GEOLOGY AND GROUND-WATER RESOURCES

of the

MONROE AREA, NORTH CAROLINA

BY EDWIN O. FLOYD

GROUND-WATER BULLETIN NUMBER 5

NORTH CAROLINA
DEPARTMENT OF WATER RESOURCES

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Prepared By The Geological Survey
United States Department Of The Interior
In Cooperation With The
North Carolina Department Of Water Resources

RALEIGH

1965

Letter of Transmittal

The Honorable Dan K. Moore
Governor of North Carolina

Dear Governor Moore:

I am pleased to submit Ground-Water Bulletin Number 5, "Geology and Ground-Water Resources of the Monroe Area, North Carolina."

This report gives the results of an investigation made by the U. S. Geological Survey in cooperation with the North Carolina Department of Water Resources, as a part of the program of reconnaissance investigations to evaluate the ground-water resources of the State. It presents the data collected and describes the general geological and ground-water conditions in Anson, Stanly and Union Counties.

This report is a valuable contribution to the knowledge of the ground-water resources of the area. It will be available to all persons and agencies concerned with the development and conservation of those resources.

Respectfully submitted,

Walter E. Fuller

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Geology and Ground-Water Resources of the Monroe Area, North Carolina

By

Edwin O. Floyd

ABSTRACT

The Monroe area includes Anson, Stanly, and Union Counties in the south-central part of North Carolina. It has an area of 1,575 square miles and had a population of 109,746 in 1960. The economy is both agricultural and industrial.

The area consists mainly of low rounded hills with gentle slopes in the southeastern part of the Piedmont province. The altitude of land surface ranges from about 150 feet to 936 feet above mean sea level, and the land surface slopes generally toward the southeast.

The surface is underlain mainly by metamorphic and igneous rocks, chiefly tuffaceous argillite, laminated argillite, tuff, phyllite, gneiss, granite, and diorite-gabbro. A belt of Triassic rocks in Anson County contains sandstone, shale, and other sedimentary rocks.

The tuffaceous argillite is the chief aquifer of the area because it has a relatively high permeability and wide areal extent. The yield of individual wells in this aquifer averages about 13 gpm (gallons per minute), and may be as much as 200 gpm.

The yield of wells in the area is related to topography. The average yield of wells on hills is about half the average yield of wells in valleys. The majority of the wells in this area are drilled on upland sites where conditions are unfavorable for obtaining more than 5 to 10 gpm from a well.

Generally, the yield of wells is determined by the secondary permeability of the rocks, which decreases with depth. There is usually little increase in the yield of wells below a depth of about 250 feet.

The present utilization of ground water in the area is only a fraction of that available from the aquifers. Recharge and discharge are apparently in natural balance because there is no evidence of perennial lowering of the water table.

The chemical quality of the ground water in the area ranges from a sodium-bicarbonate type to a calcium-bicarbonate type. The over-all quality is usually good, and the water is acceptable for domestic or municipal uses with little or no treatment. Iron concentration is generally less than 0.3 ppm. Hardness is sometimes an objectionable property of waters from the argillite and sandstone units.

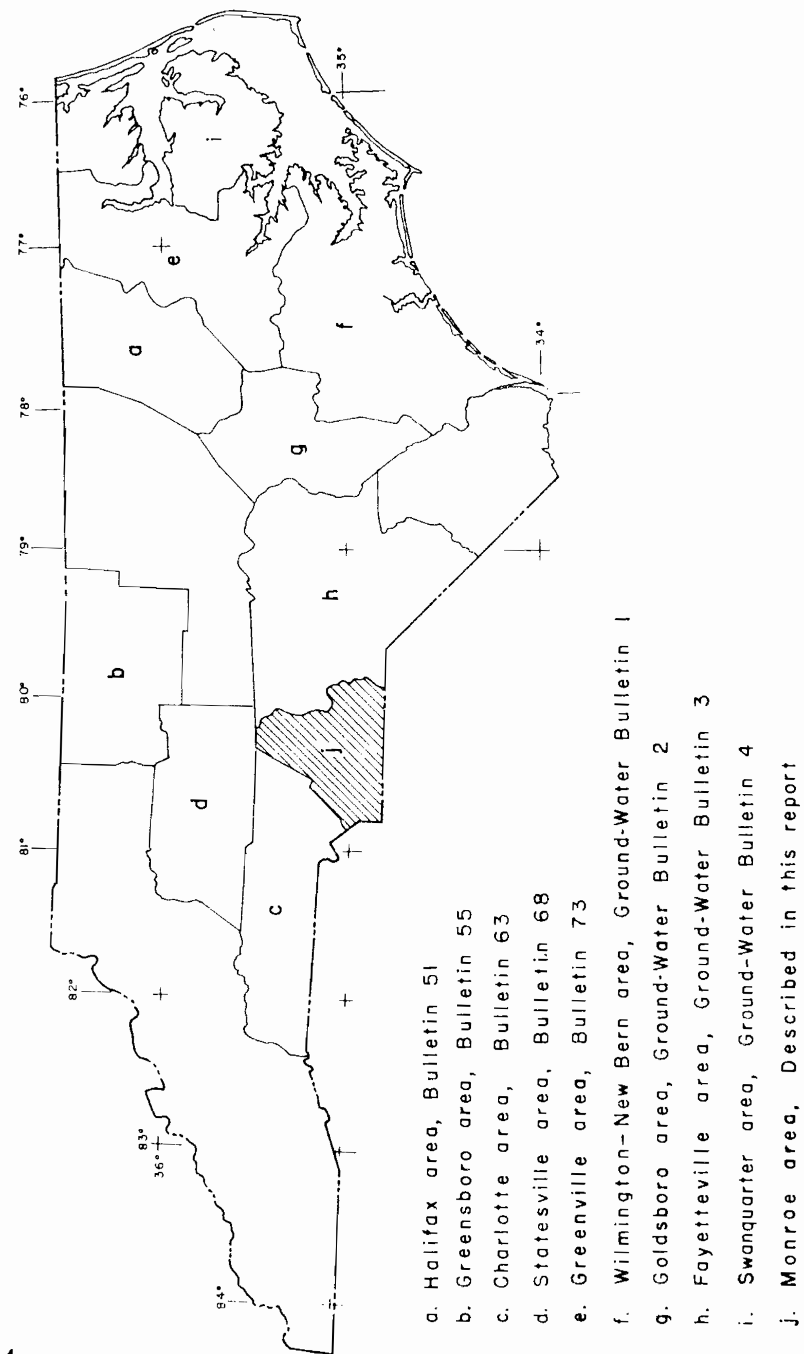
INTRODUCTION

This report is the tenth in a series designed to give a general, or reconaissance-type appraisal of ground-water resources throughout the entire State (fig. 1). The area described in this report comprises Anson, Stanly, and Union Counties. The area takes its name from the City of Monroe in Union County.

The investigation was made by the Ground Water Branch, U. S. Geological Survey, in cooperation with the North Carolina Department of Water Resources. The report was prepared under the immediate supervision of P. M. Brown, District Geologist, Ground Water Branch, U. S. Geological Survey.

The fieldwork in the Monroe area was done between July 1960 and March 1962. The work consisted mainly of collecting and interpreting data from about 560 wells, and reconnaissance mapping of the geology. Representative samples of water were collected and analyzed by J. D. Thomas, Chemist, Quality of Water Branch, U. S. Geological Survey.

Figure 1. Index map of North Carolina showing areas covered by reconnaissance ground-water investigations.



ACKNOWLEDGMENTS

The assistance of well owners, well drillers, school superintendents, and municipal officials is gratefully acknowledged. Particular acknowledgment is made to James F. Conley of the North Carolina Division of Mineral Resources for his advice and suggestions, which facilitated the geologic mapping. Also, particular acknowledgment is made to the Aycock Well Drilling Contractors and the Harrill and Myers Company for the assistance they rendered in furnishing well records and drill cuttings.

The Quality of Water section of this report was written by J. D. Thomas, Chemist, U. S. Geological Survey.

GEOGRAPHY

Area and Population

The area discussed in this report covers 1,575 square miles. According to the preliminary report of the U. S. Census Bureau, the area had a population of 109,746 in 1960. Urban population is centered in six cities or towns, each having a population in excess of 1,000. The urban population is 31,258, or approximately 28 percent of the total population. The remaining 72 percent of the population is considered rural and is centered in or near 29 incorporated and unincorporated towns and villages in the area.

Economy

The economy of all three counties in the area is predominantly agricultural. According to the 1951 farm census, 88.5 percent of the total area was in farmland. Crops and pastures covered 46 percent of the total area and 42.5 percent was covered by forests.

The agricultural crops that provide the main source of income are cotton, lespedeza, corn, wheat, and soybeans. In southeastern Anson County, peaches are an important crop. The total annual income from these products is about $15,000,000.00. During the last decade, poultry, beef, and dairy cattle have become an important industry of the area. Annual income from these sources almost equals that of farm crops.

Textile manufacturing is the most important industry in all three counties, employing well over half of all industrial workers in the area. Other industries in the area include lumber, stone and clay products, aluminum smelting, and the manufacture of furniture and hardware.

Mineral Resources

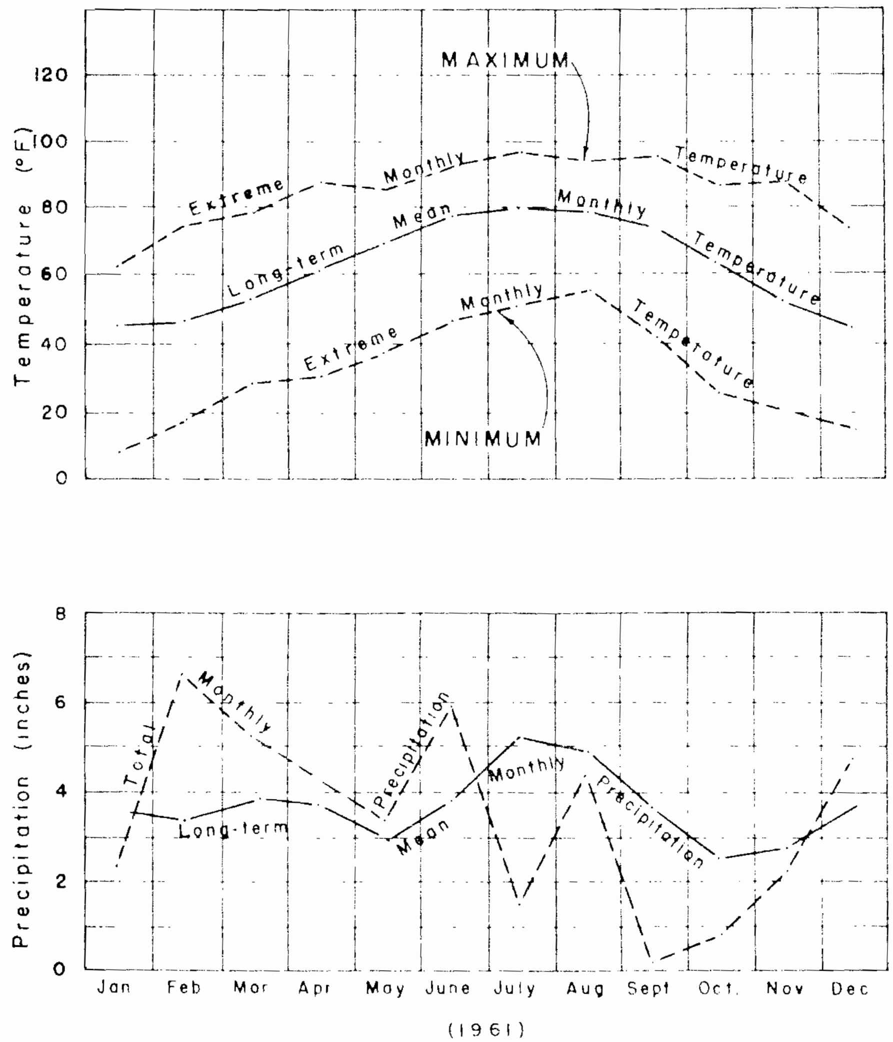
Crushed stone for road metal and for general construction purposes is produced from a large quarry near Monroe in Union County and from smaller quarries scattered throughout the three counties of the Monroe area. Brick clays are mined and bricks produced at Norwood and Isenhour in Stanly County and near Monroe in Union. Light-weight aggregate for construction purposes is produced from rock mined near Aquadale in Stanly County. Sand and gravel are mined in Anson County, particularly in the vicinity of Lilesville. The above mentioned mineral products constitute the bulk of the mineral resources currently being mined in the Monroe area. A few small quarries that produce stone for flagging purposes are operating in Stanly County. In the past, gold and copper were mined in Stanly and Union Counties.

Climate

The annual precipitation ranges from a maximum of 46.1 inches at Albemarle in Stanly County, to a minimum of 43.5 inches at Monroe in Union County, according to records from the U. S. Weather Bureau stations at Albemarle, Monroe, and Wadesboro. The monthly distribution of precipitation at the Monroe station is plotted in figure 2. The mean monthly precipitation ranges between 3 and 4 inches during the first 6 months of the year. July and August are the months of greatest precipitation, having mean totals in the magnitude of 5 inches. The lowest mean total precipitation occurs during October.

The average annual temperature in the Monroe area is 61 degrees. Records from the above-mentioned weather stations indicate there is little variation in average temperatures between stations. The lowest temperatures occur during December and January, and the highest temperatures are recorded during July, August, and September.

Figure 2. Climatic summary for Monroe, Union County.



Topography

The Monroe area lies within the upland section of the Piedmont physiographic province, which is an uplifted, submaturely to maturely dissected peneplane.

The sedimentary rocks in the area strike generally northeast-southwest. The igneous intrusives are generally elongated and strike northeast-southwest. The relative resistance of different rock types to erosion controls the topographic expression in the area.

Average altitude of the upland surface ranges from about 150 feet above mean sea level in the southeastern part of Anson County to about 800 feet in western Stanly County. The highest altitudes of the area are in northwestern Stanly County, in the Uwharrie Mountain range. The highest of these hills is Morrow Mountain, which has an elevation of 936 feet above mean sea level.

Drainage

The area is drained by the Pee Dee and the Wateree Rivers and their tributaries. Most of Anson County is drained to the north by the Rocky River, which flows into the Pee Dee River, or to the east by the Pee Dee River, which forms the eastern border of the county. A small part of southwestern Anson County is drained to the south by several small streams that empty into the Great Pee Dee River in South Carolina. The southern part of Stanly County is drained by the Rocky River, which flows along its southern boundary. Most of the eastern part of the county is drained into Badin Lake, the Pee Dee River, and Lake Tiller, which forms the eastern boundary of Stanly County. About three-fourths of Union County is drained in a northeasterly direction to the Rocky River. Approximately 20 percent of the county, the southwestern part, is drained to the southwest into the Wateree River in South Carolina. The remainder is drained to the south into Lynches River, which empties into the Great Pee Dee River in South Carolina. The courses of the individual streams within the area are diverse, and the drainage pattern is largely controlled by the geology of the area.

GEOLOGY

Introduction

During the fall and winter of 1961-62 a reconnaissance survey was made of the geology in the area. With the exception of the mapping of the Albemarle quadrangle (Conley, J. F., 1962), little geologic mapping in the area had been done prior to this time. The existing geologic maps were inadequate for the purposes of this investigation; therefore, reconnaissance geologic mapping was a necessary part of the project work. (See fig. 7, 9, 11). The rock units shown on the maps are generalized in some cases and usually contain more than one type of rock. The different rock types were grouped into mappable units on the basis of similarity in age, petrology, or water-bearing properties. They are discussed in the following section in the same order as they appear on the geologic maps.

Area Distribution and Character of Rock Units

Sands and clays of Quaternary age

Sand and gravel of Quaternary age are considered generally to be the youngest geologic unit in the area. The unit occurs at elevations ranging from about 400 feet above mean sea level in the vicinity of Lilesville to about 250 feet east of Morven. Outcrops are in isolated patches and pockets of various size throughout the southeastern part of Anson County. The unit consists of varicolored, laminated, crossbedded, kaolinitic sands and clays and deposits of well-rounded stream gravels, all apparently of continental origin. The gravels of this unit range from pea size to small boulder size. The thickness of the deposits ranges from a feather edge to more than 50 feet. Excellent exposures of this unit can be seen along Highway 74 about 3.5 miles east of Lilesville and, in the same vicinity, in a commercial gravel pit where the gravel is mined for road metal.

Triassic (Newark Group)

Rocks of the Newark Group were named for Triassic exposures near Newark, New Jersey. In 1875, W. C. Kerr (1875) correlated these rocks with the triassic exposures in North Carolina. Three formations are distinguishable within the Newark Group (Campbell, M. R., and Kimball, K. W., 1923). In descending order of age, they are the Sanford, Cunnock, and Pekin Formations. These formations form one water-bearing unit and were mapped as one unit during this investigation.

Rocks of Triassic age are exposed in the Monroe area in a belt, ranging in width from about 6 to 10 miles, that extends in a northeast-southwest direction across the central part of Anson County and into the southeastern corner of Union County.

The Triassic rocks are bordered on both sides, and probably underlain, by rocks of the Carolina volcanic-sedimentary group. Quaternary deposits of sand and clay overlie small areas of the Triassic rocks along their eastern edge.

The rocks of Triassic age consist generally of red, brown, and gray sandstone and siltstone and lenticular beds of red to purple claystone. Lenticular beds of fine-to medium-grained, crossbedded, arkosic sandstone that are conglomeratic in places are scattered throughout the unit. Several exposures of a basal fanglomerate occur along the western boundary. The basal fanglomerate usually consists of angular to well-rounded fragments of rocks from the Volcanic-Sedimentary group along with red, brown, and purple sandstone pebbles and cobbles. The matrix is clay and arkosic sand. Dikes of dense black diabase, ranging from a few feet to more than one hundred feet in width, have intruded these rocks. These dikes are considered generally to be of late Triassic age.

The Triassic sediments in Anson and Union Counties were deposited in a graben, and are thickest along the eastern side of the basin where the greatest vertical displacement occurred. Subsequent upheaval and erosion of the area have exposed the basal conglomerate on the western edge but not on the eastern edge of the graben.

Most of the outcrops of Triassic rocks are deeply weathered to a red, gray, purple, or brown residual clay. Typical exposures of this group can be found on Highway 52 between Wadesboro and Ansonville in Anson County.

Granite

Granite occurs in three widely separate localities in the Monroe area. The largest body of granite is in eastern Anson County where it has intruded rocks of the volcanic-sedimentary group and the gneiss unit. The other two granite bodies occur along the western border of Union County where they have intruded

Plate 1. Porphyritic Granite With Included Fragments of Gneiss.

rocks of the lower volcanic unit. King (1955) considers these granites to be a part of the igneous rocks in the Charlotte Belt.

In Anson County the granite is porphyritic and is exposed in an area of about one-fifth of the county. In many places it is overlain by Quaternary deposits. Xenoliths of gneissic rocks occur in the granite near the granite-gneiss contact (pl. 1). A highly metamorphosed contact zone of phyllite and schist is transitional between the granite and the volcanic-sedimentary group, indicating that the granite intruded the rocks of the volcanic-sedimentary group and the gneiss unit. The granite in this body is light gray and medium-to very coarse-grained. It contains large phenocrysts of feldspar, and biotite is prominent. Large well-rounded granite boulders are found frequently on hillsides and in stream valleys. The weathered zone ranges in thickness from a few inches to several feet. The soil produced by weathering is recognized by its coarse texture and characteristic buff to reddish-yellow color. Several outcrops of granite can be seen along Highway 52 between Wadesboro and Morven in Anson County.

The two granite bodies in Union County differ from the Anson County granite. They are non-porphyritic and contain less biotite, also they vary from light-gray, coarse-grained rocks to dull-gray, fine-grained rocks. The weathering properties of the Union County granite are similar to those of the Anson County granites, and a similar soil is produced.

Diorite-gabbro

The diorite-gabbro unit, which covers an area of about six square miles, has the smallest areal extent of the geologic units mapped in the Monroe area. It intrudes a granite body near the western extremity of Union County and extends in a north-south-trending belt, one to two miles wide, from Mecklenburg County into South Carolina. The rocks in this unit range in composition from diorite to gabbro. The diorite-gabbro is a massive, coarse-textured rock composed mainly of hornblende, feldspar, augite, and varying amounts of quartz and accessory minerals. These rocks usually crop out as rounded boulders that are relatively unweathered. On the surface these rocks are black or dark-gray and pitted, apparently due to differential weathering among the constituent minerals. Laney (1910, p. 59) explains their pitted surface as follows: "This is probably caused by the resistance of the purer phenocrysts of augite which withstand weathering better than the hornblende 'sponges' and hence are left as projecting masses." On a freshly fractured surface, these rocks have a glossy luster. The unit is covered generally by a thick layer of dark-red or brown residual soil.

Phyllite and mica schist

The phyllite and mica schist unit occurs in both Anson and Union Counties. In Anson County it forms a narrow contact zone between the porphyritic granite and the tuffaceous argillite. The width of this contact zone ranges from about a hundred yards to about three-fourths of a mile. In southwestern Union County this unit forms a contact zone between the lower volcanic unit and the southern granite body in that county. It extends as a belt, one-half mile to three and one-half miles in width and about ten miles in length.

The unit is composed principally of phyllite and mica schist, but in some places it contains other rocks—including rhyolite, granite-gneiss, and lithic tuff. The phyllites and schists were apparently derived from the volcanic rocks with which they are associated and were altered by contact metamorphism at the time of the granite intrusion. Due to extensive weathering, outcrops of fresh rock are scarce. The thick layer of residual soil consists of clay mixed with fragments of quartz and mica. The soil color is usually dark-red or reddish-yellow.

Gneiss

Within the Monroe area, gneissic rocks were mapped as a unit only in the southeastern part of Anson County where they crop out in an irregular-shaped area of about 10 square miles that is surrounded by the porphyritic granite. This unit consists mainly of biotite-gneiss and some sericite schist. There are many gradations between the gneiss and the schist in the unit. Quartz, hornblende, and garnet are the principal accessory minerals. Typically, the rock has gray color and a medium to coarse texture. Where the biotite content increases, the color becomes darker. Banding is common in this unit. Massive boulders crop out on hillsides and along creek beds; the residual soil mantle is generally only a few feet thick and dark red in color. There is a contact zone, usually less than one-quarter mile in width, of intensely weathered gneiss between the gneiss and granite unit.

