Gneiss		Do.
55	5 miles S of Francisco	K. C. Smith	do	Dr	136		6	65R	2	do	Hill	Soft water. Contains some iron.
56	3¾ miles SW of Francisco	F. V. Dearmin	Well Drillers Inc.	D-Dr	141		6		2	do	Slope	Dug 61 feet.
57	Do.	Joe Durham	J. R. Cummings	Dr	75½		6	55R	4-5	do	Hill	Soft water.
58	7 miles N of Pinnacle	R. T. Lynch	R. E. Faw	Dr	182		6		½	do	do	Do.
59	6½ miles N of Pinnacle	B. M. Jessup	do	Dr	122		6			do	Draw	
60	6 miles N of Pinnacle	E. T. Wilson	do	D-Dr	100		6	48R	1-2	do		Dug 64 feet. Soft water.
61	Pinnacle	County School		Dr	80		6		8-10	Schist	Slope	Analysis in table.
62	1¾ miles SW of Pinnacle	E. A. Jones	Well Drillers Inc.	Dr	95	30	6		2½	do	Flat	Water slightly hard.
63	3½ miles N of King	Mrs. C. W. Edwards	Will Lovell	Dr	91		6	50R	2	do	Hill	Soft water.
64	Do.	Mrs. Mamie Jones	do	Dr	81		4	40R	4-5	do	Slope	Water slightly hard.
65	Do.	C. H. Boyles	Bob George	Dr	186		6		0+	do	Hill	Yields about 25 gallons a day.
66	1¾ miles SW of Capella	G. A. Jones	Will Lovell	Dr	88	44	5		5+	do	Slope	Very good yield. Soft water.
67	Do.	Dr. S. F. Tillotson		Dr	102		6	52R	11	do	do	Water slightly hard.
68	1½ miles SW of Capella	H. C. Patterson	Well Drillers Inc.	Br-Dr	88		6		4-5	do	Hill	Bored 44 feet. Soft water.
69	½ mile N of Capella	Sam Covington	do	Dr	99		6		2-4	do	Slope	Moderately soft water.
70	¼ mile S of Capella	J. S. Robertson	do	D-Dr	142		6	50R	15	do	do	Dug 52 feet. Soft water.
71	¾ mile S of Capella	Walt Robertson	Will Lovell	Dr	77		5	40R	4-5	do	do	Moderately soft water.
72	Do.	W. R. Robertson		Dr	113		6	26R	5-7	do	do	Do.
73	1 mile S of Capella	S. B. Robertson	Well Drillers Inc.	Dr	68	30±	6	34R	4	do	do	Dug 30 feet. Water slightly hard.
74	1¼ miles S of Capella	A. T. Tillotson	do	D-Dr	103		6	40R	3-5	do	Hill	Dug 27 feet. Soft water.
75	1¼ miles SE of Capella	Roy S. Redding	do	D-Dr	145		6		3+	do	Slope	Dug 38 feet. Soft water.
76	1½ miles E of Capella	Jim Cook	Chappel	Dr	85		6		½-1	do	Hill	Soft water.
77	2 miles SE of Capella	Mrs. Bessie Overby	R. W. Clayton	Dr	92½		6		2-3	do	Slope	Soft water.
78	1¾ miles SE of Capella	Wallace Webster	Will Lovell	Dr	93		6	40R	5+	Gneiss	do	Water somewhat hard.