Carolina Volcanic-Sedimentary group

The rocks of the Carolina volcanic-sedimentary group underlie all of Stanly County, most of Union County, and approximately one-third of Anson County. They are a part of what has been popularly known as the "Carolina Slate Belt," a northeast-trending band of volcanic, sedimentary, and low rank metamorphic rocks that crop out across the entire State in the eastern and central Piedmont. Numerous writers have pointed out that the term "Slate Belt" is misleading since slate is not the predominant rock type of this group. Stromquist and Conley (1959) used the name "Carolina Volcanic-Sedimentary group" or, simply, "Volcanic-Sedimentary group" in describing these rocks. This terminology is used in this report.

Conley (1962) established a stratigraphic sequence for rocks of the volcanic-sedimentary group in the Albemarle quadrangle, part of which is in northeastern Stanly County. Due to the reconnaissance scale of the present mapping, the units described in this report correspond only in part to those mapped by Conley. However, the writer follows many of the stratigraphic and lithologic concepts advanced by Conley in the description of rock units that follow.

Upper Volcanic Unit

In the Monroe area, rocks of the upper volcanic unit crop out in scattered areas in northern and northeastern Stanly County. The outcrop areas normally correspond to topographic highs. Conley (1962) referred to these rocks as the "Upper Volcanic sequence" and mapped them in three separate units. In descending order of age, Conley's units were composed primarily of rhyolite, basaltic tuff, and andesitic tuff. Because of the relatively small areas underlain by these rocks, they are grouped into one unit for the purpose of this report. All three of the units differentiated by Conley are not present in any single outcrop area but their interrelationship is apparently conformable.

Rocks of the upper volcanic unit unconformably overlie the rocks of the tuffaceous argillite unit and the laminated argillite unit. The rhyolite of the upper volcanic unit caps Morrow Mountain and a few nearby hills. Conley (1962) indicates that the rhyolite is as much as 200 feet thick. Typically, it is a dense, fine-grained flow rock that breaks with a conchoidal fracture. The fresh rock is gray to dark-gray in color. The rhyolite flows are sometimes porphyritic and contain phenocrysts of feldspar and betaquartz crystals. The flow lines are well preserved. Usually, the rock is well jointed but resistant to weathering and erosion. The soils produced by weathering range from light gray to buff and vermilion in color. Good exposures of this rock can be seen along the approach road to, and at the apex of, Morrow Mountain.

The largest outcrop area of basaltic tuff of the upper volcanic unit extends in a north-south direction from Badin Lake to Morrow Mountain. This outcrop area comprises about seven square miles. Numerous smaller outcrops are scattered throughout northern and northeastern Stanly County.

According to Conley (1962), the basaltic tuffs attain a maximum thickness of 200 feet. They are composed typically of basaltic lithic-crystal tuffs and some interbedded basaltic flows. These rocks are well jointed, exhibit spheroidal weathering, and produce a dark-brown clayey soil.

Andesitic tuff occurs in the upper volcanic unit in the area south and east of New London. Conley (1962) indicates that the andesitic tuff has a maximum thickness of 140 feet in this area. It consists of dark-gray, massive andesitic tuff that often has a scoriaceous appearance. It weathers readily to produce a clayey, maroon-colored soil.

Tuffaceous Argillite Unit

The tuffaceous argillite unit is the most extensive geologic unit that was mapped in the Monroe area; it is exposed over about one-half of Anson County, three-fourths of Stanly County, and two-thirds of Union County, covering an estimated area of over eleven hundred square miles. It conformably overlies the laminated argillite unit.

The tuffaceous argillite unit, composed predominantly of felsic tuffaceous argillite and graywacke, contains basic tuffaceous argillite, felsic tuff, mafic tuff, and flow material interbedded with the two predominant rock types. The unit has been intruded by diabase and rhyolite dikes and gabbro sills. These rock types were mapped as one unit because of the similar hydrologic properties of the two major rock types.

Graywacke is more typical of the upper part of the unit and crops out along the axis of a large syncline near New London in Stanly County.

The graywacke is composed typically of sand-sized quartz and chloritized rock fragments, with some feldspar and argillite fragments in a fine ground mass. The fresh rock is dark gray-green but weathers to a light maroon color.

As pointed out by Conley (1962) the graywacke grades to finer-grained equivalents to the southeast along the synclinal axis. The finer-grained material is indistinguishable from argillite in hand specimen. With the exception of the graywacke described above, the remainder of the tuffaceous argillite unit, as mapped for this report, is composed principally of felsic tuffaceous argillite. The unweathered rock is medium-gray in color; it weathers to a light-gray color. In the Monroe area the thickness of individual beds ranges from about one inch to several feet. In hand specimen, the rock appears to be a fine-grained tuff, the only identifiable minerals being scattered fragments of feldspar crystals. Conley (1962) indicates, that in thin section, the rock is a microcrystalline tuff, the most readily identifiable minerals being quartz and orthoclase.

The above-described graywacke and felsic tuffaceous argillite, with related interbedded rocks, comprise the tuffaceous argillite unit. Regional structure consists of gentle open folds in most of the Monroe area except in the area of the Gold Hill fault in western Union County where the rocks have been tightly folded and sheared. The rocks of the tuffaceous argillite unit are of low metamorphic rank, except in the areas adjacent to the Gold Hill fault or to various intrusive bodies, where the rocks are of medium metamorphic rank.

Laminated Argillite Unit

The laminated argillite unit is exposed in all three counties of the Monroe area, where it overlies conformably the lower volcanic unit and is overlain conformably by the tuffaceous argillite unit.

The unit is composed primarily of thin beds, or laminae, of clay and silt-sized material. The laminae, less than one-eighth inch in thickness, give the rock a banded or striped appearance. The fresh rock is dark-gray in color; it weathers to shades of red and yellow and produces light-gray and yellow soils. The rock usually has a well-developed bedding-plane cleavage and sometimes has an incipient axial-plane cleavage.

The contact between the laminated argillite unit and the tuffaceous argillite unit is gradational. For the purposes of this report the contact was placed where the thicker beds of the overlying tuffaceous argillite unit become predominant over the laminae of the laminated argillite unit. Structurally, regional open folds predominate, but isoclinal and overturned folds occur. Metamorphism is low rank, except where the unit has been upfaulted on the western side of the Gold Hill fault in Union County. Here the rocks of the laminated argillite unit have been metamorphosed to phyllite and slate, and traces of the original bedding planes have been largely obliterated.

Slump bedding in the laminated argillite has been observed in several outcrops. Plate 2 is a photograph of such bedding made in a small quarry by the Rocky River in northern Anson County. Pettijohn (1949, p. 145) describes and explains slump structure in rocks similar to those of the laminated argillite unit as follows. "These structures are confined to a single bed or zone between undisturbed beds. In many cases the disturbance is restricted to layers a mere inch or two thick. Such deformation is usually due to subaqueous slump or gliding."

Plate 2. Slump bedding in laminated argillite. From quarry on the Rocky River near Highway No. 52.

Lower Volcanic Unit

Rocks of the lower volcanic unit crop out in the western and southwestern parts of Union County in two large irregular shaped outcrop areas. They are the oldest rocks exposed in the area.

The dominant rock types of the lower volcanic unit are fine-grained felsic tuffs and crystal tuffs that occur interbedded with rhyolite flows. These rocks are usually light-gray in color. The unit is frequently intruded by mafic dikes, quartz dikes, and rhyolite dikes.

Rocks of the lower volcanic unit generally are deeply weathered. About one-half mile south of Indian Trail in Union County, a drilled well penetrated highly weathered felsic tuff to a depth of one hundred and thirty-five feet. This is an extreme case, but the unweathered rock is usually so deeply buried as to make outcrops a rarity. The lack of unweathered outcrops is characteristic of the unit.

The rocks of this unit weather usually to a deep red color and in some instances to a creamy-yellow color. Some of the felsic tuffs weather to a clean white kaolinic clay that contains sand-size quartz fragments. A good exposure of this material can be seen about one-half mile west of Trinity in Union County.

Agriculturally, the soils of this unit are not very productive; their primary use is for pasture land.

Geologic Structure

The Carolina volcanic sedimentary group has been folded regionally with the Monroe area. The general structure is a series of northeast-trending synclines and anticlines; the larger ones have wave lengths of ten to fifteen miles. Two major faults have been mapped in the area. The largest one is the Jonesboro fault, which extends across most of North Carolina and into South Carolina. It forms the eastern boundary of the Triassic basin. The other fault is the Gold Hill fault, which extends from Davidson County through Union County and into South Carolina. Evidence of several minor faults has also been observed. There are probably other sizable faults in the Monroe area. Large displacements could exist and show little evidence of their presence because of the great thickness of the stratigraphic units.

New London syncline

Northern Stanly County and a part of Union County contain a large southwest plunging synclinal structure known as the New London syncline. The tuffaceous argillite unit wraps around this structure, and graywacke is exposed in its center (Conley, J. F., 1959). The structural axis of this syncline can be traced from northwestern Montgomery County through Stanly County and into the southwestern part of Union County.

Troy anticline

The Troy anticline is the most extensive structural unit within the Monroe area. Conley (1962) noted that the width of this structure is about 30 miles, and it extends from Moore County westwardly to the Pee Dee River. Longitudinally, the structural axis has been traced from central Randolph County into South Carolina, a distance of more than 80 miles. Within the Monroe area, the structure is exposed only in the southwestern part of

Union County. The center of the structure contains the oldest rocks exposed in the area, the lower volcanic unit. According to Conley (1959), this unit represents an old land mass built up from the sea floor by a series of volcanic eruptions and flows. Near the axis of the anticline several outcrops of rhyolite porphyry have been observed that indicate the proximity of the center of vulcanism.

The western flank of the anticline, in Union County, is tightly folded, and a part of that flank has been altered structurally by minor faults. The structure plunges to the northeast in the vicinity of Altan, where the lower volcanic unit is overlain by the laminated argillite unit and the tuffaceous argillite unit.

Jonesboro fault

The Jonesboro fault forms the contact between Triassic and pre-Triassic rocks along the eastern edge of the Triassic basin for more than one hundred miles. In the Monroe area, the Jonesboro fault bisects Anson County along a northeast trending line. No attempt has been made to determine the vertical displacement of this fault in Anson County. However, it is known that about thirty miles northeast of Anson County the vertical displacement is at least 6,000 to 8,000 feet. (Reinemund, J. A., 1955). No border conglomerate has been observed along the fault in Anson County.

Gold Hill fault

The Gold Hill fault has been traced from Guilford County through the western part of Union County into South Carolina. In Union County the fault zone is bounded on the eastern side by parts of the tuffaceous argillite unit, the laminated argillite unit, the lower volcanic unit, and the phyllite and mica schist unit. Along the western side of the fault line, throughout the area, it is bounded by a part of the laminated argillite unit, that often has an almost vertical dip and has thin slaty cleavage.

Mineralization has been observed in many instances in relation to the Gold Hill fault and to the associated minor faults. In the early part of the century gold was mined in at least six different mines in the western part of Union County. One of the oldest mines in the county was located eight and three-tenths miles southeast of Waxhaw on property now owned by Brady Green.

This mine is worthy of mention because it is situated near the axis of a large anticline previously mentioned, and it provides evidence supporting the theory that many smaller faults were developed in this area in conjunction with the Gold Hill fault. At this same location and reportedly extending for one-half mile along a ridge paralleling Can Creek is a deposit of pyrophyllite and soapstone.

GROUND WATER

Source

The source of ground water in the Monroe area is precipitation in the form of rainfall and snow. That part of total precipitation which becomes ground water percolates downward under the influence of gravity until it reaches the zone of saturation where all the interstices are filled with water. The top of the zone of saturation is the water table except where that surface is formed by an impermeable body.

Occurrence and Movement

Ground water occurs in the openings or interstices in the rocks below the water table. These openings range in size from minute pores in clays to large caverns in some limestones. Interstices in unconsolidated sedimentary rocks such as gravel, sand, and clay are primary pores or openings between the particles. Consolidation of a sedimentary rock results generally in a decrease in size and amount of primary interstices through compaction and cementation. In consolidated rocks, whether sedimentary, igneous, or metamorphic in origin, secondary interstices such as solution channels, bedding planes, joints, and planes of schistosity, generally have greater influence on the occurrence and movement of ground water than do primary interstices.

A measure of the capacity of a rock to store water, under non-artesian conditions, is its porosity, which is the volumetric percentage of the rock that is occupied by interstices. Permeability is a rock's capacity for transmitting fluids in response to variations in hydrostatic pressure. Permeability is governed by the size, shape, amount, and degree of interconnection of interstices.

Porosity and permeability are not necessarily related. A clay, for example, may have a high porosity yet yield little water, because the small size of the interstices result in water being retained by molecular attraction. On the other hand, a coarse sand or fractured consolidated rock may have a considerably lower porosity than the clay, yet it may yield more water because of the size and degree of interconnection of fractures.

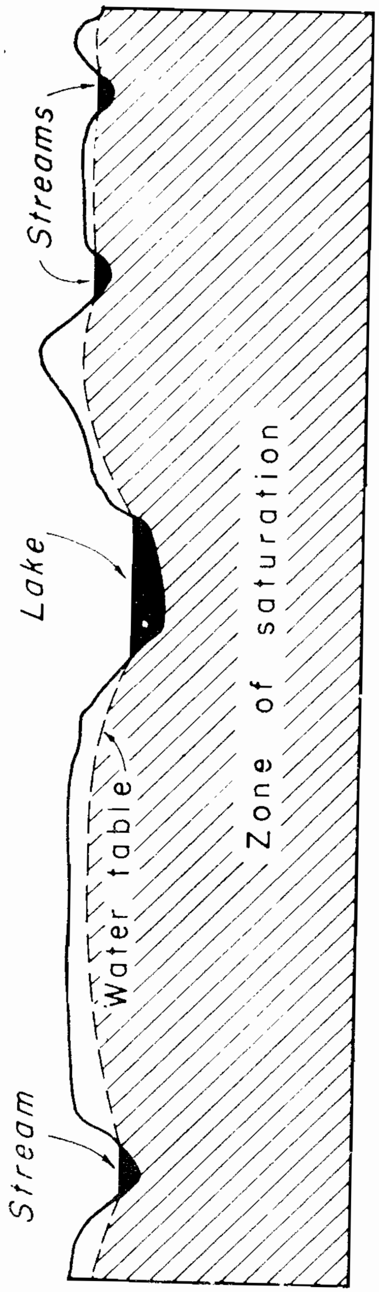
"An aquifer is a formation, group of formations, or a part of a formation that is water-bearing" (Meinzer, O. E., 1942). For the purposes of this report, an aquifer is considered to be a rock unit that is capable of storing and transmitting sufficient quantities of water to serve as a source of supply for human consumption. The available water in an aquifer may be said to be the amount of water that may be safely and economically withdrawn. This depends upon the water-storing and water-transmitting characteristics of the aquifer and the amount of recharge water available to the aquifer. If discharge exceeds recharge in an aquifer, over a period of time, the water level in the aquifer will decline.

The Water Table

The water table is not a stationary surface of fixed configuration but varies considerably according to certain natural influences. In the Monroe area the depth to the water table is governed largely by the topography. In stream valleys or swamps the water table usually is at or very near the surface. On wide flat uplands the depth to the water table varies from a few feet to thirty or forty feet. On steep hills and ridges near large streams, the depth to the water table may be as great as 100 feet. Figure 3 illustrates the relation of the water table to the topography.

Because the source of ground water is precipitation, the water table fluctuates with the amount of rainfall. The intensity and duration of the rainfall has a considerable bearing upon the proportion of water that runs off directly, evaporates, or reaches the water table. Soils differ in their ability to transmit water to the water table or ground-water reservoir; those in the Monroe area generally have low permeability. Thus a heavy rainfall of short duration will result in a high percentage of surface runoff. The same amount of rain, falling over a longer period, will result in a much larger proportion of water reaching the ground-water reservoir.

Figure 3. Diagrammatic section illustrating the relation of the water table to topography.



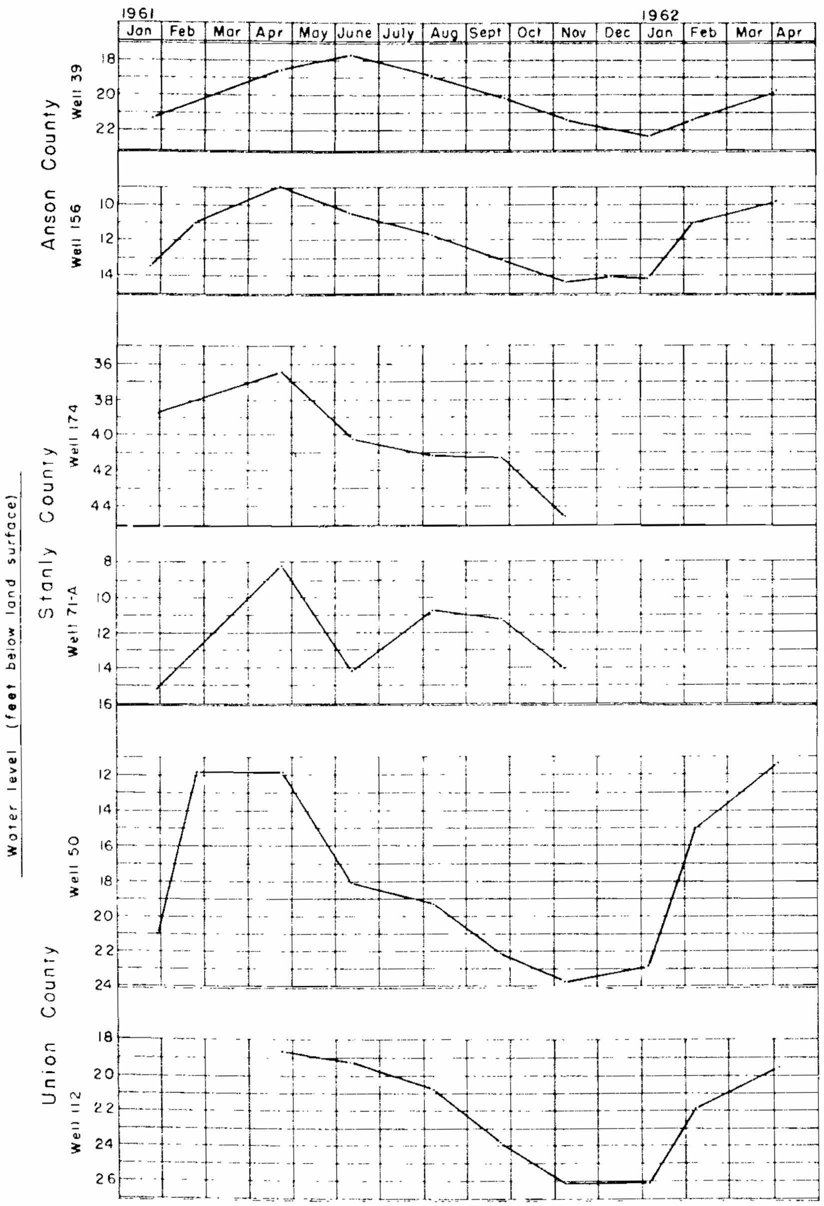
Temperature affects movement of water to the water table, because the viscosity of water varies inversely with the temperature. Cold water will move through the interstices more slowly than warm water. In general, however, ground-water temperatures do not fluctuate widely.

Evaporation and transpiration by plants also affect the elevation of the water table. The amount of water lost by evaporation from the soil is dependent upon the temperature, humidity, and rate of air movement. During warm windy seasons of the year, evaporation may be considerable. During the growing season, transpiration losses are greatest. The water lost by evaporation and transpiration generally comes from the zone of aeration above the water table. Nevertheless this loss must be replenished either by intercepting rainfall as it percolates toward the zone of saturation or by absorbing water by capillary action from the zone of saturation; either results in a lowering of the water table. Even though rainfall is greatest during the summer and fall months, the water table is at its lowest elevation because of evapotranspiration effects.

During this investigation, monthly records were kept of water-level fluctuations in 24 wells in the Monroe area. Hydrographs of six of these wells shown in figure 4, illustrate typical water-table fluctuations in various parts of the area. The hydrographs show that the trend of the seasonal fluctuations is consistent. However, there is considerable difference in the range of fluctuation between wells. Apparently, this is due to permeability variations between the materials in which the wells were drilled and to variations in the porosity.

The seasonal cycle of water-table fluctuations in the Monroe area is typical of the cycle in other parts of the State. It begins usually, with a marked rise in water levels in December or January which continues until the beginning of the growing season in April or early May. From May to December, there is a continuous decline in water levels unless unusually heavy rainfall causes slight, local rises.

Figure 4. Hydrographs of selected observation wells in the Monroe area.



QUALITY OF WATER

Introduction

Analyses of certain chemical constituents of ground water commonly are an integral part of ground-water investigations. The chemical quality of ground water may determine the usability of the water. In addition, chemical quality may reflect the geologic environment from which the water was obtained.

Rainwater contains dissolved gases, principally carbon dioxide and oxygen, which make it a weathering agent that interacts chemically with mineral compounds that make up the rocks of the earth's crust. This interaction results in some mineral constituents going into the aqueous solution of ground water and partial or total disintegration of some of the rocks involved. The amount and type of these mineral constituents, or dissolved solids in ground water determine the characteristic taste of the water. The quantities of absorbed gases and dissolved solids that occur in a ground water at any one time are dependent upon several factors which include (1) the hydrostatic and atmospheric pressures present in the system, (2) the temperature of the water, (3) the chemical composition and physical characteristics of the rocks, and (4) the length of contact time between the water and the mineral constituents of the rocks.

Salts of common metals, which include potassium, sodium, calcium, magnesium, and iron, make up a large percentage of the dissolved solids in ground waters. True salts are ionic in character, being composed of cations and anions. Chemical analyses of ground water involve the quantitative measurement of the various ionic constituents that are present in the aqueous solution. The proportionate amounts and chemical relationships of the anions and cations present in the solution determine such characteristics of the water as hardness and hydrogen-ion concentration. The results of the chemical analyses are expressed in parts per million (ppm) by weight in this report.

Most of the ground waters from the Monroe area, that were analyzed as part of this investigation, were calcium bicarbonate waters. A few waters, primarily from localized areas in the Triassic rocks, were calcium chloride waters. These calcium chloride waters usually contained, for the Monroe area, anomolously high amounts of total hardness.

The following discussion concerns the chemical constituents, that were determined for ground waters from the Monroe area, in relation to their occurrence.

Mineral Composition of Ground Waters

Hydrogen-ion Concentration (pH)

The hydrogen-ion concentration is a measure of the acidity or alkalinity of water. Water having a pH of 7.0 is regarded as neutral, a pH higher than 7.0 indicates alkalinity, and a pH lower than 7.0 indicates acidity.