79	2¼ miles SE of Capella	J. P. Tuttle	Well Drillers Inc.	Dr	102	23	6	40R	10	do	do	Water fairly hard.
80	Do.	Harvey Johnston	Will Lovell	Dr	142		6		½-1	do	Hill	Hard water.
81	Do.	M. O. Allen	Bishop	Dr	103	40	5	40R	3-4	do	do	Water somewhat hard.
82	2 miles NE of Mountain View	J. C. Ferguson	Well Drillers Inc.	Dr	101	17	6			do	do	Analysis in table.
83	Do.	W. W. Terry (Ed Webster)	do	Dr	97		6	45R	2-3	do	Slope	Soft water.
84	Do.	W. W. Terry	do	Dr	115		6		2-3	do	Hill	Do.
85	1¾ miles NE of Mountain View	W. M. Bowman	do	Dr	96		6		2-3	do	do	Moderately hard water.
86	1¼ miles E of Mountain View	D. M. Bowles	do	Dr	97	34	6		8-10	do	Slope	Soft water.
87	Mountain View	R. W. Barr	R. W. George	D-Dr	140		6	55R	10	do	do	Do.
88	½ mile E of Mountain View	S. V. Burge	do	Dr	107		6		3	do	Hill	Water slightly hard.
89	3¼ miles NE of Mountain View	L. J. Carroll	Well Drillers Inc.	Dr	125	16	6	65R	8	do	Slope	Analysis in table.
90	3¾ miles NE of Mountain View	T. W. Southern	do	Dr	70	53	6	47½M	6	do	Hill	Soft water.
91	Do.	C. S. Southern	R. W. Clayton	Dr	123	90	6	77M	5	do	do	Do.
92	3¼ miles SW of Meadows	D. W. Flint	?	Dr	120		6	60R	5	do	do	
93	3½ miles W of Meadows	Chester Smith	Well Drillers Inc.	Dr	105½	37½	6	55R	½-1	Schist	do	Soft water.
94	1¾ miles W of Meadows	Meadow Grocery Co.	Will Lovell	Dr	117		6		5±	do	do	
95	1½ miles W of Meadows	E. P. Martin	do	Dr	91		6	45R	5	Gneiss	do	Soft water.
96	1¾ miles SW of Meadows	J. W. Young		Dug	85							Goes dry during every drought.
97	Do.	do	J. R. Cummings	Dr	101	91	6	70R	7	Gneiss	Slope	Soft water.
98	1¼ miles W of Meadows	W. A. Southern	Will Lovell	Dr	86		6	50R	2	Schist	Hill	Soft water. Contains iron.
99	Do.	J. H. Bowles	Well Drillers Inc.	D-Dr	88		6		3	do	Slope	Soft water. Does not contain iron.
100	1 mile NW of Meadows	Prison Camp No. 806	J. R. Cummings	Dr	150		6			do	Low Hill	Adequate yield. Abandoned; prison camp moved.
101	½ mile N of Meadows	do	C. H. Davis	Dr	160½		6		17½	Gneiss	Hill	Moderately soft water. Temperature 59½° F.
102	Meadows	J. W. Moorefield	J. R. Cummings	Dr	76		6	20R	20	do	Valley	Soft water. Contains a little iron.
103	¾ mile N of Pine Hall	School		Dug	30		60	10R		Shale (Triassic)	Flat	Adequate yield.