Iron (Fe)

Waters percolating through rocks and soils that contain iron-bearing minerals dissolve iron from these minerals. Acidic waters have a greater tendency to dissolve iron than alkaline waters.

Water with an iron content of less than 0.3 ppm is suitable for most domestic purposes. Excessive iron in water is responsible for the yellowish brown stains on white enamel and porcelain fixtures and laundry with which the water comes in contact. Ground water contains dissolved iron in the ferrous state. A water that contains excessive iron may be clear when pumped from a well. Exposure to the atmosphere allows the oxidation of the ferrous iron and the formation of ferric hydroxide which is responsible for iron-staining.

The majority of the ground waters analyzed from the Monroe area contained less than 0.3 ppm of iron. Only 7 of the water samples contained over 0.5 ppm of iron.

Calcium and Magnesium (Ca and Mg)

Calcium and magnesium in ground water are dissolved to some extent from practically all rocks in the Monroe area. These two elements are the major contributors to the hardness of water and also the chief constituents of the scale formed in boilers or other vessels in which water is heated or evaporated. The highest calcium and magnesium contents, 287 ppm and 108 ppm, respectively, in ground waters analyzed from the Monroe area were in water obtained from Triassic rocks.

Sodium (Na) and Potassium (K)

Sodium- and potassium-bearing minerals are present in nearly all types of rocks and soils. The sodium content of ground water is generally higher than the potassium content. High concen-

trations of sodium will cause foaming in stream boilers and will limit the use of a water for irrigation. Only three water samples analyzed from the Monroe area contained more than 50 ppm sodium. The highest potassium content of water analyzed from the area was 5.2 ppm.

Bicarbonate (HCO_3) and Carbonate (CO_3)

Bicarbonate and carbonate in ground waters produce alkalinity. Ground waters sampled in the Monroe area contained no measurable amounts of carbonate. The bicarbonate content of water samples from the Monroe area ranged from 4 ppm to 391 ppm. The highest bicarbonate content was in water from the Triassic rocks. Bicarbonate has little effect on either the domestic or industrial utilization of the water. However, when water that contains bicarbonate is heated, the bicarbonate is converted to carbonate which is relatively insoluble. The carbonate contributes to scale formation in containers and boilers.

Sulfate (SO_4)

Sulfate in ground water is dissolved from various sulfate minerals which are readily soluble in water. Sulfate may also be derived from the oxidation of the iron sulfide minerals and organic matter. High concentrations of sulfate in waters impart a noticeable taste and odor to the water and contribute to scale formation. Only 6 water samples from the Monroe area contained more than 20 ppm sulfate.

Chloride (Cl)

Small amounts of chloride in ground water are dissolved from the weathering of chloride-bearing minerals. Chloride in ground water may also be derived by pollution, from sewage and industrial wastes. Only 8 water samples from the Monroe area contained more than 50 ppm chloride. The highest chloride content, 744 ppm, was in water from the Triassic rocks.

Nitrate (NO_3)

Nitrate in ground water is considered to be the final oxidation product of nitrogenous organic materials. The U. S. Public Health Service recommends that waters intended for human use should not contain more than 45 ppm nitrate. However, a concentration of greater than 3.0 ppm is generally considered to indicate the presence of a source of pollution. Dug wells and improperly cased wells are most subject to nitrate pollution by infiltration of surface water.

The presence of small seams of coal and other organic material in the Triassic rocks may be the cause of higher than normal nitrate concentrations in water samples from three wells in Anson County.

Hardness

Hardness is the property of water attributable to the presence of dissolved alkaline elements, and is expressed in analyses as equivalent calcium carbonate ($CaCO_3$). Calcium, magnesium, and other polyvalent cations are responsible for the hardness of water. Hard water is objectionable because of its soap-consuming properties and because it forms scale in boilers and containers in which it is heated. The hardness of water samples from the Monroe area ranged from 8 to 1,160 ppm. The harder waters were from Triassic rocks.

The U. S. Geological Survey classifies water with respect to hardness as follows:

Hardness as $CaCO_3$ (ppm)	*Classification*
0-60	Soft water
61-120	Moderately hard water
121-180	Hard water
181+	Very hard water

ROCK UNITS AND THEIR WATER-BEARING PROPERTIES

Introduction

There are seven principal water-bearing rock units in the Monroe area. Tables are presented and discussed to allow comparison of the water-bearing properties of the various rock units and to illustrate the effects of well depth and topographic location on the yield of wells in the Monroe area.

The comparisons discussed in this section are believed to be representative of the rock units mentioned. However, comparisons based on such a small number of wells cannot be considered highly accurate, mathematically.

Table 1. Average Yield of Wells According to Rock Type.

	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
All Wells	407	120	½-200	14	0.11
Rock unit					
Sand (Quaternary)	2	28	5	5	0.18
Sandstone (Triassic)	26	156	3/4-65	16	0.10
Granite	15	95	1-100	18	0.19
Phyllite and mica schist	5	236	2½-90	37	0.16
Tuffaceous argillite	302	119	½-200	13	0.11
Laminated argillite	39	113	1½-75	15	0.13
Lower volcanic unit	18	128	1-60	12	0.09

Relative Water-Bearing Properties of the Rock Units

Data on depth and yield were compiled for 407 wells in the Monroe area. Table 1 shows the average yield per well and per foot of well for both the total number of wells and the number of wells in each rock unit.

As shown by the data in Table 1, the 407 wells inventoried in the Monroe area have an average depth of about 120 feet, an average yield per well of about 14 gpm, and an average yield per foot of well of 0.11 gallons per minute (gpm).

Comparison of the average yield values in Table 1 indicates that the highest average yield per well is obtained from wells in the phyllite and mica schist unit and that the lowest average yield per well is obtained from wells in Quaternary sand. The highest yield per foot of well is obtained from wells in the granite unit and the lowest yield per foot of well is obtained from wells in the lower volcanic unit.

Sands and Clays of Quaternary Age

The sand and clay unit of Quaternary age covers most of the southeastern part of Anson County. It consists of interbedded kaolinitic sands and clays and well-rounded stream gravel. The gravel ranges from pea-size to large cobbles. The thickness of the unit ranges from a featheredge to more than 50 feet. Ground water is contained in the pore spaces, or primary interstices of these unconsolidated sediments and in some of the thicker parts of this unit ground water occurs under semi-artesian conditions; the clay strata acting as semiconfining layers above and below sand or gravel strata.

Because this unit is relatively thin, it has minor importance as an aquifer. Yield figures are available for only two wells in this unit. Most of the existing wells are either dug or bored and are less than 50 feet deep.

Chemical analysis was made of water from one well in this unit. Except for a moderately high nitrate content, the water was of very good quality. The nitrate content was probably due to contamination by surface water. The analysis showed the content of iron and hardness in this water to be 0.08 ppm and 48 ppm, respectively. However, some owners of wells in this same unit have reported objectionable amounts of iron.

Triassic (Newark Group)

Rocks of Triassic age are exposed in the Monroe area in a belt ranging in width from about 6 to 10 miles and extending in a northeast-southwest direction across the central part of Anson County and into the southeastern corner of Union County. These rocks consist of sandstone, siltstone, claystone, and conglomerate.

Primary porosity of the sandstone and conglomerate has been reduced by post depositional compaction and cementation, and the occurrence and movement of water in these rocks are controlled mainly by secondary interstices, or fractures.

The data in Table 2 indicate that the rocks of Triassic age have an average yield per foot that is about the same as that for the tuffaceous argillite and rocks of the lower volcanic unit. Table 2 gives data for wells in the rocks of Triassic age according to depth and topographic location.

The Triassic rocks generally yield adequate supplies of water for most domestic purposes.

The diabase dikes that have intruded these rocks yield little water but the rock adjacent to a dike often is highly fractured and many of the higher yielding wells in the Triassic rocks are drilled adjacent to dikes.

Chemical analyses of water from the Triassic rocks indicate

Table 2. Average Yield of Wells in Rocks of Triassic Age

According to depth

Range in depth (feet)	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
0-100	9	89	3-40	18	0.20
101-150	7	127	5-65	18	0.14
151-200	6	165	6-50	21	0.12
201-250	-	-	-	-	-
251-300	2	295	4-18	11	0.04
Greater than 300	2	395	½-3	2	0.004
All wells	26	156	½-65	17	0.11

According to topographic location

Topographic location	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
Hill	17	137	3-65	14	0.10
Flat	5	118	4-50	21	0.18
Slope	2	289	3-40	22	0.07
Draw	None				
Valley	None				

that the water is frequently hard and, locally, may contain objectionable amounts of iron and chloride.

Granite

There are three separate bodies of granite within the Monroe area. The largest body is in the eastern section of Anson County where it has intruded the rocks of the volcanic-sedimentary group and the mica-gneiss unit. Two smaller bodies of granite occur along the western border of Union County.

The granite in Anson County is light-gray in color and porphyritic in texture, containing large phenocrysts of feldspar and a considerable amount of biotite. About one-fifth of Anson County is underlain by this granite body. The porphyritic granite usually provides sufficient water for domestic and small industrial supplies. According to the data in Table 3, the yield of individual wells in granite ranges from 1 to 100 gpm.

The granite in Union County differs from the granite in Anson County in that it is fine-grained and contains less biotite. The combined data for all wells in granite from both counties indicate that the average well depth is about 91 feet, and the average yield is about 19 gpm. Chemical analyses of water from the granite bodies indicate that the water is soft and low in iron.

Diorite-Gabbro

The Diorite-gabbro unit is the smallest geologic unit mapped in the Monroe area. Diorite-gabbro intrudes the granite unit and crops out in a belt one to two miles wide which extends in a north-south direction from Mecklenburg County into South Carolina. Locally, the rocks range from diorite to gabbro, but as a whole, the rocks of this unit are intermediate between diorite and gabbro.

No information is available on wells drilled in this unit in Union County. However, just west of the Union County line in Mecklenburg County, LeGrand and Mundorff (1952) reported that wells in this unit had an average yield of 13 gpm. The average depth was 135 feet, and the average yield per foot of well was 0.10 gpm.

Phyllite and Mica Schist Unit

This unit occurs in the southwestern part of Union County forming a contact zone between granite and the rocks of the

Table 3. Average Yield of Wells in Granite.

According to depth

Range in depth (feet)	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
0-100	11	72	1-45	15	0.20
101-150	3	130	5-100	36	0.28
151-200	1	182	-	7	0.04
All wells	15	91	1-100	19	0.20

According to topographic location

Topographic location	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
Hill	7	95	3½-30	9	0.10
Flat	4	112	7-100	47	0.42
Slope	3	70	3-15	8	0.11

Table 4. Average Yield of Wells in the Phyllite and Mica Schist Unit
(Topographically, all wells are on slopes)

Range in depth (feet)	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
101-150	1	150	-	2	0.02
201-250	1	250	-	50	0.20
251-300	2	237	3-40	21	0.09
Greater than 300	1	301	-	90	0.30
All wells	5	235	2½-90	37	0.16

lower volcanic unit. In Anson County this unit forms a contact zone between the granite and the tuffaceous argillite unit. In Union County, the contact zone is from one-half to three and one-half miles wide. In Anson County, the width of this contact zone varies from a few hundred yards to about three-fourths of a mile.

The unit is principally a phyllite with subordinate occurrences of mica schist and minor occurrences of rhyolite and lithic tuff. Water occurs in the fractures and along the planes of schistosity.

Data are available for only five wells drilled in the phyllite and mica schist unit. Only one of the five wells is in Anson County. It was drilled to a depth of 275 feet and yields 3 gpm. The areal extent of the phyllite and mica schist unit in Anson County is too small to be of any importance as an aquifer except for domestic purposes.

Three of the four wells in this unit in Union County were drilled for the town of Waxhaw and yield 40, 50, and 90 gpm. Other data on these wells are given in Table 4.

Analyses of water from the phyllite and mica schist unit indicate that the water has a low iron content and a total hardness of less than 60 ppm.

Gneiss

Gneissic rocks crop out in the southeastern part of Anson County in an irregularly shaped body covering about 10 square miles. This unit is composed of biotite gneiss with small amounts of sericite schist. Ground water moves through fractures and along schistose planes in this unit.

The only ground-water supplies drawn from this unit are obtained from a few dug wells. The outcrop area is in a practically uninhabited section of Anson County. Since it has little use as an aquifer, there are few data available on its hydrologic properties.

Upper Volcanic Unit

In the Monroe area, the upper volcanic unit crops out only in Stanly County. It has been mapped in two principal bodies covering areas of about eleven and nine square miles, two secondary areas of one and one-tenth and eight-tenths square miles, and at least three dozen minor bodies of less than one square mile in the area. The largest body extends from Badin Lake to Morrow Mountain. The second largest outcrop extends from about one mile southwest of, and including, New London to the Yadkin River. Small outcrops are scattered over the northern half of the county from the vicinity of Millingport to about four miles southeast of Albemarle.

The dominant rocks of the upper volcanic unit are lithic tuffs and lithic-crystal tuffs of massive andesitic composition and basaltic composition. Rhyolite flows cap the highest hills in the eastern part of the unit.

As in the other rock units of the area, topography should be given careful consideration when selecting a well site. According to Conley (1962) the basaltic tuffs of this unit have a maximum thickness of 200 feet, and the andesitic tuffs do not exceed 140 feet in thickness. During this investigation, no drilled wells were found which derived water from these rocks. Apparently all the drilled wells in this unit obtain water from the underlying argillite units.

Tuffaceous Argillite

The tuffaceous argillite unit crops out in all three counties in the Monroe area, covering an area of more than 1,100 square miles. The unit contains several types of related rocks, the most common of which are interbedded felsic and mafic tuffaceous argillites, fine-grained tuffs, breccias, and flows. The tuffaceous argillites are overlain in some areas by graywacke sandstones and siltstones with some interbedded mafic tuffs, breccias, and conglomerates. The rocks of this unit are largely made up of fine ash and other volcanic ejecta which were deposited in water with very little reworking and sorting.

Because of its areal extent, the tuffaceous argillite unit is the most important aquifer in the Monroe area. The movement of ground water in this unit is along cleavage planes, bedding planes, joints, and quartz veins.

Adequate supplies for small municipal and industrial users as well as domestic users are available in all parts of the unit. Data collected on 304 wells in this unit indicate that yields of up to 200 gpm may be expected and that the yield per foot ratio decreases below a depth of about 150 feet.

Topographic location is also an important factor in selecting a well site in this unit. The best yields have been obtained from wells drilled in draws, valleys, and on slopes, respectively.

Table 5 illustrates the results of the tabulation of pertinent data for wells in the tuffaceous argillite unit.

Analyses of several water samples from this unit show that the water is generally hard and contains moderate amounts of iron. Apparently, much of the objectionable iron reported in the water by some well owners is secondary and is derived from rusting of the well casings and pipes in the water systems.

Table 5. Average Yield of Wells in Tuffaceous Argillite

According to depth

Range in depth (feet)	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
0-100	148	75	½-90	12	0.15
101-150	91	118	½-100	12	0.11
151-200	41	180	3/4-90	13	0.07
201-250	6	235	1½-15	6	0.03
251-300	11	278	1-30	5	0.02
Greater than 300	7	353	½-200	68	0.19
All wells	304	119	½-200	13	0.11

According to topographic location

Topographic location	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
Hill	163	110	½-75	10	0.09
Flat	34	109	½-95	11	0.10
Slope	24	123	2-180	20	0.16
Draw	6	75	7½-90	29	0.39
Valley	7	194	5-200	46	0.24

Laminated Argillite

Laminated argillite is exposed in all three counties in the area where it lies conformably upon the rocks of the lower volcanic unit. The predominant rock is fine-grained, laminated argillite showing graded bedding; the laminae are commonly less than one-sixteenth inch in thickness. Over most of its outcrop area, the rocks of this unit are open folded. However, west of the Gold Hill fault in Union County, the laminated argillite has been tightly folded and metamorphosed to a phyllite with thin slaty cleavage. The metamorphism has in many places almost completely destroyed the bedding planes.

The occurrence and movement of water in this unit is in the bedding planes, joints, and cleavage planes. Many domestic wells obtain water from laminated argillite, and their yields range from 1 to 75 gpm, with the average yield being about 14 gpm. The highest average yields for wells in this unit have been obtained from wells drilled in flat areas.

The data in Table 6 show the comparative yields according to depth and topographic location, for wells in the laminated argillite unit.

The rocks of the laminated argillite unit are similar in chemical composition to the rocks of the tuffaceous argillite unit. As would be expected, the quality of water in the laminated argillite unit is very similar to that of water in the tuffaceous argillite unit. It is generally hard and contains low to moderate amounts of iron.

Table 6. Average Yield of Wells in Laminated Argillite

According to depth

Range in depth (feet)	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
0-100	20	84	1½-40	13	0.16
101-150	12	116	5-75	16	0.14
151-200	3	173	6-30	14	0.08
201-250	1	203	-	35	.17
251-300	1	257	-	1	.004
Greater than 300	1	330	-	2	.004
All wells	38	116	1-75	14	.12

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic location	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
Hill	28	116	1½-75	13	0.11
Flat	6	104	5-40	20	0.19
Slope	3	135	1-10	6.0	0.04
Draw	3	92	5-20	10.0	0.11

Lower Volcanic Unit

Within the Monroe area, rocks of the lower volcanic unit crop out only in the western and southwestern parts of Union County.

The unit is composed primarily of fine-grained felsic tuffs, and felsic and mafic crystal tuffs with interbedded rhyolite flows. The unit is frequently intruded by diabase, rhyolite, and quartz dikes.

The occurrence of ground water is in the fractures and along cleavage planes. Generally, rocks of this unit are deeply weathered, but, because of the low permeability of the weathered material, it is frequently necessary to drill into the unweathered rock before satisfactory supplies of water can be obtained.

Data collected for 19 wells in this unit show that individual wells yield as much as 60 gpm. The average yield is slightly more than 11 gpm, and the average depth for the 19 wells is 121 feet.

The relation of yield to depth and the relation of yield to the topographic location for the wells in the lower volcanic unit are shown in Table 7.

Analyses of five water samples from this unit show the water to be of very good quality. The water is usually soft and the iron content is seldom greater than 0.3 parts per million.

Table 7. Average Yield of Wells in the Lower Volcanic Unit

According to depth

Range in depth (feet)	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
0-100	9	65	3-12	7	0.10
101-150	6	137	2-30	15	0.11
151-200	3	190	1-60	21	0.11
201-250	-	-	-	-	-
251-300	-	-	-	-	-
Greater than 300	1	303	-	1	0.003
All wells	19	121	1-60	11	0.09

According to topographic location

Topographic location	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
Hill	13	134	1-6	15	0.11
Flat	1	100	-	12	0.12
Slope	1	195	-	1	0.01

UTILIZATION OF GROUND WATER

In the Monroe area, ground water is obtained from wells and springs. While the use of springs as a source of ground-water supply is not uncommon in this area, the use of wells is far more common. Three types of wells—dug wells, bored wells, and drilled wells are used in this area.

Dug Wells

Dug wells are large diameter holes that are dug deep enough to intersect the water table. They are constructed manually using pick, shovel, and, in places, dynamite. A cribbing of wood, brick, stone, or cement is placed against unstable material inside the well to prevent it slumping and to retard seepage of surface water or foreign matter into the well. The depth of dug wells in the Monroe area ranges between 20 and 60 feet. Frequently, and for best results, they are dug in the fall season when the water table is at its lowest level.

Bored Wells

Within the Monroe area the use of bored wells is limited to those parts of Anson County that are covered by the sands and clays of Quaternary age. Bored wells are constructed with a machine-driven auger which bores a hole ranging in diameter from 12 inches to about 42 inches. These holes are usually lined with tile and tap a strata of sand or gravel below the water table. The depth of a bored well is dependent upon the nature of the material penetrated and the depth to the water table. In this area the depth of bored wells is seldom more than 40 feet.

Bored wells are better protected against pollution from surface seepage than dug wells because they are more tightly cased and covered. Bored wells can be constructed to a deeper depth than dug wells, therefore, they are less likely to go dry during periods of drought.

Drilled Wells

There are three methods used for drilling wells in the Monroe area. The smaller diameter wells (2 to 4 inches) are constructed by core drilling with chilled shot. The larger diameter wells are drilled by percussion methods, using either a cable-tool drill or the more modern air-rotary drill.

The shot-drill method employs a bit 6 to 8 feet long and from 2 to 4 inches in diameter. The bit is attached to the end of a drill stem, usually 3/4 to 1 inch in diameter, and rotated by machine. The bit is slotted on the bottom to hold the chilled shot which is poured down the hole outside of the drill stem and bit. The rotation of the bit causes the shot to cut the rock. Water, forced down the inside of the drill stem, cools the bit and brings the drill cuttings to the surface. Cores are removed from the bit when it is withdrawn from the hole. This drilling method is very slow, however, it is still used by a few drillers.

The cable-tool drill rig is basically a derrick, sheave, cable, drum, a string of drilling tools, and engine. The drilling tools and a short bit are attached to the cable. This string of tools is repeatedly raised and dropped by the machine at a rate of 25 to 30 times per minute. The percussion action causes the rock to be broken or crushed in the hole. When cuttings have accumulated in the hole, the tools are withdrawn and the cuttings are removed by a bailer. The bailer is a long cylindrical bucket with a valve at the bottom which permits free entrance of water and drill cuttings when the bailer is lowered but closes when the bailer is lifted.

The air-rotary drilling method is relatively new. The initial high cost of this equipment has limited its use to the larger drilling companies. However, the cost of a well drilled by this method is usually no more than the cost of any other method of drilling a well. In effect, the air-rotary method is similar to the cable-tool method in that the rock is broken by percussion. The air-rotary bit is driven by compressed air which is forced down the inside of the drill stem. The bit strikes the rock several blows per second, and the drill cuttings are forced to the surface, either dry or in suspension with water, by the compressed air. Even in hard rock, some air-rotary drills can drill 18 to 20 feet per hour.

All drilled wells in the Monroe area are cased. In properly constructed wells, the casing is driven into and seated in solid rock so that water from the surface cannot enter the well. In addition, cement or clay is usually poured around the casing at the surface to prevent the entrance of surface water.

FACTORS TO BE CONSIDERED IN SELECTING A WELL SITE

Many well sites are selected for their convenience to the place where the water will be used or to an available source of electric current for operating the pump. This usually is done because money may be saved by not installing extra wiring or pipe. However, in the Monroe area the cost of drilling a domestic well is from $3.00 to about $6.00 per foot. Several feet of small pipe can be laid at the surface or several feet of electrical wiring can be installed for the cost of one foot of drilling. Thus, taking a chance on a poor site in order to save several feet of wiring or pipe may be poor economy.

Certain geologic factors can give a strong indication of the existence of favorable conditions for obtaining a suitable water supply. For instance, coarse-textured rocks are generally better aquifers than fine-textured rocks. Cleavage planes and planes of schistosity often provide small channels through which ground water can move. Where these planes are numerous and where they have some degree of connection, the rock will yield more water. Many of the rocks in the Monroe area are of sedimentary origin and have bedding planes along which water may move. The porosity is greater in areas where the rocks have been folded because the bedding planes are slightly separated and become more open. Most of the rocks in the area are also fractured to some extent. Water occurs and moves through most of these fractures, and therefore, they are more favorable water bearers than the more massive rocks. Several wells within the area obtain substantial amounts of water from quartz veins. Quartz is hard and brittle and frequently has been highly fractured by subsequent earth movements. The quartz veins, when fractured, provide excellent channels through which water may move. Similarly, areas adjacent to dikes have been made more brittle and fractured by the intense heat and intrusion of the molten rock. The dike itself generally yields little water to wells, but wells drilled in the fractured zones near the dikes have proved to be better than average producers.

The topographic features of an area reflect the character of the underlying rock and are good indicators of conditions favorable for well sites. Topography is controlled by erosion, which, in turn is controlled largely by the relative resistance of the rocks. Depressions such as valleys were cut where the rock is

less resistant, and hills are left at places where the rock is more resistant. In many cases the rock in these depressions is less resistant because of the presence of fractures and other types of openings which permit the entrance and circulation of water and thus promotes weathering. Wells drilled in a depression thus have a better chance of intersecting more fractures and openings thereby yielding more water. The natural movement of ground water is toward depressions and away from hills. The depressions serve as catch basins for the water moving into them. Thus, wells drilled in such depressions would have a greater source of supply to draw upon and would be capable of a greater sustained yield.

Another factor which may be considered in selecting a well site is the thickness of the soil cover above solid rock. Thick soil cover overlying its parent rock strongly suggests relatively permeable underlying rock. In addition, a thick layer of residual soil serves as a reservoir to feed water into the underlying rock.

Effect of Topographic Location

The topographic locations were compared for 372 wells within the Monroe area. The number of wells, average depth, range in yield, average yield per well, and yield per foot of well in five different topographic locations are given in Table 8. The average yield per foot of well for wells in the different topographic locations is shown graphically in figure 5.

The topographic terms used here may require some explanation. The terms "hill" and "valley" are readily understood. However, the other topographical terms used may cause some confusion. Whether a low gentle rise should be listed as "hill" or "flat" is a matter of personal opinion. Similarly, a well a short distance from the crest of a hill might be considered to be on a hill by one observer and on a slope by another. The term "draw" is used for a slight to moderate depression leading downward to a stream valley, but draws grade into valleys and the distinction between the two becomes arbitrary and is based on personal opinion. Generally speaking, valleys are much larger than draws and usually have a floodplain or bottom land along a perennial stream.

Table 8 indicates the influence of topography on well yield. The yield per well and per foot of well for wells drilled in

Table 8. Average Yield of Wells According to Topographic Location

Topographic location	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
Hill	226	114	1-75	11	0.10
Flat	71	123	½-100	14	0.12
Slope	59	131	1-180	18	0.14
Draw	9	81	5-90	23	0.30
Valley	7	194	5-200	46	0.24
All wells	372	119	½-200	14	0.11

valleys and draws is significantly higher than for wells drilled on hills.

As mentioned previously, drainage and topography in the Monroe area are usually influenced by rock type and structure. Interstices in rocks provide storage space for ground water and avenues for its movement. Chemical weathering of the rocks by their contained ground water results in partial disintegration. Thus, fractured zones, which constitute good aquifers, are usually expressed as valleys and draws. The more resistant, less fractured rocks are less susceptible to weathering and form ridges and hills. Thus, wells drilled in valleys and draws are apt to penetrate more interstices and yield more water than wells drilled on hills. In addition, the natural movement of ground water is from a higher to a lower elevation. Thus, wells drilled in valleys have a larger ground-water reservoir, or recharge area, from which to draw water than do wells drilled on the hills.

In most parts of the Monroe area, flat areas are usually remnants of an old uplifted peneplane and give no indication of the resistance of the underlying rock. Mundorff (1948) theorized that wells drilled in flat areas should have the same yield as the average for wells in all topographic locations. This is substantiated in Table 8.

Data in Table 8 show that the highest yields would be ex-

Figure 5. Average yield per foot of well in gallons per minute.

A. Average yield, per foot of well, of wells in the different rock units.

B. Average yield, per foot of well according to topographic location.

C. Average yield, per foot of well, according to range in depth.

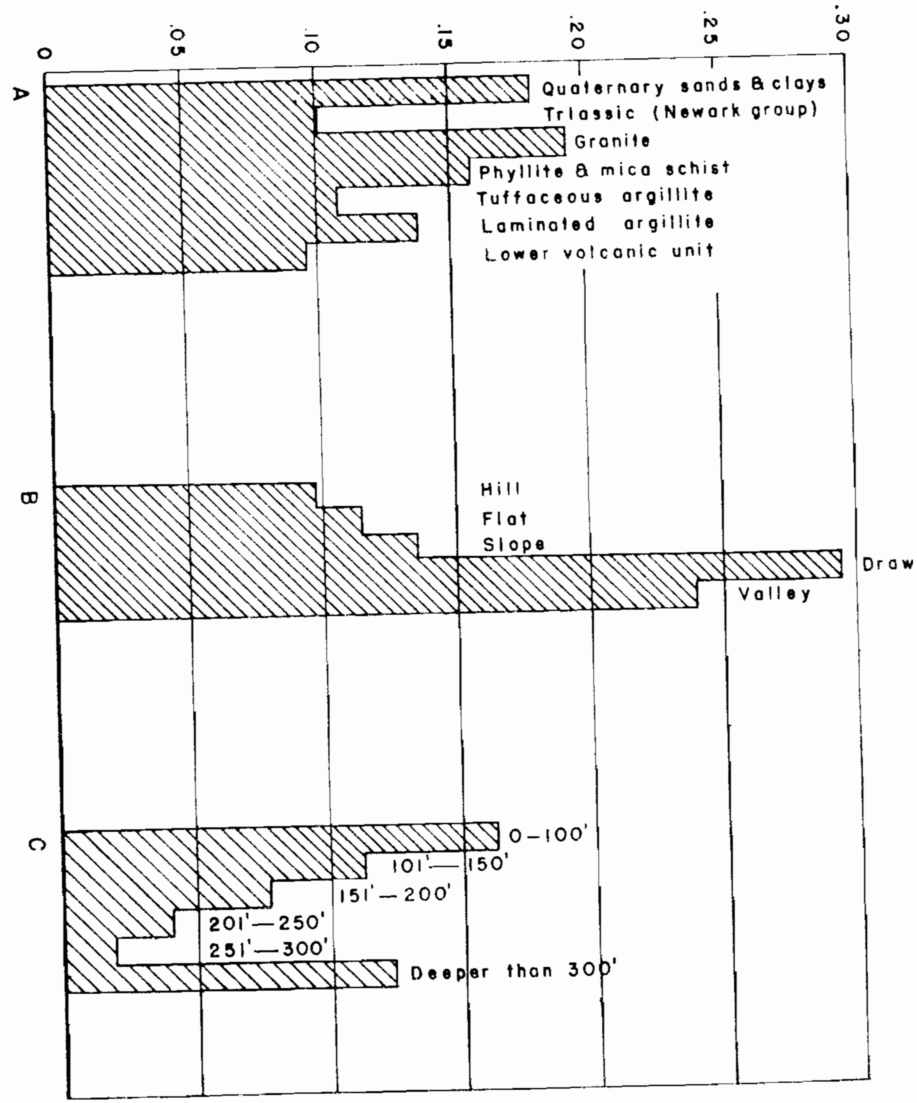


Table 9. Average Yield of Wells According to Depth

Range in depth (feet)	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
0-100	200	75	½-75	12	0.16
101-150	118	120	1½-100	14	0.11
151-200	56	179	1-95	14	0.08
201-250	8	227	1½-35	9	0.04
251-300	14	284	1-30	6	0.02
Greater than 300	11	354	½-200	44	0.12
All wells	407	120	½-200	13	0.11

pected from wells drilled in draws and valleys and the lowest yields would be expected from wells drilled on hills.

Relation of Well Depth to Yield

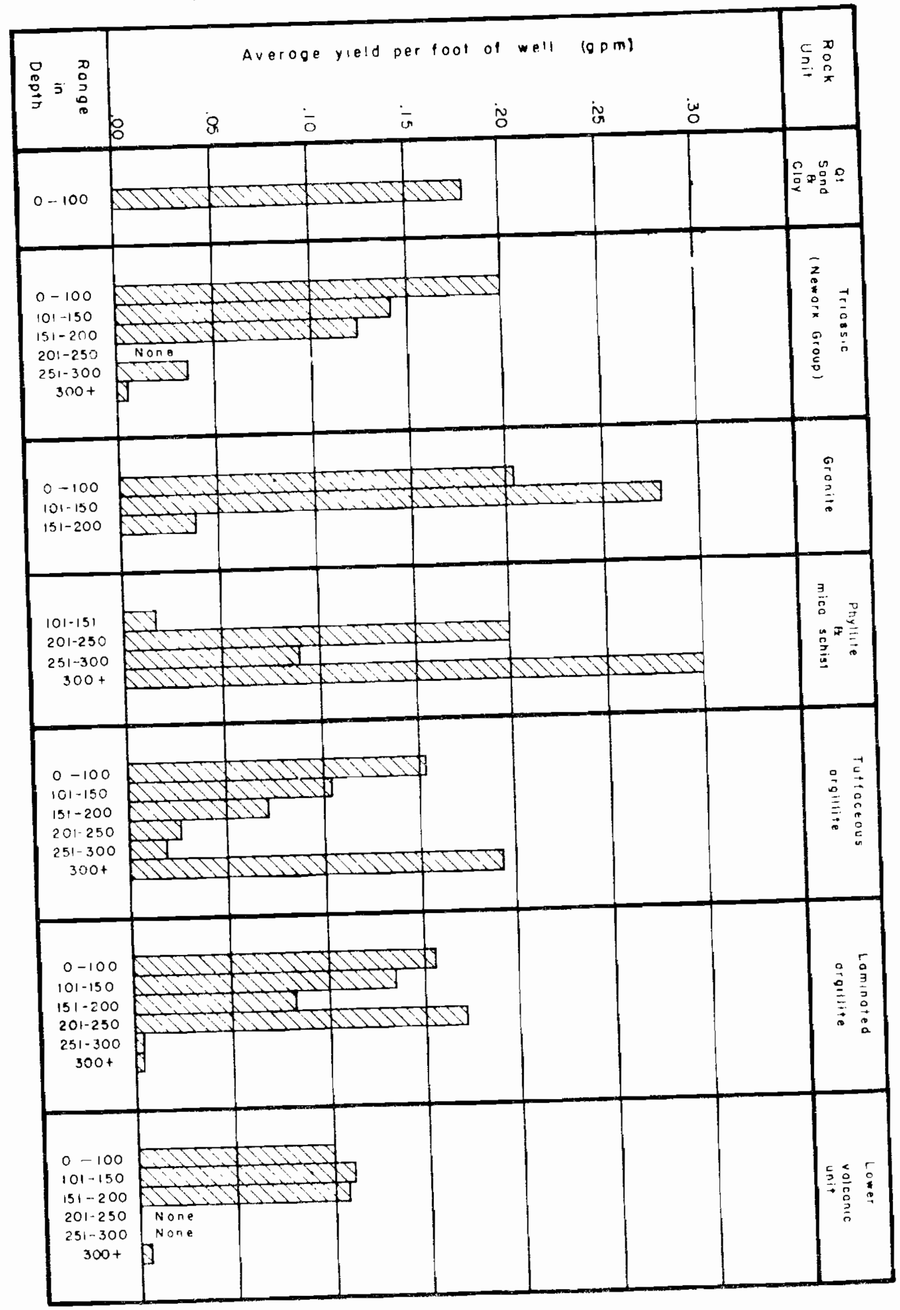
The relation of well depth to well yield is given in Table 9, and shown graphically in figure 5. Figure 6 shows the average yield, per foot of well, for wells in the different rock units according to range in depth.

As shown in Table 9, wells less than 100 feet deep have a greater average yield per foot of well than wells in any greater depth range. Also, the yield per foot ratio decreases with depth. A few wells greater than 300 feet deep in the area have been excellent producers. However, when the driller's records have been available, they have shown that most of the total yield was obtained from that part of the aquifer above 300 feet.

The reason for the decrease in yield per foot with increase in depth is that fewer fractures and other openings exist at depth.

Little is to be gained by drilling to depths greater than 300 feet in the rocks in the Monroe area as most water in individual wells is obtained above a depth of 300 feet. If a well has been drilled to ±250 feet, and a substantial supply of water has not been encountered, it would generally be inadvisable to continue drilling at that site.

Figure 6. Average yield, per foot of well, of wells in the different rock units, according to range in depth.



COMPLETION AND TESTING OF DRILLED WELLS

The casing of a drilled well should be driven tightly into solid rock to seal out direct entrance of water from the residual soil cover. This lessens the danger of contamination and prevents entrance of turbid water into wells in which the casing is not properly seated. Cement or clay should be placed around the casing to provide a seal to prevent surface water from running down along the outside of the casing. Surface drainage should be directed away from the well, and the casing should extend several inches above ground level and be tightly closed.

An accurate yield has been determined for only a small percentage of wells drilled in the Monroe area. Most drillers measure the discharge during the time the well is being developed, but this provides, at best, only an estimate of the well's capacity. The cost of conducting an accurate pumping test is a small percentage of the total cost of a well, and in many cases it would be worth several times the additional expense. Much of the supposed pump trouble could be eliminated with the data obtained from an accurate pumping test because such data allows determination of proper pump size and setting.

In conducting a pumping test, the static water level should be measured accurately before starting the pump. The pumping level and yield should be measured at intervals during pumping, and the yield should be held to a constant rate during the test. In aquifers where the number and size of interstices are irregular, it is also useful to pump a well at different rates and determine the pumping level, or drawdown, for each rate. In this manner an average specific capacity for the well can be determined which is more representative of the wells productive potential. The specific capacity of a well is determined by dividing its yield by the drawdown during a period of uniform pumping rate. After pumping has ceased, the water level should be measured periodically for several hours to determine the rate of recovery. The length of time for which a pumping test should be conducted depends upon the intended use of the well. For instance, for a domestic water supply for an average family, the length of the test should be at least six hours. For a municipal supply, the test should be run at least 48 hours.

In order to obtain the most satisfactory service and to facilitate any maintenance which may be needed on the pump or well, the well owner and driller should record certain essential facts about it. These include the depth of the well, diameter of casing and of the well below casing, depth of casing, static water level, quantity of water yielded, and drawdown at the maximum yield. Depths at which water was encountered during drilling and depths at which the pump intakes are set should also be known. Pumps should also be installed in such a way as to permit the periodic measurement of static and pumping water levels.

COUNTY DESCRIPTIONS

Introduction

In the following pages the ground-water resources, geography, and geology of the Monroe area are discussed by counties in alphabetical order. A geologic map and a well inventory map are included for each county. Tables of well data and chemical analytical data follow each county description.

Anson County

(Area: 533 square miles; population in 1960: 24,811)

Geography and physiography

Anson County forms the southeastern part of the Monroe area. It has the second largest area of the three counties but has the smallest population. It is bounded on the west by Union County and on the north and east by the Rocky River and the Pee Dee River. The southern boundary is the North Carolina-South Carolina border.

The topography is typical of the Piedmont province. The county is an upland plane moderately dissected by streams. The highest land surface altitude is slightly in excess of 500 feet above mean sea level in the northwest corner of the county. The land surface slopes south-eastward, and the lowest altitude is about 150 feet along the Pee Dee River at the South Carolina border.

Anson County is drained by the Pee Dee River. The larger streams in the county empty either into the Rocky River on the north or directly into the Pee Dee River on the north and east. The Rocky River in turn empties into the Pee Dee River. Several small streams in the southern part of Anson County flow into South Carolina before emptying into the Pee Dee River.

Geology

A considerable part of the southeastern one-half of Anson County is covered by sands and clays of Quaternary age. These sands and clays form the youngest geologic unit in the Monroe area. The unit, occurring between the altitudes of 250 feet east of Morven and about 400 feet in the vicinity of Lilesville, consists of varicolored, laminated and cross-bedded kaolinitic sands and clays interlayered with deposits of well-rounded stream gravel. The gravel ranges from pea-size up to large cobbles. The thickness of the deposits ranges from a feather edge to more than 50 feet.

Rocks of the Newark Group of Triassic age are exposed in a belt 6 to 10 miles in width which extends in a northeast-southwest direction across the central part of Anson County. Typically, these rocks consist of red, brown, and gray sandstone and siltstone with lenticular beds of red to purple mudstone. Lenticular beds of arkosic sandstone occurring throughout the formation, are usually cross-bedded and become conglomeratic in places. Basal conglomerate crops out at several places along the western edge of the Triassic belt.

About one-fifth of Anson County is underlain by porphyritic granite that has intruded the rocks of the volcanic-sedimentary group and the gneiss unit in the east-central and southeastern part of the county. The granite in Anson County is generally of light gray color and medium- to very coarse-grained. Biotite and large phenocrysts of feldspar are prominent.

The zone of contact between the granite and the rocks of the volcanic-sedimentary group is a zone of metamorphosed phyllite and subordinate amounts of mica schist. The width of the contact zone varies from a few hundred yards to about three-fourths of a mile.

The gneissic rocks mapped in the Monroe area occur in the southeastern part of Anson County where they crop out over an area of about ten square miles. This unit, composed mainly of biotite gneiss with minor amounts of sericite schist, shows prominent banding.

The tuffaceous argillite unit crops out over approximately the northwestern one-half of Anson County. It is the most extensive member of the volcanic-sedimentary group mapped in the Monroe area. The unit contains several types of related rocks, the most abundant of which are interbedded mafic and felsic

tuffaceous argillites, fine-grained tuffs, breccias and flows. The tuffaceous argillite is overlain and in some places interbedded with graywacke sandstone and siltstone. The argillites contain individual beds ranging from several inches to several feet in thickness.

The laminated argillite unit is exposed in an area of about ten square miles in the northern part of the county north of Ansonville. This unit occurs along the flanks of an anticlinal structure where it conformably overlies the lower volcanic unit. It is usually open folded but also is found isoclinally folded and sometimes overturned. The unit is composed primarily of fine-grained, laminated argillite. The laminae are commonly less than one-sixteenth inch in thickness and have graded bedding.

Ground water

Most of the domestic supplies and two municipal supplies are obtained from drilled wells. A few domestic supplies are obtained from springs, and some are obtained from dug wells. Nearly all the dug wells obtain their water from the weathered and disintegraged rock zone lying above unweathered rock, except in the south-eastern part of the county where they obtain water from deposits of sand and gravel. Dug wells are frequently unsatisfactory. Because of their shallow depths they usually have low yields, and are subject to contamination from surface water. In periods of drought, they often become dry.

Some domestic water supplies are obtained from bored wells. Most of these wells were bored in the sand and gravel deposits, but some have been bored in the weathered zone of granite and in the sedimentary rocks of Triassic age. The bored wells are usually satisfactory for domestic supplies.

Most wells in Anson County are drilled wells ranging from 2 to 8 inches in diameter. They have been drilled by various methods from core-drilling with chilled shot to the modern air-rotary drilling method.

Records for more than 160 wells are included in the table of well data. Complete records for 89 wells were used in compiling Table 10, a summary of data for wells in the county.

The data in Table 10 indicate that the highest yield per well is obtained from wells drilled in the sandstone and conglomerate of Triassic age. The highest yield per foot of well is obtained from wells drilled in the sand and gravel deposits. However, this value is based on data from only two wells and may be misleading. Granite has the next highest yield per foot of well. The data in Table 10 also indicate that wells tapping the phyllite and mica schist unit have both the lowest yield per well and per foot of well.

Analyses of 17 water samples from wells in Anson County are given in Table 12. Of these, seven are from wells in tuffaceous argillite, one in laminated argillite, five in granite, one in sand and gravel of Quaternary age, and three in sandstone and conglomerates of Triassic age. Hardness of water ranged from 22 ppm in granite to 1,160 ppm in Triassic rock. Obviously, this extreme hardness in water from the rocks of Triassic age is anomolous. The two other water samples from the same unit had hardness concentrations of 64 and 71 ppm. The iron concentrations ranged from 0.02 ppm to 1.0 ppm; both extremes occurred in waters from rocks of Triassic age. Abnormally high concentrations of nitrate were found in samples from three wells, each in a different rock unit. The high nitrate in water from Well No. 161 which penetrates Triassic rocks is likely to be caused by the well having penetrated thin seams of low rank coal reported by well drillers to be found occasionally in this unit. The other high nitrate concentrations may be caused by a source of pollution near the wells.

Municipal supplies

There are three municipal water supplies in Anson County. One of these, owned by the city of Wadesboro, uses surface water. Lilesville and Morven obtain their municipal water supplies from wells.

The town of Lilesville, population 605 (1960 census), obtains its water supply from two wells. The older well was drilled in 1939 to a depth of 300 feet, and it supplies 40 gpm. The newer well was drilled in 1953 to a depth of 472 feet, and it also supplies 40 gpm. Both wells are drilled in granite and obtain water of a satisfactory chemical quality that requires no treatment.

The town of Morven, has a population of 601 (1960 census) and obtains its water supply from two wells that are drilled in granite. Both wells were drilled in 1936, and both yield 35 gpm. One well is 210 feet deep, and the other 186 feet deep. Analyses of water samples from both wells are essentially the same. The water is of good chemical quality and is not treated prior to use.