[1], [2], [3] Footnotes given at beginning of table.

RECORDS OF WELLS IN STOKES COUNTY—*Continued*

Well Number	Location	Owner	Driller[1]	Type of Well[2]	Depth of Well (feet)	Depth of Casing (feet)	Diameter of Well (inches)	Depth to Water (feet)[3]	Yield Gallons a Minute	Chief Aquifer	Topographic Location	Remarks
104	Pine Hall	T. D. Preston	T. D. Preston	Dr	70		4	35R		Shale (triassic)		
105	Do.	do		Dug	36		60			do		Large yield, furnishes 3 families.
106	½ mile W of Pine Hall	Pine Hall Brick & Pipe Co. Brick Plant		Dr	75		5		5+	do	Valley	
107	1 mile W of Pine Hall	do		Dr	65		4		5	do	Ridge	Seven other wells 45 to 65 feet deep yield 3 to 5 gallons a minute each.
108	1¾ miles SW of Pine Hall	do		Dr	60		4		5	do	Hill	Five other wells 45 to 60 feet deep yield ¼ to 5 gallons a minute each. Some of them go dry during periods of drought.
109	2¼ miles SW of Pine Hall	do		Dr	95		4		10	Conglomerate (Triassic)	Valley	
110	Do.	Pine Hall Brick & Pipe Co.		Dr	45		4		10–15	Sand (Aluvinm)	do	Soft water.
111	Walnut Cove	Town		Dr	811		10		?	Triassic	Slope	Not used.
112	Do.	do	Vir. Mach. Co.	Dr	400		8			do	do	Do.
113	Do.	do	do	Dr	1027		10	18R	150	do	Valley	Drawdown 50 feet. Analysis in table. Temperature 62° F.
114	Do.	D. T. Ramsey, Ice Plant	M. A. Hoder	Dr	120		5⅝		8	Shale (Triassic)	Slope	Not in use.
115	1½ miles W of Walnut Cove	B. P. Bailey	R. W. Clayton	Dr	140		6		8–10	Triassic	do	Water is not hard.
116	2 miles NW of Walnut Cove	Clinton Lee	do	D–Br	40		20	28R		do		
117	3½ miles NE of Germanton	E. W. Watt	Well Drillers Inc.	Br–Dr	124		6			Gneiss	Slope	Bored 40 feet. Moderately soft water.
118	3 miles N of Germanton	Clifton Jones	R. W. Clayton	D–Dr	142		6	65R	15	do	Ridge	Dug 75 feet. Soft water.
119	Germanton	J. E. Wagoner	Well Drilers Inc.	Dr	100		6	50R	5	Shale (Triassic)	Flat	Hard water, contains iron.
120	2¾ miles NW of Germanton	Harvey Browder	R. W. George	Dr	100		6		5	Gneiss	Slope	
121	3 miles NW of Germanton	do	do	Dr	100		6		¼	do	Ridge	Hard water.
122	3½ miles W of Germanton	W. J. Wall	Bishop	Dr	102		6		1	do		Hard water. Not used.
123	3½ miles NW of Germanton	C. R. Kiser	Well Drillers Inc.	Dr	58		6	30R		do	Slope	Soft water.
124	4 miles W of Germanton	W. E. Tuttle	R. W. George	Dr	138		6	40R	1	do	Hill	Dug 55 feet. Soft water.
125	1¼ miles E of King	Dr. R. S. Helsabeck	Well Drillers Inc.	Dr	163		6		20	do	Slope	
126	King	School		Dr	180		6		5–7	do	do	Will not supply entire need of school.
127	Do.	do		Dug	50		96	37R		do	Hill	
128	1½ miles NW of King	R. C. Meadows	Well Drillers Inc.	Dr	172		6		½	do	do	Soft water.

RECORDS OF SPRINGS IN STOKES COUNTY

Location	Owner	Yield gallons a minute	Chief aquifer	Remarks
A—Lawsonville	County School	4–5	Gneiss	Issues from a fracture in the gneiss. Reported to yield 25 percent more during wet weather. Temperature 60° F., August 18, 1943. Analysis in table.
B—Danbury, 1 mile northwest of	W. G. Petrie		Quartzite and schist	Three springs supply the inhabitants of Danbury.

[1], [2], [3] Footnotes given at beginning of table.

ANALYSES OF GROUND WATER FROM STOKES COUNTY, NORTH CAROLINA

(Analysts: William L. Lamar and Evelyn Holloman, U. S. Geological Survey. Numbers at heads of columns correspond to numbers in table of well data)

(parts per million)

	24	50	61	82	89	113	A
Silica (SiO_2)			28				
Iron (Fe)	0.11		.22	0.13		0.18	0.04
Calcium (Ca)			6.0				
Magnesium (Mg)			2.8				
Sodium and Potassium (Na+K)			7.8				
Carbonate (CO_3)			0				
Bicarbonate (HCO_3)	73	182	42	28	368	108	13
Sulfate (SO_4)	a4	a10	1.1	a3	a8	a2	a2
Chloride (Cl)	8	44	4.6	6	56	8	2
Fluoride (F)			.0				
Nitrate (NO_3)			1.6				
Dissolved solids			76				
Total hardness as $CaCO_3$	64	202	26	10	342	90	12
Date of collection	Aug. 17, 1943	Aug. 18, 1943	Oct. 26, 1944	Sept. 1, 1943	Aug. 31, 1943	Aug. 13, 1943	Aug. 18, 1943
Depth (feet)	97	700	80	101	125	1027	Spring
Chief aquifer	Gneiss	Quartzite	Schist (Quartzite unit)	Gneiss	Gneiss	Triassic rocks	Gneiss

a By turbidity