Table 10. Summary of Data on Wells in Anson County

According to rock type

Type of rock	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
Sand and gravel (Quaternary)	2	27	-	5	0.18
Sandstone and conglomerate (Triassic)	26	156	3/4-65	16	0.10
Granite	14	92	1-45	13	0.14
Phyllite and mica schist	1	275	-	3	0.01
Tuffaceous argillite	42	112	1-60	10	0.09
Laminated argillite	4	94	3-15	9	0.09
All wells	89	121	3/4-65	13	0.11

According to topographic location

Topographic location	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
Hill	54	113	1-65	10	0.09
Slope	11	128	3-40	12	0.10
Flat	18	116	1-60	20	0.17

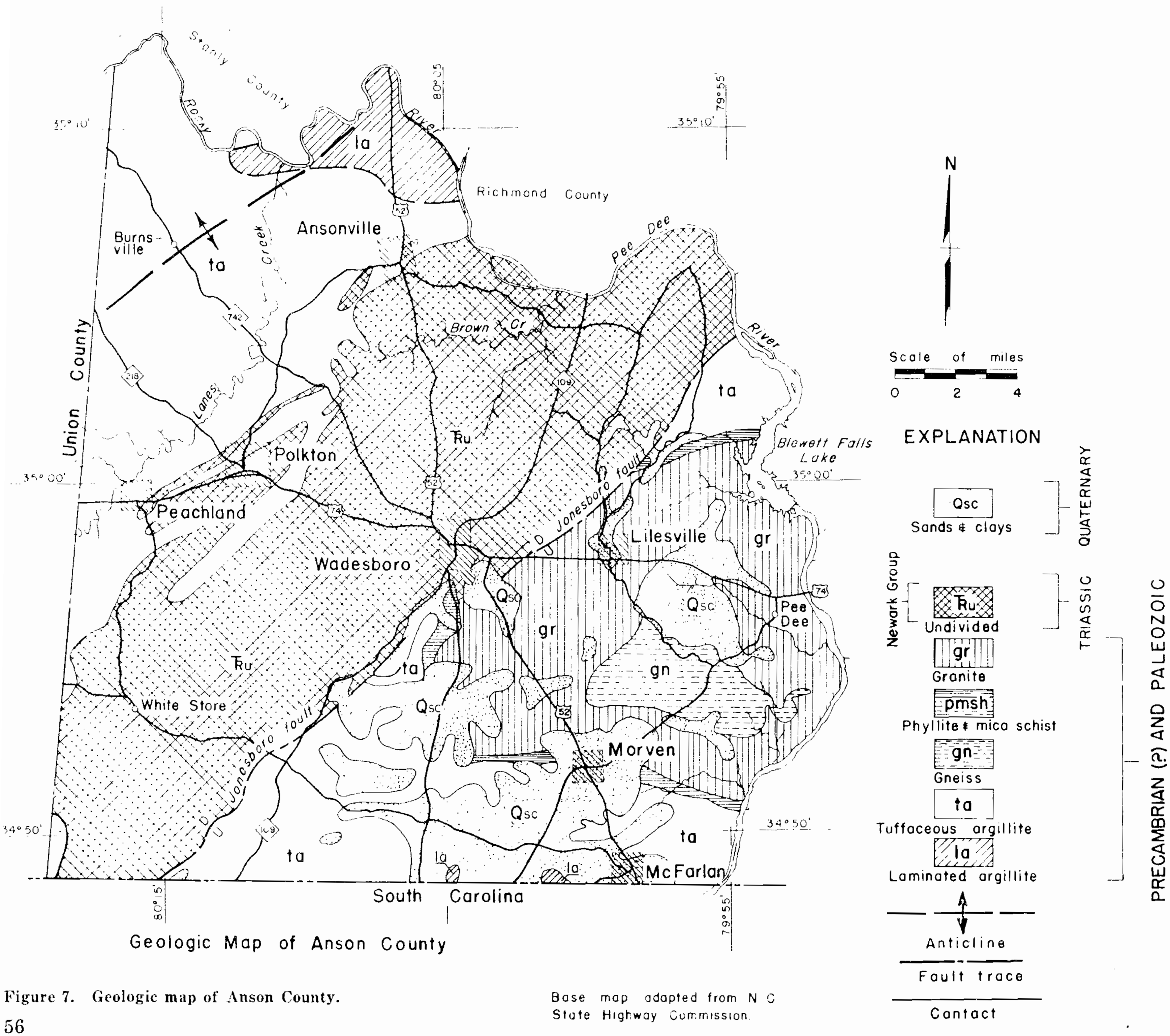


Figure 7. Geologic map of Anson County.

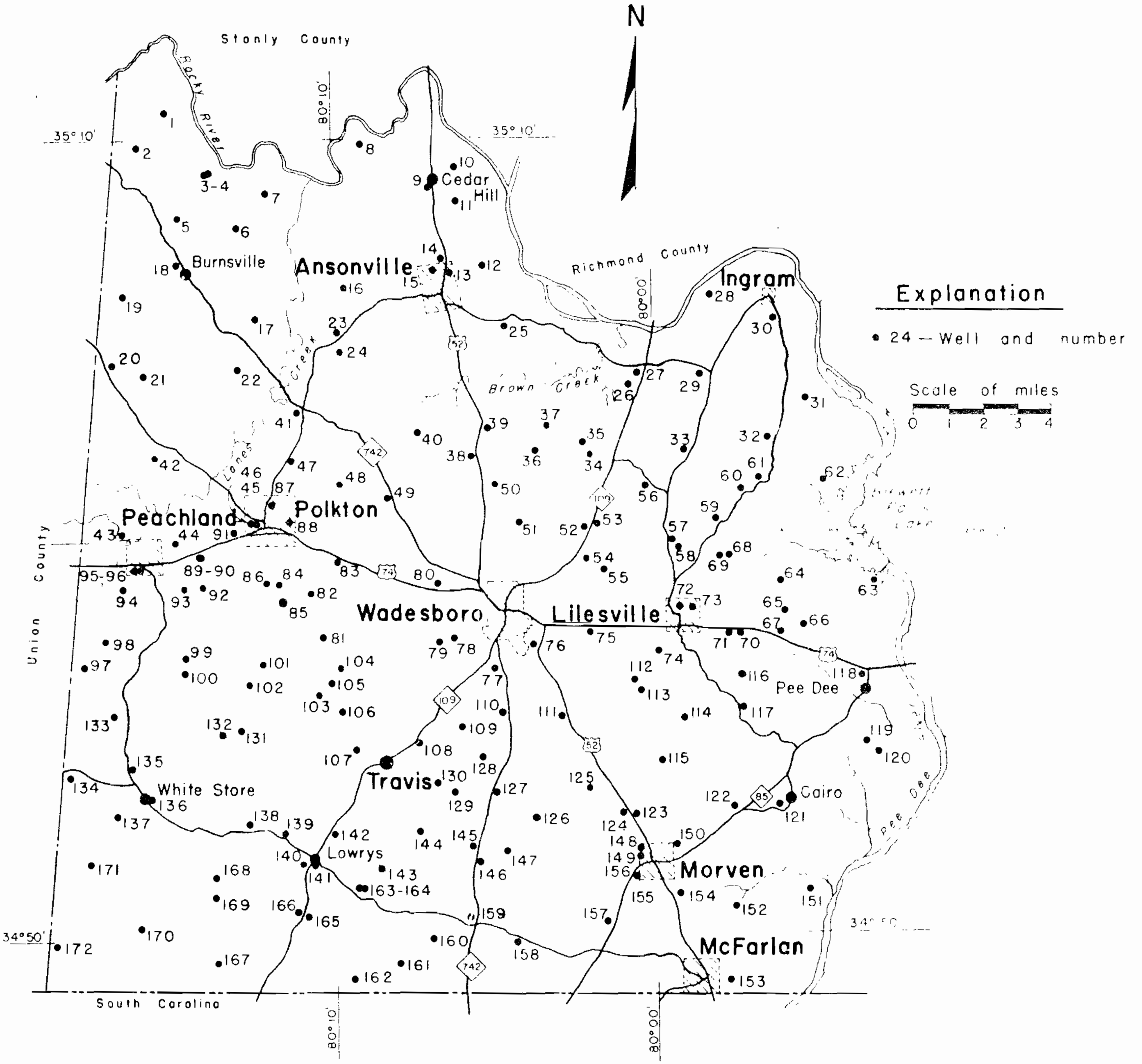


Figure 8. Map of Anson County showing the location of ground-water supplies.

Base map adapted from N.C. State Highway Commission

Table 11. Records of Wells in Anson County

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
1	4.7 Mi. N. of Burnsville----	M. D. Thomas----	Drilled	50	4	------	Tuffaceous argillite--	25	6-7	-----	Hill----	
2	3.8 Mi. NNW of Burnsville----	F. M. Taylor, Sr	--do--	105	4	20	--do---------	40-50	6	-----	--do----	
3	3.0 Mi. NNE of Burnsville----	W. C. Allen-----	--do--	261	6	40	--do---------	30	4	-----	--do----	
4	3.0 Mi. NNE of Burnsville----	W. C. Allen-----	--do--	130	4	------	--do---------	80	2	-----	--do----	
5	1.7 Mi. N of Burnsville----	W. S. Baucom----	--do--	52	4	------	--do---------	20	6'	-----	--do----	
6	2.0 Mi. NE of Burnsville----	J. Fleet Lee----	--do--	70	4	22	--do---------	20	6-7	-----	--do----	
7	3.3 Mi. NE of Burnsville----	Julian Lee------	--do--	102	6	-------	--do---------	------	10	-----	--do----	
8	2.3 Mi. NW of Cedar Hill----	Mrs. E. C. Howell--------	--do--	70	6	40	Laminated argillite--	35-40	6	-----	--do----	
9	0.2 Mi. ENE of Cedar Hill----	A. E. Hendley, Jr.	--do--	66	4	30	Tuffaceous argillite--	10	3	-----	--do----	
10	1.1 Mi. NE of Cedar Hill----	H. A. Simpson---	--do--	175	6	20	--do---------	50-75	15	-----	--do----	
11	1.0 Mi. ESE of Cedar Hill----	Joe A. Dunlap---	--do--	65	6	40	--do---------	30-35	10	-----	--do----	
12	1.4 Mi. ENE of Ansonville---	Walter Edwards--	--do--	100	4	------	--do--------	-------	15-20	-----	--do----	
13	At Ansonville---	Dorton Gilmore--	--do--	125	6	20	--do--------	20	10	44	Slope---	
14	0.2 Mi. N of Ansonville----	Gideon Dula-----	--do--	60	6	40	--do--------	15-20	3	------	Flat----	
15	At Ansonville---	Gary Sullivan---	--do--	126	6	102	--do--------	25	20	------	--do----	
16	2.0 Mi. W of Ansonville----	Kary N. Edwards	--do--	110	6	30	--do--------	30	6	------	Knoll--	
17	2.4 Mi. SE of Burnsville----	John Curran-----	--do--	176	6	20	--do--------	20	1.5	------	Hill---	
18	0.4 Mi. WNW of Burnsville----	Lucy Thomas-----	--do--	67	4	------	--do--------	------	------	------	Valley	

Table 11. Records of Wells in Anson County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
19	2.0 Mi. WSW of Burnsville---	R. R. Thomas---	Dug---	38.5	48	-------	Tuffaceous argillite--	20-25	3-4	------	Hill---	
20	3.4 Mi. SW of Burnsville---	New Home Baptist Church-------	Drilled	103	6	27	--do---------	------	3	------	-------	
21	3.3 Mi. SSW of Burnsville---	W. R. Beachum--	--do--	95	4	------	--do---------	------	10	------	Hill---	
22	3.2 Mi. SSE of Burnsville---	H. H. Tarlton--	--do--	180	6	18	--do---------	12-15	6	------	--do---	
23	3.3 Mi. WSW of Ansonville---	H. B. Porter---	--do--	200	6	-------	--do---------	------	10	------	--do---	
24	3.4 Mi. WSW of Ansonville---	Unknown--------	--do--	42	4	-------	--do---------	3.72	-----	------	Flat---	
25	2.0 Mi. ESE of Ansonville----	R. V. Lockhart	Dug---	25	24	-------	Triassic sandstone--	12	-----	------	Hill---	
26	4.9 Mi. SW of Ingram-------	H. R. Dennis---	Drilled	227	4	119	--do---------	17	-----	------	--do---	
27	4.5 Mi. SW of Ingram-------	Lee C. Colson--	--do--	96	6	40	--do---------	------	-----	------	Slope--	
28	1.7 Mi. W of Ingram-------	L. L. McAlister	--do--	120	4	70	--do---------	------	-----	-----		
29	3.1 Mi. SSW of Ingram-------	Gus Litte------	--do--	210	6	90	--do---------	------	-----	-----		
30	0.7 Mi. SSE of Ingram-------	Zeb Pate-------	--do--	85	4	40	--do---------	20	15	------		
31	3.2 Mi. SSE of Ingram-------	Joel Downer----	--do--	100	6	-------	Tuffaceous argillite--	------	------	------		
32	4.1 Mi. S of Ingram-------	Joel Price-----	--do--	130	6	25	--do---------	------	------	------		
33	4.8 Mi. N of Lilesville---	W. T. Forie----	--do--	94	3	20	Triassic sandstone--	18	3-4	------	Hill---	
34	5.4 Mi. NNW of Lilesville---	B. H. Dennis---	--do--	70	6	-------	--do---------	------	------	------	Slope--	

Table 11. Records of Wells in Anson County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
35	5.8 Mi. WNW of Lilesville	R. F. Dennis	Drilled	72.5	6	15	Triassic sandstone	24.4	----	----	Slope	
36	4.4 Mi. SSE of Ansonville	J. P. Boylin	--do--	105	6	----	--do--	----	10-20	----	Level	
37	4.8 Mi. SSE of Ansonville	Lester D. Little	--do--	60	6	40	--do--	30	4	----	Hill	
38	4.9 Mi. SSE of Ansonville	J. ?. Sellers	--do--	100	6	50	--do--	----	15	----	Knoll	
39	4.1 Mi. SSE of Ansonville	Lester D. Little	Dug	40	24	[illegible]	--do--	21.1	----	----	Flat	
40	4.0 Mi. SSW of Ansonville	Robert Turner	Drilled	94	2.5	[illegible]	Tuffaceous argillite	----	----	----	--do--	
41	3.5 Mi. NNE of Polkton	Sandy Davis	--do--	135	6	18	--do--	16	3	----	--do--	
42	3.9 Mi. NW of Polkton	Dewey R. Moore	--do--	96	6	21	--do--	20	3.5	----		
43	4.3 Mi. W of Polkton	R. F. Wright	--do--	57	4	----	--do--	----	----	----	Hill	
44	2.7 Mi. WSW of Polkton	E. W. Caudle	--do--	115	6	20	--do--	40-45	7	----		
45	At Polkton	Mrs. Floyd Moore	--do--	175	6	----	Triassic sandstone	----	50-100	----	Flat	
46	At Polkton	J. W. Presslar	--do--	290	6	55	--do--	30	18	----	Hill	
47	2.1 Mi. NNE of Polkton	Guy R. Edwards	--do--	82	6	----	Tuffaceous argillite	----	10	----	--do--	
48	2.5 Mi. NE of Polkton	W. C. Horne	Dug	45	48	----	--do--	27	----	----	--do--	
49	3.8 Mi. ENE of Polkton	M. C. Hamrick	Drilled	129	4	77	Triassic sandstone	3-5	10	----	Ridge	
50	3.8 Mi. N of Wadesboro	Anson County	--do--	77	4	----	--do--	----	5	----	Flat	

Table 11. Records of Wells in Anson County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
51	2.7 Mi. NNE of Wadesboro	Pine Davis	Dug	35	36	----	Triassic sandstone	12	----	----	Flat	
52	3.4 Mi. NE of Wadesboro	C. F. Burns	Drilled	----	6	----	--do--	----	5	----	Slope	
53	3.8 Mi. NE of Wadesboro	C. A. Green	--do--	110	6	20	--do--	----	10	----	Hill	
54	2.9 Mi. ENE of Wadesboro	Bill Williams	--do--	95	6	33.5	--do--	----	----	----	--do--	
55	3.2 Mi. ENE of Wadesboro	Kermit R. Pratt	--do--	300	6	270	--do--	10	4-5	----	--do--	
56	3.9 Mi. NNW of Lilesville	Eugene Freeman	--do--	92	4	----	--do--	----	12	----	--do--	
57	2.2 Mi. NNW of Lilesville	W. S. Lindsey	Dug	35	24	----	Quaternary sand	24	5	----	Slope	
58	2.0 Mi. NNW of Lilesville	J. T. Lyon	Drilled	135	6	----	Triassic sandstone	----	----	----	Hill	
59	2.9 Mi. NNE of Lilesville	Wilson Buir	--do--	275	6	20	Phyllite & mica schist	----	3-4	----		
60	3.9 Mi. NNE of Lilesville	Billy Tice	--do--	190	8	190	Tuffaceous argillite	60	5	130		
61	4.6 Mi. NNE of Lilesville	Jerry Ingram	--do--	145	6	140	--do--	50	2	----		
62	5.5 Mi. NE of Lilesville	W. L. Ingram	--do--	71	6	71	--do--	25-30	----	----		
63	3.1 Mi. NNE of Pee Dee	Carolina Power & Light Co.	--do--	94	4	65	Granite	35	----	----	Hill	
64	3.0 Mi. ENE of Lilesville	George H. Clark	Bored	60	20	60	Quaternary sand	40	----	----	--do--	
65	2.9 Mi. E. of Lilesville	Will Tucker	Drilled	187	6	180	Granite	----	----	----	Flat	

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
66	3.5 Mi. ESE of Lilesville-----	Luby Orchards--	Drilled	170	6	59	Granite-----	------	-----	-----		
67	2.8 Mi. ESE of Lilesville-----	--do-----------	--do---	57	6	57	--do---------	------	-----	-----	Hill---	
68	2.1 Mi. NE of Lilesville-----	Dr. F. Y. Sorrell------	--do---	55	6	25	--do---------	6	-----	-----	--do---	
69	2.0 Mi. NE of Lilesville-----	--do-----------	--do---	105	6	25	--do---------	25	4-5	-----	--do---	
70	1.7 Mi. ESE of Lilesville-----	Will Tucker----	--do---	90	6	90	Quaternary sand------	-------	-----	-----		
71	1.5 Mi. ESE of Lilesville-----	E. G. Chewning--	--do---	41	4	2	Granite-----	-------	35	-----	Flat---	
72	At Lilesville----	Town of Lilesville---	--do---	300	8	-------	--do---------	------	40	-----		
73	At Lilesville----	--do-----------	--do---	472	8	-------	--do---------	------	40	-----		
74	1.4 Mi. SSW of Lilesville-----	L. M. Leonard--	Dug----	25	42	-------	--do---------	22	5	-----	Slope--	
75	2.4 Mi. ESE of Wadesboro------	Clifton Lineberry--------	Drilled	70	------	-------	--do---------	Flows--	5	-----	Draw---	
76	1.2 Mi. SE of Wadesboro------	Mrs. C. W. McInnis------	--do---	139	6	-------	Triassic sandstone--	-------	5	-----	Hill---	
77	1.6 Mi. SSW of Wadesboro------	J. C. Triggs----	--do---	234	6	159	Granite------	0	-----	-----	Slope--	
78	1.6 Mi. WSW of Wadesboro-----	Robert D. Atkinson-----	--do--	144	6	30	Triassic sandstone--	14	7	-----	Hill---	
79	2.2 Mi. WSW of Wadesboro------	J. C. Rogers---	--do--	105	6	60	--do---------	12-15	65	-----	--do---	
80	2.2 Mi. WNS of Wadesboro-----	V. B. Goodwin--	--do--	180	6	-------	--do---------	------	10	-----		
81	3.6 Mi. SSE of Wadesboro------	J. W. Parker---	--do--	100	6	-------	--do---------	------	-----	-----	Hill---	

Table 11. Records of Wells in Anson County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
82	2.3 Mi. SSE of Polkton--------	F. P. Hyatt----	Drilled	95	4	40	Triassic sandstone--	------	12	-----	Hill---	
83	2.4 Mi. ESE of Polkton--------	Johnny Moore---	--do--	70	6	38	--do---------	12	-----	-----	Flat---	
84	1.6 Mi. SSE of Polkton--------	Paul E. High---	--do--	89	6	44	Tuffaceous argillite--	-------	20	-----	Hill---	
85	2.4 Mi. SSE of Polkton--------	Howard Fressler	--do--	80.5	6	36	Triassic sandstone--	6	-----	-----	--do---	
86	1.7 Mi. S of Polkton--------	Paul E. High---	--do--	157	6	100	Tuffaceous argillite--	57	20	-----	Flat---	
87	At Polkton-------	Polkton School--	--do--	115	6	-------	--do---------	-------	-----	-----		
88	--do------------	--do------------	--do--	115	6	-------	Triassic sandstone--	80	-----	-----	--------	
89	2.1 Mi. WSE of Polkton--------	W. Ashe Caudle	--do--	110	6	40	Tuffaceous argillite--	20	10	-----	Slope--	
90	2.1 Mi. WSW os Polkton--------	--do-----------	--do--	105	6	40	--do---------	15	20-25	-----	--do---	
91	1.0 Mi. WSW of Polkton--------	Norman I. Hutton	-do--	58	6	23	Triassic sandstone--	------	4	-----	Flat---	
92	2.5 Mi. SW of Polkton-------	J. D. Horne----	--do--	57	6	28	Tuffaceous argillite	------	18-20	-----	Slope--	
93	2.9 Mi. SW of Polkton-------	J. B. Horne----	--do---	59.9	6	42	--do---------	------	5	-----	Hill---	
94	4.6 Mi. WSW of Polkton-------	J. D. Kemp-----	--do--	400	6	-------	--do---------	10	-----	-----	--do---	
95	At Peachland----	Anson Co. Board of Education--	--do---	-----	6	-------	--do---------	15.42	-----	-----	Knoll--	
96	--do------------	Peachland School	--do--	100	6	-------	--do---------	40	-----	-----		
97	4.2 Mi. NNW of White Store----	James Horne----	--do--	88	6	18	--do---------	14-15	60	-----	Flat---	

Table 11. Records of Wells in Anson County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
98	1.8 Mi. NNW of White Store----	Grant M. Sikes	Drilled	[illegible]	6	21	[illegible]	21.5	16	-----	Level---	
99	1.2 Mi. NNE of White Store----	Baxter Smith---	Dug----	51.6	------	------	--do--------	46.7	-----	-----	Hill----	
100	3.8 Mi. NNE of White Store----	C. M. Johnson--	Drilled	43	4	------	[illegible]	------	-----	-----	Slope---	
101	1.0 Mi. S. of Polkton--------	S. [illegible]. Funderburke--------	--do---	[illegible]	6	[illegible]	--do--------	------	.5	-----	Slope---	
102	1.7 Mi. SSW of Polkton-------	Jack Funderburke	--do---	[illegible]	6	30	--do--------	------	[illegible]	-----	--do----	
103	2.9 Mi. NW of Travis--------	Thomas [illegible]. Hamilton-----	--do---	[illegible]	6	40	--do--------	------	-----	-----	Hill----	
104	2.9 Mi. NNW of Travis--------	Ross Sikes-----	--do---	[illegible]	6	[illegible]	--do--------	[illegible]	16	-----	Flat----	
105	2.8 Mi. NNW of Travis--------	F. [illegible]. Bennett--	--do---	[illegible]	4	15	--do--------	4	-----	20	Hill----	
106	2.0 Mi. NW of Travis--------	Joe Horton-----	--do---	[illegible]	6	[illegible]	--do--------	------	-----	-----	--do----	
107	1.2 Mi. W of Travis--------	George Craig---	Dug---	10	------	------	--do--------	------	-----	-----	--do----	
108	0.7 Mi. ENE of Travis--------	Paul Little----	Drilled	[illegible]	6	[illegible]	--do--------	36	15	-----	--do----	
109	2.0 Mi. ENE of Travis--------	Paul Hildreth--	--do--	92	6	[illegible]	Tuffaceous argillite----	------	12	-----	Flat----	
110	2.8 Mi. S of Wadesboro------	Eddie Gilmore--	--do--	[illegible]	------	------	Granite--------	------	30	-----	Hill----	
111	3.3 Mi. SSE of Wadesboro------	M. P. Eddins, Jr.	Dug--	32.5	36	------	--do--------	28	6	-----	--do----	
112	2.5 Mi. SSW of Lilesville----	Mrs. Ella Henry	Drilled	100.2	6	30	--do--------	------	3.8	-----	--do----	
113	2.6 Mi. SSW of Lilesville-----	W. W. Henry----	--do--	126	6	40	--do--------	------	3	-----	Slope---	

Table 11. Records of Wells in Anson County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
114	3.0 Mi. S of Lilesville-----	Paul Clemons----	Drilled	90	6	9	Granite------	------	45	------	Flat---	
115	2.9 Mi. NNE of Morven---------	M. S. Hedricks	Dug----	32	------	------	--do---------	------	-----	------	Slope--	
116	2.5 Mi. SE of Lilesville-----	W. W. Marks-----	--do---	38.5	24	20	Quaternary sand-------	8.91	-----	------	Hill----	
117	3.2 Mi. SSE of Lilesville-----	Garrett W. McCormick-----	--do---	20	24	-------	--do---------	6-10	-----	------	Level---	
118	0.4 Mi. N of Pee Dee--------	County Board of Education----	--do---	60	48	-------	Granite------	18.15	-----	------	Hill----	
119	1.6 Mi. S of Pee Dee--------	C. A. Boggan---	Drilled	100	6	45	--do---------	-------	10	------	--do----	
120	1.9 Mi. SSE of Pee Dee--------	F. H. Cromwell--	--do---	200	6	-------	--do---------	36.14	-----	------	Hill----	
121	At Cairo---------	L. R. Diggs-----	--do---	100	4	90	--do---------	7	1	80		
122	2.9 Mi. NE of Morven---------	C. B. Ratliff---	--do---	150	6	22	--do---------	25	5	------	Hill----	
123	1.5 Mi. NNW of Morven---------	J. B. Covington	Dug----	19	------	-------	--do---------	2	-----	------	Flat----	
124	1.6 Mi. NNW of Morven---------	C. G. Gulledge--	Drilled	80	6	65	--do---------	-------	6	------	Hill----	
125	2.8 Mi. NNW of Morven---------	V. L. Wall------	--do---	163	4	38	--do---------	-------	-----	------	Slope---	
126	3.6 Mi. WNW of Morven---------	George Robinson	--do---	58	6	30	--do---------	10.6	15	------	--do----	
127	3.1 Mi ESE of Travis---------	New Hope Bethel Methodist Church--------	--do---	253	6	80	Tuffaceous argillite--	-------	1	------	Flat----	
128	2.6 Mi. E of Travis---------	R. Lee Ratliff--	Dug----	45	------	-------	Quaternary sand-------	15-20	-----	------	Hill----	
129	2.0 Mi. ESE of Travis---------	M. G. Dalla Pozza---------	Bored	50	24	-------	--do---------	20	-----	------	--do----	

Table 11. Records of Wells in Anson County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
130	1.3 Mi. ESE of Travis	W. T. Gatlings	Dug	30	24	------	Quaternary sand	27	------	-----	Slope	
131	3.5 Mi. NE of White Store	M. W. Frank	Drilled	98	6	------	Triassic sandstone	30	------	-----	Flat	
132	3.0 Mi. NE of White Store	M. G. Frank	--do--	75	6	35	--do--	------	------	-----	Hill	
133	2.7 Mi. NNW of White Store	E. C. Harrington	--do--	167	6	60	--do--	20-25	7	-----	--do--	
134	2.3 Mi. WNW of White Store	F. M. Faulkner	--do--	93	6	20	Tuffaceous argillite	------	------	-----	--do--	
135	1.0 Mi. NNW of White Store	J. S. Griffin	Bored	30	24	------	Triassic sandstone	7.8	------	-----	--do--	
136	At White Store	James Huntley	Drilled	120	6	10-12	--do--	------	------	-----	--do--	
137	1.0 Mi. WSW of White Store	Thelma Rivers	--do--	155	4	100	--do--	------	8	-----	--do--	
138	2.2 Mi. WNW of Lowrys	George Lowery	--do--	161	6	21	--do--	20	6	-----	--do--	
139	1.2 Mi. NW of Lowrys	Mrs. Cloe Griffin	--do--	113	6	20	--do--	------	-----	-----	--do--	
140	0.3 Mi. W of Lowrys	W. C. Rayfield	--do--	235	4	60	Tuffaceous argillite	30	-----	-----	--do--	
141	0.2 Mi. S of Lowrys	--do--	--do--	100	4	-------	--do--	------	6	-----	--do--	
142	0.9 Mi. NE of Lowrys	Lacy Chewning	Dug	30	36	-------	--do--	20	-----	-----	Flat	
143	1.9 Mi. ESE of Lowrys	Joe Hart Chewning	--do--	30	------	-------	Quaternary sand	12	-----	-----	Hill	
144	3.2 Mi. ENE of Lowrys	George Capel	Drilled	90	6	-------	Tuffaceous argillite	30	7	-----	--do--	

Table 11. Records of Wells in Anson County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
145	4.7 Mi. E of Lowrys	Robert Batten	Drilled	100	6	40	Tuffaceous argillite	40	25	-----	Flat	
146	4.8 Mi. ESE of Lowrys	Grady Ratcliff	--do--	145	6	107	--do--	25	-----	-----	Hill	
147	4.3 Mi. WSW of Morven	E. T. Jarman	--do--	86	6	56-60	--do--	18	-----	-----	--do--	
148	At Morven	Town of Morven	--do--	210	6	90	--do--	-----	35	-----		
149	At Morven	--do--	--do--	186	6	90	--do--	-----	55	-----		
150	0.8 Mi. NE of Morven	G. M. Thomas	--do--	182	4	140	Granite	19.6	7	-----	Level	
151	4.7 Mi. ESE of Morven	Fannie C. Ratcliff	--do--	190	6	9	--do--	160	-----	-----	Hill	
152	2.8 Mi. SE of Morven	Rob Gaddy	Dug	38.6	------	------	--do--	22.6	-----	-----	Flat	
153	4.2 Mi. SSE of Morven	S. J. Carter	Drilled	104	4	80	Tuffaceous argillite	75	-----	-----		
154	1.3 Mi. SSE of Morven	R. H. Manney	--do--	100	3&4	40	--do--	------	1	100	Hill	
155	1.0 Mi. SSW of Morven	Delia Johnson	Bored	36	24	------	Quaternary sand	20	------	-----	Flat	
156	0.7 Mi. SW of Morven	Harris Chapel Church	Dug	33	36	------	--do--	13.5	------	-----	Hill	
157	2.3 Mi. SSW of Morven	A. P. Freeman	Drilled	135	4	100	Tuffaceous argillite	-----	5	-----	--do--	
158	4.7 Mi. SW of Morven	H. R. Vaughn	Dug	20	42	-------	Quaternary sand	16	5-6	-----	Flat	
159	4.9 Mi ESE of Lowrys	E. Y. Ratcliff	Drilled	165	6	100	Tuffaceous argillite	------	-----	-----	Hill	
160	4.2 Mi. SE of Lowrys	J. H. Gaddy	--do--	69	4	30	--do--	42	5	-----	--do--	
161	3.9 Mi. SSE of Lowrys	C. L. Gaddy	Dug	40	------	-------	--do--	35	------	100	Flat	

Table 11. Records of Wells in Anson County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
162	3.7 Mi. SSE of Lowrys-------	Levine Privette	Dug---	-----	-----	45	Tuffaceous argillite--	------	-----	-----	Hill---	
163	1.6 Mi. SE of Lowrys-------	Deep Creek School #1----	Drilled	90	6	-------	--do---------	------	-----	-----		
164	1.6 Mi. SE of Lowrys-------	Deep Creek School #2----	--do--	100	6	-------	--do---------	50	-----	-----		
165	1.6 Mi. SSW of Lowrys-------	Pauline Ellis--	--do--	80	6	-------	--do---------	------	-----	-----	Hill---	
166	1.6 Mi. SSW of Lowrys-------	Pauline Ellis--	--do--	92	6	-------	--do---------	------	24	-----	--do---	
167	4.3 Mi. SW of Lowrys-------	Dr. Williamson--	Dug---	50	------	-------	--do---------	4-5	-----	-----	--do---	
168	3.0 Mi. WSW of Lowrys-------	W. E. Huntley--	Drilled	250	6	42	Triassic sandstone--	40	-----	-----	--do---	
169	3.2 Mi. WSW of Lowrys-------	Clinton Edwards	--do--	155	6	30	--do---------	30	30	-----	Flat---	
170	3.8 Mi. S of White Store---	John McCray----	--do--	400-500	4	-------	--do---------	------	------	------	--do---	
171	2.5 Mi. SSW of White Store---	B. B. Austin---	--do--	486	6	40	--do---------	------	3	-----	Slope--	
172	5.0 Mi. SSW of White Store---	Howard Martin--	--do--	71	6	51	Tuffaceous argillite--	30	18	-----	Hill---	

Table 12. Chemical analyses of ground water from Anson County

(Well numbers correspond to well numbers in table of well data)

Parts per million

Well No.	Date of Collection	Silica (SiO_2)	Iron (Fe) in Total	Calcium (Ca)	Magnasium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as ($CaCO_3$)	PH	Water Bearing Material
9	3/62		0.27	14	18	14	1.1	28	7.4	36	62	110	6.0	Laminated argillite------
17	3/62		.26	23	8.1	7.5	.3	116	3.6	4.0	.1	90	7.1	Tuffaceous argillite-----
29	3/62		.08	13	7.5	14	.3	86	5.0	12	6.7	64	6.6	Triassic sandstone-------
58	3/62		.33	7.3	2.3	1.9	2.9	36	.6	1.0	1.5	28	6.8	Tuffaceous argillite-----
62	3/62		.08	17	1.7	3.7	11	42	8.4	3.0	21	48	7.1	Quaternary sand----------
72	4/55	11	.09	13	3.3	13	2.2	83	6.7	3.2	-------	47	7.3	Granite------------------
73	4/55	19	.07	10	2.7	8.2	1.6	41	1.5	7.2	10	36	7.0	--do---------------------
77	3/62		.02	14	8.7	7.5	.7	99	5.0	2.4	1.3	71	6.9	Triassic sandstone-------
86A	3/62		.10	85	48	68	2.0	277	12	220	.8	410	7.2	Tuffaceous argillite-----
108	3/62		.09	5.4	2.0	12	2.8	4	9.6	15	20	22	5.4	Granite------------------
113	3/62		.24	13	3.9	13	4.9	36	1.2	11	35	49	6.2	--do---------------------
116	3/62		.09	8.0	3.5	7.9	2.5	40	6.2	3.0	18	34	6.9	--do---------------------
148	4/55	36	.05	6.2	4.8	3.1	7.4	52	8.1	1.8	.6	35	7.1	Tuffaceous argillite-----
149	4/55	38	.22	6.9	5.2	3.2	7.7	54	7.3	2.0	.0	38	7.1	--do---------------------
166	3/62	20	.44	87.	47.	75.	.8	183	19	226.	94.	420	7.0	--do---------------------
169	3/62	18	1.0	287.	108.	156.	4.6	391	18	744.	89.	1160	6.9	Triassic sandstone-------

Stanly County

(Area: 399 square miles; population in 1960: 40,519)

Geography and physiography

Stanly County is the northernmost county in the Monroe area. It has the smallest total area but has the second largest population of the three-county group. It is bounded on the west by Cabarrus County, on the north by Rowan County, on the east by the Yadkin River, Badin Lake, Lake Tillery, and the Pee Dee River. On the south it is bounded by the Rocky River.

Topographically, there are numerous rolling hills formed by the partially dissected peneplane of the Piedmont province. The topography becomes more rugged near the larger streams and particularly along the Pee Dee River at the eastern boundary of the county. The highest altitudes of land surface in the Monroe area occur in eastern Stanly County in the Uwharrie Mountains. The highest of these is Morrow Mountain and its elevation is about 936 feet above mean sea level.

One stream in the northernmost part of the county flows to the northeast and eventually empties into the Pee Dee River. All other streams in the county flow to the southeast and are tributary to either the Rocky River or the Pee Dee River.

Geology

Overlying the tuffaceous argillite and laminated argillite units in the northern and eastern part of Stanly County are rocks of the upper volcanic unit. These rocks, exposed in two principal bodies and several minor bodies, are chiefly lithic and lithic-crystal tuffs and rhyolite flows, with interlayered basaltic and andesitic flows. Typically, the lithic-crystal tuff contains actinolite, feldspar, and chlorite and may show faint bedding. The medium- to fine-grained texture along with the feldspars and chlorite give the rock a gabbro-like appearance, in some cases. The rhyolite of this unit is a very dense fine-grained rock that has a light gray color on the surface. It forms the caps of most of the higher hills in the eastern part of the county.

About three-fourths of Stanly County is underlain by the tuffaceous argillite unit. It contains felsic and mafic tuffaceous agrillites along with fine-grained tuffs, some breccias and flows, and in some parts of the county is frequently interlayered with graywacke sandstone and siltstone (see fig. 9).

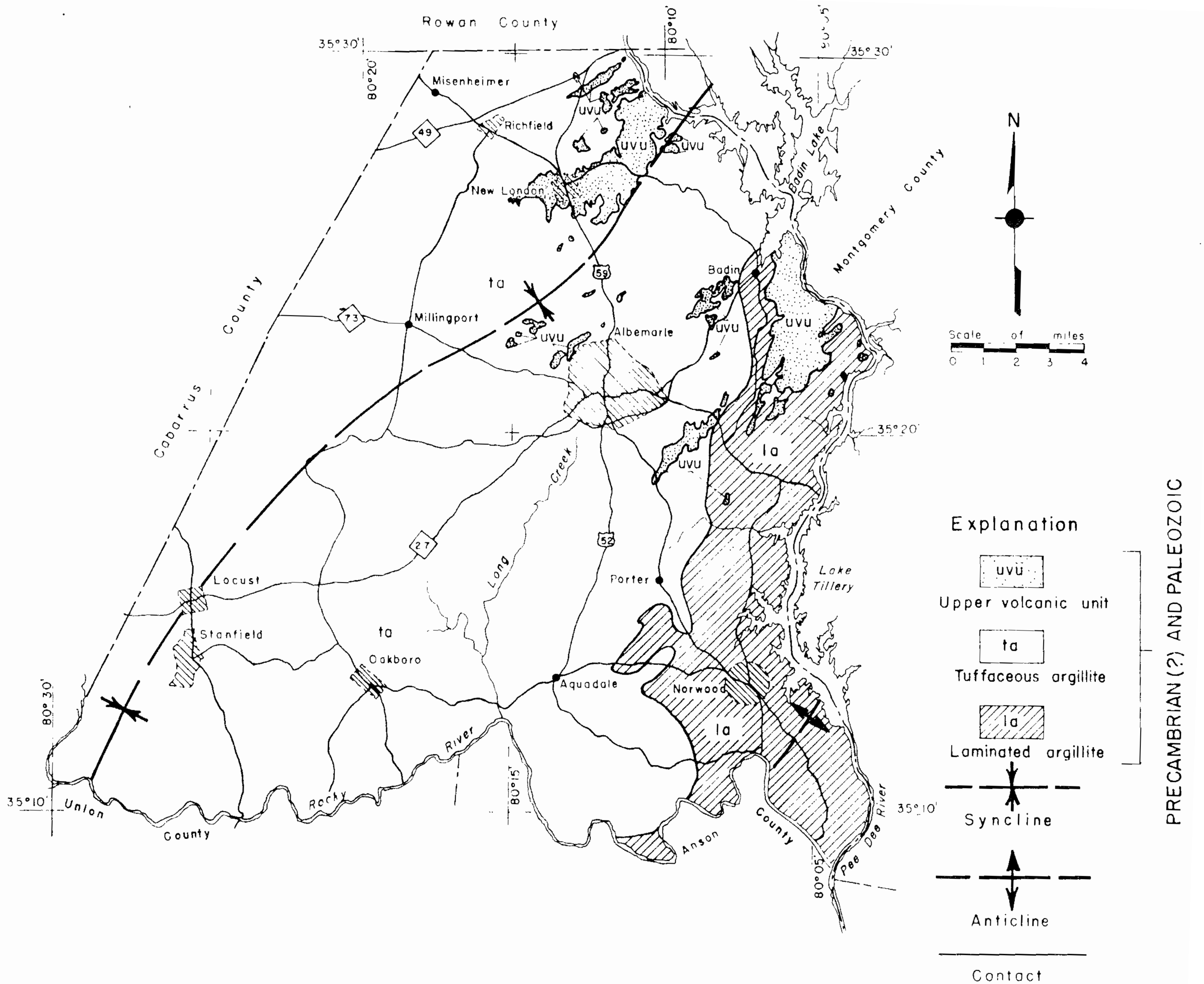


Figure 9. Geologic map of Stanly County.

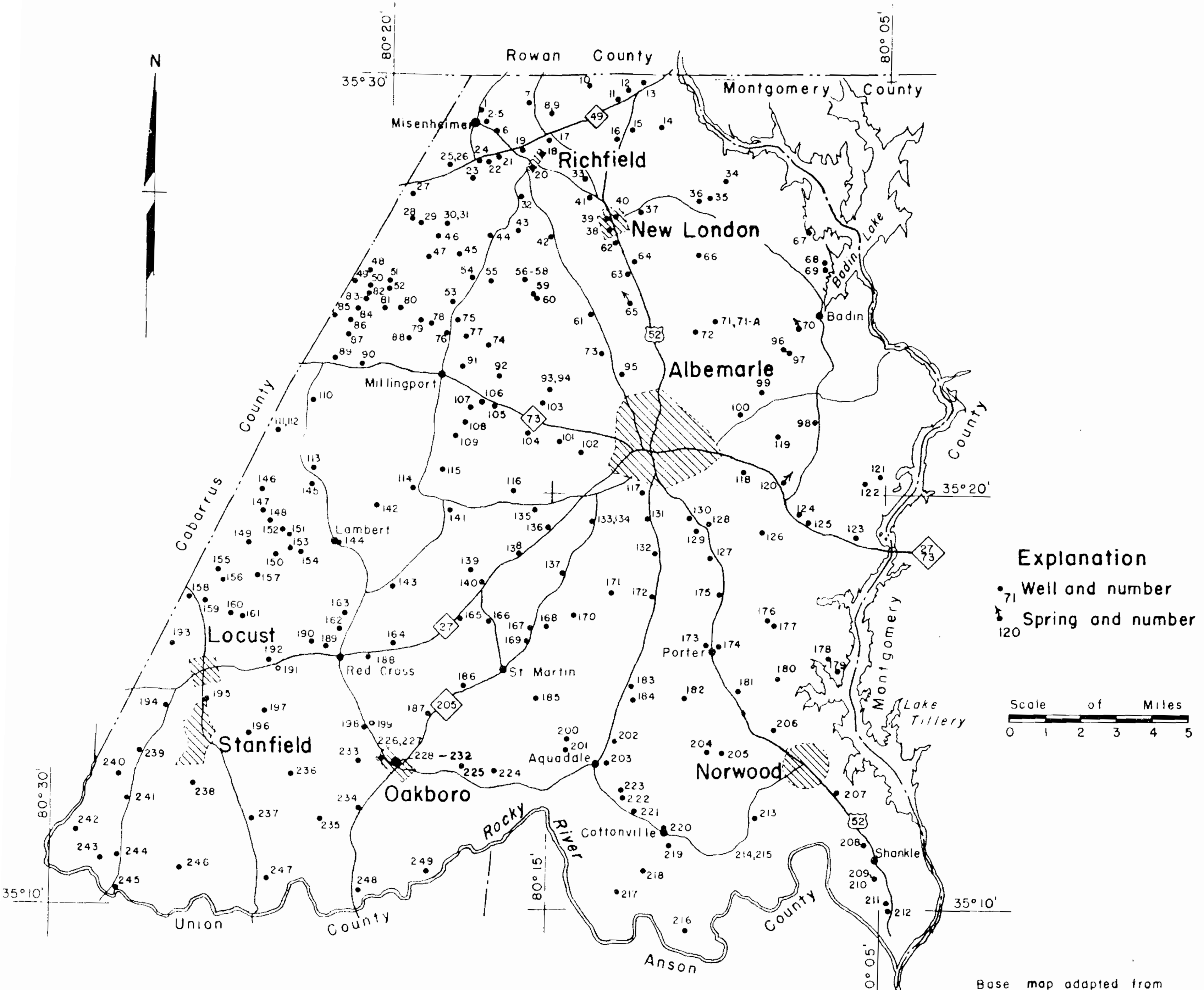


Figure 10. Map of Stanly County showing the location of ground-water supplies.

The laminated argillite unit is found along the eastern boundary of Stanly County. It extends from Badin Southwardly into Anson County and forms an elongated zone about four miles in width and covers about 75 square miles of the county.

The laminated argillite unit lies conformably on the rocks of the lower volcanic unit and grades upward into the tuffaceous argillite unit. The mineral compositions of the laminated argillite and tuffaceous argillite units are very similar. Their main difference seems to be in the manner of their deposition. This was discussed in a foregoing section of the report. In the unweathered state the rock varies from dark blue-green to an olive green color, and it weathers to various shades of red and yellow.

Ground water

Nearly all domestic water supplies and one municipal water supply are obtained from wells in Stanly County.

Dug wells are used frequently for domestic water supplies in rural areas. They are generally from 20 to 50 feet deep and from 3 to 5 feet in diameter. Dug wells are not entirely satisfactory for present-day domestic needs, and they are rapidly being replaced by drilled wells.

Small-diameter core-drilled wells are the predominant type of well in Stanly County, but they are limited in the amount of water they can yield inasmuch as about 12 gpm is the maximum amount of water which can be removed from a 2-inch well with a domestic type pump.

Records for more than 220 drilled wells are given in the tables of well data for Stanly County. Of these, 184 were used in compiling Table 13, a summary of data for wells in Stanly County.

The Tuffaceous Argillite unit comprises the major aquifer of the county. No one section of this aquifer can be said to be better than another as a water producer, and local conditions should be given considerable attention in locating a well site.

The quality of water in Stanly County is acceptable for most uses except for excessive hardness in some areas where the water was found to be extremely hard and to have large concentrations of calcium and magnesium. This condition is related probably to dolomitic zones in the argillite.

Analyses of 19 samples of water from Stanly County are

Table 13. Summary of Data on Wells in Stanly County.

According to rock type

Type of rock	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
Tuffaceous argillite	173	112	½-200	15	0.13
Laminated argillite	11	116	4-35	11	.10
All wells	184	112	½-200	15	0.13

According to topographic location

Topographic location	No. of wells	Average depth (feet)	Yield (gallons per minute)		
			Range	Average	Per foot of well
Hill	90	101	½-30	9	0.09
Flat	36	105	½-95	11	0.11
Slope	35	143	1-180	24	0.17
Draw	4	88	9-90	35	0.39
Valley	7	194	5-200	46	0.24

given in Table 15 following the well records. Seventeen of the analyses are from wells in the tuffaceous argillite unit, and the remaining two analyses are from wells in the laminated argillite unit.

Municipal supplies

Only one municipality in Stanly County uses wells as a source for its water supply. The town of Oakboro (population 631) is presently using three drilled wells with reported yields of 80, 54, and 100 gpm. The newest well, No. 232 (Table 13) is now furnishing more than half of the town's supply. A textile mill in Oakboro has its own ground-water supply, which is obtained from two drilled wells. The yields are reported to be 95 and 17 gpm, and the average daily withdrawal is about 11,000 gallons.

The other municipal water supplies in the county use surface water as a source.

Table 14. Records of Wells in Stanly County

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
1	0.4 Mi. N of Misenheimer---	John A. Bolton, Jr.-----------	Drilled	35	4	25	Tuffaceous argillite--	20-25	10	-----	Hill---	
2	At Misenheimer--	Pfeiffer College	--do--	360	6	------	--do--------	40	180	110	Slope---	
3	--do-----------	--do-----------	--do---	122	6	------	--do--------	25	75	55	--do---	
4	--do-----------	--do-----------	--do---	-----	6	------	--do--------	20	20	160	--do---	
5	--do-----------	--do-----------	--do---	363	6	------	--do--------	22	25	-----	--do---	
6	0.6 Mi. SE of Misenheimer---	B. F. Burrage---	--do---	90	4	------	--do--------	10	5-10	-----	--do---	
7	1.7 Mi. N of Richfield-----	W. [illegible]. Forrest---	Dug----	37	48	------	--do--------	22.7	-----	-----	--do---	
8	1.5 Mi. NNE of Richfield-----	[illegible]. H. Parker----	Drilled	57	6	24	--do--------	30	9	-----	--do---	
9	--do-----------	--do-----------	Dug----	33.5	48	------	--do--------	20.2	-----	-----	--do---	
10	2.7 Mi. NNE of Richfield-----	Winfred Hatley--	Drilled	65	4	18	--do--------	12	4	-----	Hill---	
11	3.0 Mi. NE of Richfield-----	R. B. Russel---	--do---	83	6	------	--do--------	17.5	-----	-----	--do---	
12	3.3 Mi. NE of Richfield-----	Doc Hartsell----	--do---	100	4	20	--do--------	15	10	-----	Slope---	
13	3.9 Mi. NE of Richfield-----	William Kock----	--do---	165	6	-------	--do--------	------	7	-----	--do---	
14	2.9 Mi. NE of New London---	C. M. Caldwell--	--do---	85.5	4	28	--do--------	27.8	-----	-----	--do---	
15	2.6 Mi. NNE of New London---	C. C. Arey------	--do---	128	4	10	--do--------	15	-----	-----	--do---	
16	2.3 Mi. NNE of New London---	A. L. Crowell---	--do---	100	4	21	--do--------	22	9	-----	--do---	
17	0.9 Mi. ENNE of Richfield----	Jasper A. Drye	--do--	108	4	21	--do--------	17	5-10	-----	Slope---	
18	At Richfield---	Richfield Meth. Church-------	--do--	106	4	22	--do--------	13.8	10	7	--do---	
19	0.5 Mi. NW of Richfield-----	J. W. Miller---	--do--	200	6	40	--do--------	-----	8	-----	--do---	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
20	At Richfield-----	Mrs. C. B. Meisenheimer---	Drilled	45	6	------	Tuffaceous argillite--	27	25+	-----	Flat----	
21	0.9 Mi. NNW of Richfield------	S. L. Sells-----	--do---	109	4	20	--do---------	-------	2-3	-----	Slope---	
22	1.1 Mi. W of Richfield------	A. Bolton-------	--do---	60	4	-------	--do---------	37	2-3	-----	Hill----	
23	1.6 Mi. WSW of Richfield------	G. W. Culp------	Dug----	50	48	-------	--do---------	25	-----	-----	Slope---	
24	1.4 Mi. W of Richfield------	J. A. Morris---	Drilled	65	4	20	--do---------	------	9	-----	-------	
25	2.3 Mi. W of Richfield------	Richard Van Den Berg---------	--do--	101	6	36.5	--do---------	30	65	-----	Hill---	
26	--do-----------	--do-----------	Dug---	45	48	------	--do---------	40	1	-----	--do---	
27	3.3 Mi. WSW of Richfield------	E. L. Holt-----	--do--	28	36	------	--do---------	10	11	-----	Slope--	
28	3.5 Mi. WSW of Richfield------	K. L. Plowman--	Drilled	108	4	19	--do---------	57	2.5	-----	Hill---	
29	--do-----------	K. F. Clark----	--do--	115	4	20	--do---------	18	6	-----	Valley--	
30	2.9 Mi. SW of Richfield------	C. L. Williams--	--do--	98	4	18	--do---------	16	-----	-----	Flat----	
31	--do-----------	--do-----------	Dug---	40	48	------	--do---------	17	-----	-----	--do---	
32	1.1 Mi. SSW of Richfield------	C. H. Meisenheimer-	Drilled	107	4	21	--do---------	19	3	-----	--do---	
33	1.3 Mi. NNW of New London-----	Lucian Crowell	--do--	108	4	20	--do---------	18	-----	-----	--do---	
34	3.5 Mi. ENE of New London-----	Albert Smith---	Dug---	50	48	-------	--do---------	23	-----	-----	Hill---	
35	2.9 Mi. ENE of New London-----	Buford Maner---	Drilled	96	4	18	--do---------	50	5	-----	--do---	
36	2.6 Mi. ENE of New London-----	Hoyle Burris---	--do--	78	4	-------	--do---------	------	4-5	-----	--do---	
37	1.0 Mi. ENE of New London----	C. B. Lentz----	--do--	115	4	56	--do---------	35	8-10	-----	--do---	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
38	New London------	W. O. Crowell--	Drilled	75	4	74	Tuffaceous argillite--	20	50+	------	Slope--	
39	--do-----------	New London School-------	--do---	250	6	62	--do---------	------	5	------	--do---	
40	--do-----------	M. R. Elliot---	--do---	195	6	95.5	--do---------	------	15	------	--do---	
41	0.9 Mi. NNW of New London----	Edgar M. Harris	--do---	100	4	33	--do---------	------	8+	------	Flat---	
42	1.7 Mi. WSW of New London----	W. W. Saunders	--do---	89	6	60	--do---------	40	9	------	Hill---	
43	2.6 Mi. W of New London--------	W. Ross--------	--do---	116	4	------	--do---------	------	8±	------	Slope---	
44	3.3 Mi. WSW of New London----	Spurgo Brooks--	--do---	70	4	20	--do---------	35	10	------	Hill---	
45	4.3 Mi. WSW of New London----	Ruben Almond---	--do---	107	4	20	--do---------	17	4	------	Slope---	
46	3.2 Mi. SW of Richfield------	A. M. Meisenheimer-------	--do---	89	6	16	--do---------	25	8.5	------	Flat---	
47	3.4 Mi. NNW of Millingport----	C. E. Lefler---	--do---	39	4	20	--do---------	10	4	------	--do---	
48	3.5 Mi. NW of Millingport----	H. Tucker------	--do---	140	4	------	--do---------	------	0.5	------	Hill---	
49	3.6 Mi. NW of Millingport----	H. L. Moose----	--do---	185	4	36	--do---------	29	8	------	--do---	
50	3.2 Mi. NW of Millingport----	J. H. Lowder---	--do---	99.5	4	30	--do---------	6	10	------	Valley--	
51	3.1 Mi. NW of Millingport----	J. B. Furr-----	--do---	197	4	60	--do---------	38	4±	------	Slope---	
52	2.8 Mi. NW of Millingport----	C. C. Lowder----	Dug----	52	36	-------	--do---------	45	------	------	Hill---	
53	2.1 Mi. NNE of Millingport----	Martin Furr-----	Drilled	81	4	50	--do---------	------	15	------	--do---	
54	2.9 Mi. NNE of Millingport----	Joseph Drye----	--do---	82	4	40	--do---------	11	------	------	Slope---	
55	3.0 Mi. NNE of Millingport----	Casey Purser---	--do---	129	4	40	--do---------	42	3.5	------	Flat---	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
56	3.6 Mi. NE of Millingport---	E. Pickler-----	Drilled	330	6	------	Tuffaceous argillite--	60	15	-----	Valley--	
57	--do-----------	--do-----------	--do---	230	6	------	--do---------	------	15	-----	Hill----	
58	--do-----------	--do-----------	--do---	115	6	------	--do---------	30	5	-----	Valley--	
59	3.4 Mi. NE of Millingport---	Heath Pickler--	--do---	110	4	50	--do---------	------	9	-----	-------	
60	3.5 Mi. NE of Millingport---	Grant Pickler---	--do---	105	4	65	--do---------	------	-----	-----	Flat----	
61	2.8 Mi. SSW of New London----	J. S. Pickler---	Dug----	37	36	------	--do---------	30	-----	-----	Hill----	
62	0.6 Mi. SSE of New London----	J. C. Forest----	Drilled	90	4	30	--do---------	25	5.5	-----	--do----	
63	1.7 Mi. SSE of New London----	W. L. Allen-----	--do---	106	4	25	--do---------	50	10	-----	--do----	
64	1.4 Mi. SSE of New London----	North Stanly School--------	--do---	143	6	43	--do---------	------	100	-----	Slope---	
65	2.6 Mi. SSE of New London----	Brady Almond----	Spring				--do---------					
66	2.8 Mi. ESE of New London----	Henry Thompson--	Dug---	29	48	------	--do---------	20	------	-----	--do----	
67	2.5 Mi. N of Badin---------	A. Ridenhour----	Drilled	95	4	20	--do---------	14	10	-----	Hill----	
68	1.5 Mi. NNE of Badin---------	H. A. Gilbert---	--do--	55	6	35	--do---------	23	2	-----	--do----	
69	1.4 Mi. NNE of Badin---------	--do-----------	--do--	85	6	35	--do---------	------	10+	-----	Slope---	
70	0.6 Mi. SW of Badin---------	Mrs. R. L. Stiller-------	Spring				--do---------					
71	2.8 Mi. W of Badin---------	Edward Harris---	Drilled	109	4	30	--do---------	14	4	-----	--do----	
71A	--do-----------	--do-----------	Dug---	30	36	[illegible]	--do---------	12	------	-----	--do----	
72	3.4 Mi. WSW of Badin---------	Gerald Dennis--	Drilled	142	4	33	--do---------	9	6	-----	Hill----	
73	3.7 Mi. S of New London----	J. P. Herlocker	--do---	80	4	20	--do---------	30	2	-----	--do----	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
74	1.6 Mi. NE of Millingport----	H. J. Harwood--	Drilled	117	4	40	Tuffaceous argillite--	------	15	-----	Flat---	
75	1.7 Mi. NNE of Millingport----	W. Heath Williams	--do--	[illegible].5	4	40	--do---------	------	9	-----	--do---	
76	1.3 Mi. NNE of Millingport----	C. L. Hatley---	--do---	127	4	40	--do---------	30	10	-----	Hill---	
77	--do------------	--do------------	--do---	75	4	35	--do---------	25	1.5	-----	--do---	
78	1.4 Mi. NNW of Millingport----	T. L. Harwood--	--do---	71	4	21	--do---------	20	------	-----	-------	
79	1.7 Mi. NNW of Millingport----	--do------------	--do---	101	4	100	--do---------	30	------	-----	Hill---	
80	2.2 Mi. NNW of Millingport----	H. F. Whitley--	--do---	150	4	40	--do---------	30	5	-----	--do---	
81	2.6 Mi. NW of Millingport----	C. L. Plott----	--do---	127	4	55	--do---------	55	------	-----	--do---	
82	3.1 Mi. NW of Millingport----	J. Burlsion----	--do---	100	4	21	--do---------	20	8	-----	Valley--	
83	3.0 Mi. NW of Millingport----	D. J. Isenhour--	Dug----	45	48	[illegible]	--do---------	30	6	-----	Hill---	
84	--do------------	Ralph Lowder---	Drilled	65	4	-------	--do---------	20	9	-----	Slope---	
85	3.5 Mi. WNW of Millingport----	Richard Hatley	--do---	74	4	40	--do---------	70	7	-----	Hill---	
86	3.1 Mi. WNW of Millingport----	D. L. Lowder---	--do--	73	6	20	--do---------	------	-----	-----	Slope---	
87	2.9 Mi. WNW of Millingport----	C. C. Hatley---	--do--	185	4	40	--do---------	50	6	-----	Hill---	
88	1.4 Mi. NW of Millingport----	Coy Pickler----	--do--	200	4	60	--do---------	20	-----	-----	--do---	
89	3.0 Mi. WNW of Millingport----	W. C. Hatley---	--do--	187	4	40	--do---------	157	5	-----	Flat---	
90	2.3 Mi. WNW of Millingport----	J. Huneycutt---	--do--	80	4	20	--do---------	10	10	-----	Slope---	
91	0.7 Mi. ENE of Millingport----	B. W. Lowder---	--do--	154	4	44	--do---------	20	6	-----	Flat---	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
92	1.7 Mi. E of Millingport----	Everett Hatley	Drilled	130	4	40	Tuffaceous argillite--	-------	9	------	Flat---	
93	3.4 Mi. E of Millingport----	W. A. Lowder---	--do---	[illegible]	6	-------	--do---------	37	200	------	Valley--	
94	3.1 Mi. ESE of Millingport----	--do------------	--do---	200	6	-------	--do---------	-------	80	------	--do---	
95	2.3 Mi. NNW of Albemarle------	Read Whitley---	--do---	160	4	60	--do---------	60	8	------	Hill---	
96	1.2 Mi. SW of Badin---------	A. D. Drye, Jr.	Dug----	65	40	65	--do---------	59	------	------	--do---	
97	--do------------	--do------------	Drilled	83	4	47	--do---------	40	12	------	Slope--	
98	3.0 Mi. S of Badin----- ----	J. F. Festerman	Dug---	42	48	[illegible]	--do---------	33.9	------	------	--do---	
99	2.6 Mi. SW of Badin---------	W. S. Holt------	Drilled	75	4	30	--do---------	4	------	------	--do---	
100	2.8 Mi. ENE of Albemarle------	Vicker's Transfer Co.	--do--	90	4	-------	--do---------	-------	5	------	--do---	
101	2.6 Mi. WNW of Albemarle------	C. B. Parker---	--do--	100	4	-------	--do---------	-------	10	------	--do---	
102	1.9 Mi. W of Albemarle------	Q. C. Kimmer---	--do--	180	4	36	--do---------	36	8	------	Hill---	
103	2.9 Mi. ESE of Millingport----	L. C. Burleyson	--do--	105	4	-------	--do---------	49.6	-----	------	Slope--	
104	--do------------	A. E. Lowder---	--do--	93	4	87	--do---------	40	5	------	Flat---	
105	1.7 Mi. ESE of Millingport----	Vernon Harwood--	--do--	110	4	60	--do---------	20	25	------	--do---	
106	1.5 Mi. ESE of Millingport----	R. E. Huneycutt	--do--	102	4	31	--do---------	30	5	------	--do---	
107	1.2 Mi. SE of Millingport----	--do------------	--do--	50	4	23	--do---------	14	-----	------	Hill---	
108	1.5 Mi. SSE of Millingport----	Mrs. T. C. Hurlocker----	--do--	189	4	37	--do---------	45	3.5	------	-------	
109	1.7 Mi. SE of Millingport----	W. W. Hager----	Dug---	34	------	-------	--do---------	28	-----	------	Flat---	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
110	3.7 Mi. WSW of Millingport---	L. E. Harwood, Jr.-----------	Drilled	80	4	40	Tuffaceous argillite	40	------	-----	Slope---	
111	5.0 Mi. WSW of Millingport---	Paul Almond-----	Dug----	27	------	------	--do--------	14.7	------	-----	--------	
112	--do------------	--do------------	--do--	31	------	------	--do--------	8.8	------	-----	--------	
113	4.4 Mi. SW of Millingport---	J. C. Hinson----	Drilled	202	4	25	--do--------	25	5	-----	Slope---	
114	2.8 Mi. ENE of Lambert-------	J. P. Bowers---	--do---	110	6	40	--do--------	60	10.5	-----	Hill----	
115	3.7 Mi. ENE of Lambert-------	C. E. Parker---	--do---	92	4	40	--do--------	-------	7	-----	Flat----	
116	3.9 Mi. WSW of Albemarle-----	L. P. Almond---	--do---	110	4	32	--do--------	30	12	-----	Hill----	
117	1.1 Mi. SSW of Albemarle-----	R. C. Morgan---	--do---	175	6	------	--do--------	33.18	-----	-----	--do----	
118	2.7 Mi. ESE of Albemarle-----	Bill Austin----	--do---	50	6	29.5	--do--------	16	20	-----	Slope---	
119	3.6 Mi. E of Albemarle-----	Walter H. Lewis	--do---	96.5	4	18	--do--------	4	-----	14	--do----	
120	3.9 Mi. ESE of Albemarle-----	Jim Henly------	Spring	-----	-----	-------	--do--------	-------	5	-----	--do----	
121	7.5 Mi. E of Albemarle-----	L. K. Hudson---	Drilled	97	4	40	--do--------	35.85	-----	-----	--do----	
122	7.0 Mi. E of Albemarle-----	--do-----------	--do---	148	6	-------	--do--------	26.37	-----	-----	--do----	
123	6.2 Mi. ESE of Albemarle-----	Mrs. Charles Fultz--------	--do--	257	4	-------	Laminated argillite-	30	1	-----	--do----	
124	4.5 Mi. ESE of Albemarle-----	Alvin J. Hinson	--do--	73	4	23	--do--------	18.05	7	-----	--do----	
125	4.9 Mi. ESE of Albemarle----	Swaringen------										
126	3.9 Mi. SE of Albemarle----	J. B. Smith----	--do--	153.5	5	24	Tuffaceous argillite--	40	6	-----	Hill----	
127	3.4 Mi. SSE of Albemarle----	Roy Marbrey----	--do--	57	4	20	--do--------	2.5	4	-----	Slope---	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
128	2.6 Mi. SE of Albemarle------	Bud Mauldin----	Drilled	46.1	4	------	Tuffaceous argillite	16	-----	-----	Hill---	
129	2.6 Mi. SSE of Albemarle------	South Albemarle Volunteer Fire Dept.---------	--do---	78	6	20	--do--------	26.7	-----	-----	--do---	
130	2.2 Mi. SSE of Albemarle------	G. H. Moose Dairy---------	--do---	100	4	30	--do--------	------	9	-----	--do---	
131	1.9 Mi. S of Albemarle------	Jim M. Holt----	--do---	57	4	50	--do--------	29.1	-----	-----	--do---	
132	2.8 Mi. S of Albemarle------	W. R. Poplin---	--do---	95	4	-------	--do--------	50	-----	-----	Slope--	
133	2.5 Mi. SSW of Albemarle------	Jason Aldridge-	--do---	109	4	-------	--do--------	20	5	-----	--do---	
134	--do------------	Robert E. Lee--	--do---	148	4	32	--do--------	33	9	-----	Draw---	
135	3.6 Mi. WSW of Albemarle------	P. D. Howell---	--do---	32	4	21	--do--------	12	12	-----	Hill---	
136	3.6 Mi. SW of Albemarle------	F. L. Morgan---	--do---	120	4	40	--do--------	-------	-----	-----	Flat---	
137	3.2 Mi. NNE of St. Martin-----	Craig C. Efird-	--do---	85	4	30	--do--------	30	4	-----	Slope--	
138	3.3 Mi. NNE of St. Martin-----	Gene Almond----	--do---	250	4	32	--do--------	50	5	-----	--do---	
139	3.0 Mi. NNW of St. Martin-----	G. C. Huneycutt	--do---	130	4	32	--do--------	25	4	-----	Hill---	
140	2.5 Mi. NNW of St. Martin-----	G. A. Teeter---	--do---	104	4	22	--do--------	20	9	-----	Flat---	
141	3.4 Mi. ENE of Lambert--------	Wayne Furr-----	--do---	128	4	39.5	--do--------	18	4	-----	--do---	
142	1.6 Mi. NNE of Lambert--------	J. C. Eudy-----	--do---	104	4	-------	--do--------	25	9	-----	Hill---	
143	2.0 Mi. SE of Lambert--------	P. I. Whitley--	--do--	100	4	33	--do--------	25	6	-----	Flat---	
144	0.5 Mi. N of Lambert--------	Hoyle Moyle----	--do--	70	4	40	--do--------	40	6	-----	--do---	
145	1.8 Mi. NNW of Lambert--------	Mrs. W. D. Huneycutt----	Dug---	33.2	-----	------	--do--------	17.6	-----	-----	Hill---	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
146	2.5 Mi. NW of Lambert	M. F. Straten	Drilled	56	4	21	Tuffaceous argillite	25	5	-----	Flat	
147	2.3 Mi. WNW of Lambert	Dolly Blackwelder	--do--	125	4	42	--do--	15	3	-----	Hill	
148	2.0 Mi. WNW of Lambert	Oldale Almond	--do--	130	4	-------	--do--	20	4	-----	--do--	
149	2.4 Mi. W of Lambert	W. O. Lambert	--do--	[illegible]	4	17	--do--	12	12	-----	-------	
150	1.7 Mi. WSW of Lambert	A. A. Lambert	--do--	[illegible]	4	35	--do--	10	4	-----	Flat	
151	1.7 Mi. W of Lambert	G. L. Almond	--do--	[illegible]	6	------	--do--	[illegible]	5	-----	Hill	
152	1.5 Mi. WNW of Lambert	Mrs. Lotha Lambert	--do--	[illegible]	4	30	--do--	20	5	-----	--do--	
153	1.3 Mi. W of Lambert	Virgil Lambert	Bored	45	10	45	--do--	14	6	-----	--do--	
154	1.1 Mi. W of Lambert	Virgil Lambert, Jr.	Drilled	48.5	4	30	--do--	31.5	5	-----	--do--	
155	3.4 Mi. WSW of Lambert	Mrs. C. H. Henderson	--do--	71	6	32	--do--	12	15	-----	Flat	
156	--do--	M. J. Hathcock	--do--	60	4	40	--do--	30	4	-----	-------	
157	2.4 Mi. WSW of Lambert	Reece Almond	--do--	87	4	38	--do--	18	3	-----	Flat	
158	4.5 Mi. WSW of Lambert	Little	--do--	100	6	20	--do--	18	12-14	-----	--do--	
159	4.0 Mi. WSW of Lambert	Dan Hurlocker	--do--	99	4	36	--do--	24	14	-----	--do--	
160	3.6 Mi. SW of Lambert	Bob Thomas	--do--	33	4	12	--do--	above ground	-----	-----	--do--	
161	3.3 Mi. SW of Lambert	C. W. Almond	--do--	64	4	28	--do--	12	4	-----	--do--	
162	2.4 Mi. S of Lambert	F. L. Whitley	--do--	92.8	4	15	--do--	18	9	-----	-------	
163	2.0 Mi. SSE of Lambert	N. G. Whitley	Dug	50	------	-------	--do--	33.5	-----	-----	Flat	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
164	3.2 Mi. SSE of Lambert	J. G. Burris	Drilled	92	4	52	Tuffaceous argillite	40	15	-----	Hill	
165	2.0 Mi. NNW of St. Martin	J. V. Cotle	--do--	105	4	------	--do--	-------	9	-----	--do--	
166	1.6 Mi. NNW of St. Martin	Dean Bowers	--do--	82	4	21	--do--	1.55	25	-----	Slope	
167	1.5 Mi. NE of St. Martin	C. J. Speights	--do--	98	4	26	--do--	36	12	-----	Hill	
168	--do--	Marvin Bowers	--do--	38	4	21.5	--do--	3	50	-----	-------	
169	1.1 Mi. NE of St. Martin	Alton Whitley	--do--	104	4	-------	--do--	Flows	2	-----	Hill	
170	2.6 Mi. NE of St. Martin	Clay Efird	--do--	129	4	22	--do--	26	8	-----	Knoll	
171	3.3 Mi. NW of Porter	Jesse G. Marton	--do--	62	4	37	--do--	25	5	-----	Hill	
172	2.3 Mi. NW of Porter	Cecil B. West	--do--	62	4	22	--do--	8	-----	-----	--do--	
173	0.3 Mi. NW of Porter	Sam Kimrey	--do--	96	4	26	--do--	28	5			
174	0.2 Mi. NE of Porter	Porter Baptist Church	--do--	70.5	4	-------	--do--	44.2	5	-----	--do--	
175	1.6 Mi. NNE of Porter	C. L. Foreman	Dug	55	36	-------	--do--	23.2	-----	-----	--do--	
176	1.8 Mi. ENE of Porter	C. B. Dennis	--do--	35	48	-------	Laminated argillite	30	-----	-----	--do--	
177	1.9 Mi. ENE of Porter	--do--	Drilled	108	4	30	--do--	40	7	-----	--do--	
178	3.2 Mi. ESE of Porter	T. N. Snuggs	--do--	111	4	40	--do--	32.7	5	-----	--do--	
179	3.6 Mi. ESE of Porter	Randal Methodist Church	--do--	174	4	26	--do--	25	6	-----	--do--	
180	2.0 Mi. SE of Porter	I. C. Bowers	--do--	01	5	-------	--do--	------	10	-----	--do--	
181	1.4 Mi. SSE of Porter	Calvary Baptist Church	--do--	85-88	4	40	Tuffaceous argillite	45	-----	-----	--do--	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
182	1.5 Mi. SSW of Porter	J. F. Loftin	--do--	68	4	------	Tuffaceous argillite	29.5	2	-----	Hill	
183	2.5 Mi. WSW of Porter	Silver Springs Baptist Church	--do--	66	6	------	--do--	------	5-10	-----	--do--	
184	2.5 Mi. SW of Porter	F. T. Russel	--do--	40	4	22	--do--	Flows occasionally	20	-----	--do--	
185	1.1 Mi. SE of St. Martin	R. L. Hinson	--do--	-----	4	22	--do--	------	8	-----	--do--	
186	1.2 Mi. WSW of St. Martin	Rayvon Smith	--do--	88.5	4	------	--do--	------	4-5	-----	--do--	
187	2.5 Mi. WSW of St. Martin	L. C. McLester	--do--	89	6	40	--do--	30	12	-----	--do--	
188	3.2 Mi. SSE of Lambert	Consolidated High School	--do--	160	6	24	--do--	-----	90	-----	------	
189	2.9 Mi. S of Lambert	Theron Smith	--do--	125	6	83	--do--	28	20	-----	Hill	
190	2.8 Mi. SSW of Lambert	Floyd Smith	--do--	140	4	60	--do--	30	5	-----	Flat	
191	2.8 Mi. NE of Stanfield	Church	--do--	60	4	------	--do--	25	5	-----	------	
192	2.8 Mi. NNE of Stanfield	F. L. Hartsell	--do--	47	4	29	--do--	22	9	-----	Flat	
193	2.9 Mi. NNW of Stanfield	Milar Hatley	--do--	119	4	41	--do--	36	7-8	-----	Hill	
194	1.4 Mi. NW of Stanfield	H. J. Little	--do--	109	4	42	--do--	50	20	-----	Flat	
195	1.1 Mi. N of Stanfield	G. M. Easley	--do--	200	6	32	--do--	12	25	-----	--do--	
196	1.2 Mi. ENE of Stanfield	Bill McIntire	--do--	115	4	21	--do--	20	5	-----	--do--	
197	1.8 Mi. ENE of Stanfield	K. E. Smith	Dug	30	------	------	--do--	18.7	-----	-----	--do--	
198	4.2 Mi. WSW of St. Martin	Claude F. Hartsell	Drilled	97	6	------	--do--	15	10	-----	Draw	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Drawdown (ft)	Topography	Remarks
199	4.0 Mi. WSW of St. Martin	Thompson	Drilled	90	6	------	Tuffaceous argillite	16-18	2.5	------	Hill	
200	2.6 Mi. SSE of St. Martin	Carolina Solite Corp.	--do--	125	6	20	--do--	65	10	------	--do--	
201	2.9 Mi. SSE of St. Martin	--do--	--do--	65	6	10	--do--	------	90	15	Draw	
202	2.9 Mi. NNW of Cottonville	Bruce Poplin	--do--	98	4	22	--do--	------	1	------	Hill	
203	2.6 Mi. NW of Cottonville	Curlee	------	42	6	30	--do--	0	30	------	Draw	
204	2.5 Mi. NNE of Cottonville	Clyde B. Mabry	Drilled	147	4	------	Laminated argillite	------	4-5	------	Hill	
205	2.8 Mi. NNE of Cottonville	Board of Education South Stanly School	--do--	203	6	40.5	--do--	------	35	------	------	
206	2.8 Mi. SE of Porter	C. P. Hopkins	--do--	70.5	4	30	--do--	25-30	5	------	Hill	
207	2.2 Mi. NNW of Shankle	C. H. Gibson	--do--	131	6	------	--do--	20	8	------	--do--	
208	0.6 Mi. NNW of Shankle	Charles Gregg	--do--	24	4	------	--do--	9.53	-----	------	--do--	
209	0.5 Mi. SSW of Shankle	W. S. Lowder	--do--	100	4	40-50	--do--	50	10	------	------	
210	--do--	--do--	Dug	50	36	------	--do--	33.1	-----	------	Hill	
211	1.2 Mi. SSE of Shankle	G. L. Mauldin	Drilled	-----	6	125	--do--	------	8	------	--do--	
212	1.4 Mi. SSE of Shankle	Mrs. J. P. Lowder	Dug	38.9	48	------	--do--	12.65	-----	------	Slope	
213	2.6 Mi. ENE of Cottonville	W. B. Allen	Drilled	101	4	22	--do--	40	8	------	Hill	
214	1.9 Mi. ESE of Cottonville	E. R. Crump	--do--	75	4	20	Tuffaceous argillite	15	3	------	--do--	
215	--do--	--do--	--do--	160	4	20	--do--	15	3	------	--do--	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
216	2.7 Mi. SSE of Cottonville---	Ray Lee----------	Drilled	90	6	------	Tuffaceous argillite--	50	4-5	------	Hill----	
217	2.2 Mi. SW of Cottonville---	Clyde Keply-----	--do--	40	4	------	--do---------	5-6	10	------	--do----	
218	1.2 Mi. SSW of Cottonville---	R. H. Blalock---	--do--	176	8	20	--do---------	16	6	------	--do----	
219	0.4 Mi. SSE of Cottonville---	Billy Mabrey----	--do--	[illegible].5	6	22	--do---------	------	10	------	--do----	
220	0.2 Mi. ENE of Cottonville---	Paul Thompson---	--do--	62	4	20	--do---------	14	4	------	------	
221	1.1 Mi. NW of Cottonville---	J. M. West------	--do--	42	4	20	--do---------	10	0.5	------	Flat----	
222	1.5 Mi. NW of Cottonville---	Frank W. Turner	--do--	74	-	30	--do---------	22	------	------	------	
223	--do----------	--do----------	--do--	30	4	------	--do---------	24	------	------	Slope---	
224	2.7 Mi. S of St. Martin---	W. C. Allen-----	--do--	45	4	28	--do---------	25	5	------	Hill----	
225	2.8 Mi. SSW of St. Martin---	Glenn Taylor----	--do--	53	6	22	--do---------	------	12-15	------	--do----	
226	Oakboro---------	Oakboro Mills---	--do--	195	8	------	--do---------	15	95	------	Flat----	
227	--do----------	--do----------	--do--	103	6	16	--do---------	8	17	------	Hill----	
228	--do----------	Town of Oakboro, #1----------	--do--	120	8	------	--do---------	------	60	------	------	
229	--do----------	Town of Oakboro, #2----------	--do--	115	8	------	--do---------	------	60	------	------	
230	--do----------	Town of Oakboro, #3----------	--do--	500	6	------	--do---------	------	80	------	------	
231	--do----------	Town of Oakboro, #4----------	--do--	350	6	22	--do---------	------	55	------	Slope---	
232	--do----------	Town of Oakboro, #5----------	--do--	150	6	30.7	--do---------	------	100	------	--do----	
233	1.2 Mi. WNW of Oakboro-------	Raymond Hatley	--do--	278	6	45	--do---------	40-60	30	------	Hill----	
234	1.6 Mi. SW of Oakboro-------	Cebron Coble---	--do--	82	4	27	--do---------	20	10	------	--do----	

Table 14. Records of Wells in Stanly County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
235	2.7 Mi. SW of Oakboro-------	W. R. Berger---	Drilled	44	4	------	Tuffaceous argillite--	------	15	-----	Hill----	
236	3.1 Mi. WSW of Oakboro-------	L. F. Huneycutt	--do---	144	6	60	--do---------	20	5	-----	--do----	
237	2.5 Mi. SE of Stanfield-----	Frances Green---	--do---	72	4	20	--do---------	15	8	-----	Flat----	
238	1.2 Mi. SSW of Stanfield-----	Melbourne Love--	--do---	90	6	4	--do---------	15	10	-----	Hill----	
239	1.8 Mi. WSW of Stanfield-----	H. L. Love------	--do---	45	4	------	--do---------	------	4	-----		
240	2.5 Mi. WSW of Stanfield-----	D. M. Yow-------	--do---	69.5	4	29	--do---------	15	9	-----	Flat----	
241	2.7 Mi. SW of Stanfield-----	W. L. Little----	--do---	109	4	21	--do---------	30	3	-----	--do----	
242	4.5 Mi. SW of Stanfield-----	J. F. Hatlock---	--do---	100	6	32	--do---------	30	30	-----	Hill----	
243	4.5 Mi. SSW of Stanfield-----	Willie Efird----	--do---	100	4	21	--do---------	60	3	-----	--do----	
244	4.1 Mi. SSW of Stanfield-----	H. D. Efird-----	--do---	109	4	28	--do---------	30	6	-----	--do----	
245	4.9 Mi. SSW of Stanfield-----	E. L. Efird-----	--do---	59	4	16	--do---------	15	9	-----	--do----	
246	3.6 Mi. SSW of Stanfield-----	Hormer L. Taley	--do---	35	6	20	--do---------	18	20	-----	--do----	
247	4.1 Mi. SSE of Stanfield-----	Boyce Tarlton--	--do---	101	6	40	--do---------	30	8	-----	--do----	
248	3.5 Mi. SSW of Oakboro-------	W. D. Brooks---	--do---	120	4	40	--do---------	50	15	-----	--do----	
249	2.9 Mi. SSE of Oakboro-------	E. C. Carpenter	--do---	49	4	20	--do---------	30.5	-----	-----	Slope---	

Table 15. Chemical analyses of ground water from Stanly County

(Well numbers correspond to well numbers in table of well data)

Parts per million

Well No.	Date of Col- lec. tion	Sil- ica (SiO_2)	Iron (Fe) in Total	Cal- cium (Ca)	Mag- na- sium (Mg)	Sodium (Na)	Potas- sium (K)	Bicar- bonate (HCO_3)	Sul- fate (SO_4)	Chlo- ride (Cl)	Ni- trate (NO_3)	Hard- ness as ($CaCO_3$)	PH	Water Bearing Material
6	1/62	------	1.6	108	21	26	.7	216	111	78	.1	356	6.9	Tuffaceous argillite------
15	6/62	------	.25	77	22	------	------	243	15.	------	.4	284	7.3	--do----------------------
25	3/62	34	2.7	75	30	42	.5	200	132	66.	-------	312	6.9	--do----------------------
26	3/62	------	.71	10	6.8	15	1.8	28	21	23	15.	54	6.3	--do----------------------
35	6/62	------	.00	19	4.9	9.8	.5	86	1.4	3.4	9.5	68	7.1	--do----------------------
44	1/62	------	.44	12	7.7	7.0	.3	52	4.8	13	8.8	62	6.1	--do----------------------
64	6/62	------	.27	38	4.6	7.2	.5	143	5.6	2.6	2.1	114	7.8	--do----------------------
101	1/62	------	.06	44	29	18	.4	235	10	56	7.2	230	6.8	--do----------------------
108	6/62	------	.08	26	6.3	.52	.01	85	4.6	24	7.7	90	6.8	--do----------------------
106	1/62	------	.13	6.4	4.1	8.2	.3	51	4.6	2.5	1.7	23	6.4	--do----------------------
151	-----	------	.64	133	27.	------	.6	223	11.	249	1.3	532	7.0	--do----------------------
166	1/62	------	.10	16	4.8	15	2.6	36	15	20	8.6	60	6.0	--do----------------------
184	1/62	------	.05	27	16	13	.4	127	8.6	20	13	130	7.0	Laminated argillite-------
219	1/62	------	.04	52	45	19	2.4	339	14	33	9.0	316	7.0	--do----------------------
228	4/55	29	.01	61	8.2	18	.4	145	64	25	.0	186	7.2	Tuffaceous argillite------
229	4/55	24	.0	65	11	20	.4	157	41	54	.0	208	7.3	--do----------------------
230	4/55	29	2.6	63	14	18	.2	166	55	40	.0	217	7.3	--do----------------------
231	7/59	31	1.1	63	6.4	23	.3	161	55	34	.6	193	7.4	--do----------------------
232	3/62	17	.06	29	5.8	13	.2	106	9.6	16	1.5	97	7.4	--do----------------------

Union County

Area: 643 square miles; population in 1960: 44,416)

Geography and physiography

Union County, the southwestern part of the Monroe area, has the largest area and population of the three-county area. The county seat is the city of Monroe which has a population of 10,829 according to the 1960 U. S. Census.

Union County is bounded on the north by Cabarrus County and the Rocky River, on the east by Anson County, on the south by South Carolina, and on the west by Mecklenburg County and South Carolina.

Topographically, Union County is typical of the eastern part of the Piedmont province. It consists of a series of moderately level interstream areas which become more rugged near the larger streams. No hills stand out prominently above the general level of the upland. The highest land surface elevations in the county are along the western border near Stallings where the altitude is slightly more than 750 feet above mean sea level. The topography slopes generally toward the south and east.

About four-fifths of the county is drained towards the northeast by large streams that are tributaries of the Rocky River. The remainder of the county is drained to the southwest and south by smaller streams that empty into the Wateree River or into the Lynches River in South Carolina.

Geology

Rocks of Triassic age crop out in a small area in the extreme southeast corner of Union County. They consist largely of red, brown, and gray sandstones and siltstones with lenticular beds of red to purple mudstone. Lenticular beds of crossbedded, arkosic sandstone and conglomerate are frequently interbedded with other mineral.

Granite.—There are two granite bodies in the western part of the county. The northernmost body occupies a narrow zone, one-half to two miles in width, that extends in a southeastern direction from the county line near the village of Stallings to the South Carolina border. The second body of granite is in the extreme southwestern corner of the county. It covers an area approximately two miles wide and seven miles long, and it extends from the South Carolina border to about one-half mile south of the town of Waxhaw. The Union County granites differ from the Anson County granites in being nonporphyritic and containing less biotite.

Diorite-gabbro.—Near the western extremity of Union County, rocks intermediate between diorite and gabbro crop out in a zone one to two miles wide. These rocks intrude a large body of granite and extend from Mecklenburg County into South Carolina. The diorite-gabbro is a massive, coarse-textured rock composed mainly of hornblende, feldspar, augite, and varying amounts of quartz and accessory minerals. Large rounded boulder outcrops are common. On the surface these rocks are black or dark gray and have a pitted surface that is apparently due to differential weathering among the constituent minerals.

Phyllite and mica schist unit.—In Union County these rocks were mapped in a zone (aureole), one-half to three and one-half miles in width, around the southernmost granite body in the county. The unit is composed chiefly of phyllite with some mica schist. It is occasionally intruded by or interlayered with other types of rock such as rhyolite, granite-gneiss, and lithic tuff. The phyllite and schist are metamorphic equivalents of the lower volcanic unit and were altered at the time of the granitic intrusion and again in conjunction with faulting in the area.

Tuffaceous Argillite unit.—About two-thirds of Union County is underlain by rocks of the tuffaceous argillite unit. As in the other counties of the Monroe area, the unit is comprised of interbedded felsic and mafic tuffaceous argillites, fine-grained tuffs, and some breccias and flows. Graywacke sandstone and siltstone are found occasionally overlying and interlayered with the argillites. The argillites are coarsely bedded with individual beds varying from three inches to several feet in thickness.

Laminated Argillite unit.—This unit was mapped in Union County in a belt-like zone varying from about one-half mile to about four miles in width. It has been traced from the southeastern corner of Cabarrus County through the western part of Union County where, in the vicinity of Mineral Springs, it wraps around a synclinal and adjacent anticlinal structure before passing into South Carolina.

The laminated argillite unit grades upward into tuffaceous

argillite unit and conformably overlies the lower volcanic unit. In general, the lower section of the laminated argillite unit consists of coarser-grained volcanic ash than does the upper section. However, the manner of deposition is apparently the same.

The flanks of the anticlines adjacent to the Gold Hill fault have been tightly folded, resulting in rocks of the lower volcanic unit and rocks of the upper and lower sections of the laminated argillite unit being adjacent to each other within short distances.

West of the Gold Hill fault in Union County, the laminated argillite has been tightly folded and compressed to form a low grade phyllite with thin, slaty clevage. The metamorphism, which accompanied the folding and faulting, has almost destroyed the original bedding planes in many places.

Lower Volcanic unit.—Rocks of this unit were found only in the western and southwestern parts of Union County. Here they occur in two separate bodies, cropping out along the axes of eroded anticlines. The westernmost body, found along the western border of Union County extends from Mecklenburg County into South Carolina. Along the Mecklenburg County border, from about one-half mile south of highway 74 and into South Carolina, this body has been intruded by granite and diorite-gabbro. In the southern part of the county, the lower volcanic unit crops out near Trinity and extends westward to within three and one-half miles of the North Carolina-South Carolina State line.

The dominant rocks of the lower volcanic unit are fine-grained felsic tuff and crystal tuff with interbedded rhyolite flows. The unit is frequently intruded by dikes of diabase, quartz, and rhyolite.

Usually, rocks of the lower volcanic unit are deeply weathered, and outcrops of fresh rock are rare. This, in itself, is one of the outstanding characteristics of the unit.

Ground water

Most domestic water supplies and one municipal water supply are obtained from wells in Union County. A few domestic supplies are obtained from one or more springs. Dug wells provide the water supply for a number of families. The springs and nearly all the dug wells obtain water from the weathered zone above unweathered rock. Both types of wells are subject to surface contamination and may go dry during droughts. No bored wells were inventoried in Union County during this investigation. Most wells in the county are drilled wells. Data for 134 wells were used to compile Table 16, a summary of data for wells in Union County.

Table 16 indicates that the well having the highest yield in Union County was drilled in granite. Reference to the topographic section of the table indicates that wells drilled in draws apparently have the highest yield per foot, and that wells drilled on slopes apparently have the lowest yield per foot.

Analyses of 18 water samples from wells in Union County are given in Table 18. One analysis is from a well drilled in granite, three are from wells in laminated argillite, and five are from wells in rocks of the lower volcanic unit. The water from the well in granite is of excellent quality. Similar water is obtained by the town of Waxhaw from the phyllite and mica schist unit. The water is not treated prior to use. Analyses of water samples from tuffaceous argillite and laminated argillite show the quality of water from each unit to be practically identical. As a rule, the iron content is low, and the water is hard. Water from the lower volcanic unit is generally acceptable for most uses.

Municipal supplies

The town of Waxhaw has the only municipal ground-water supply in Union County. Other municipalities use surface water.

Waxhaw, population 818 (1960 census), obtains its water supply from three wells. The oldest well, Number 120 (Table 17) was drilled in 1940 to a depth of 250 feet and yields 50 gpm. Well Number 121 (Table 17) was drilled in 1949 to a depth of 200 feet and yields 40 gpm with a drawdown of about 118 feet. Well Number 122 (Table 17) was drilled in 1961 to a depth of 301 feet, at a site selected as a result of this investigation, and yields more than 90 gpm.

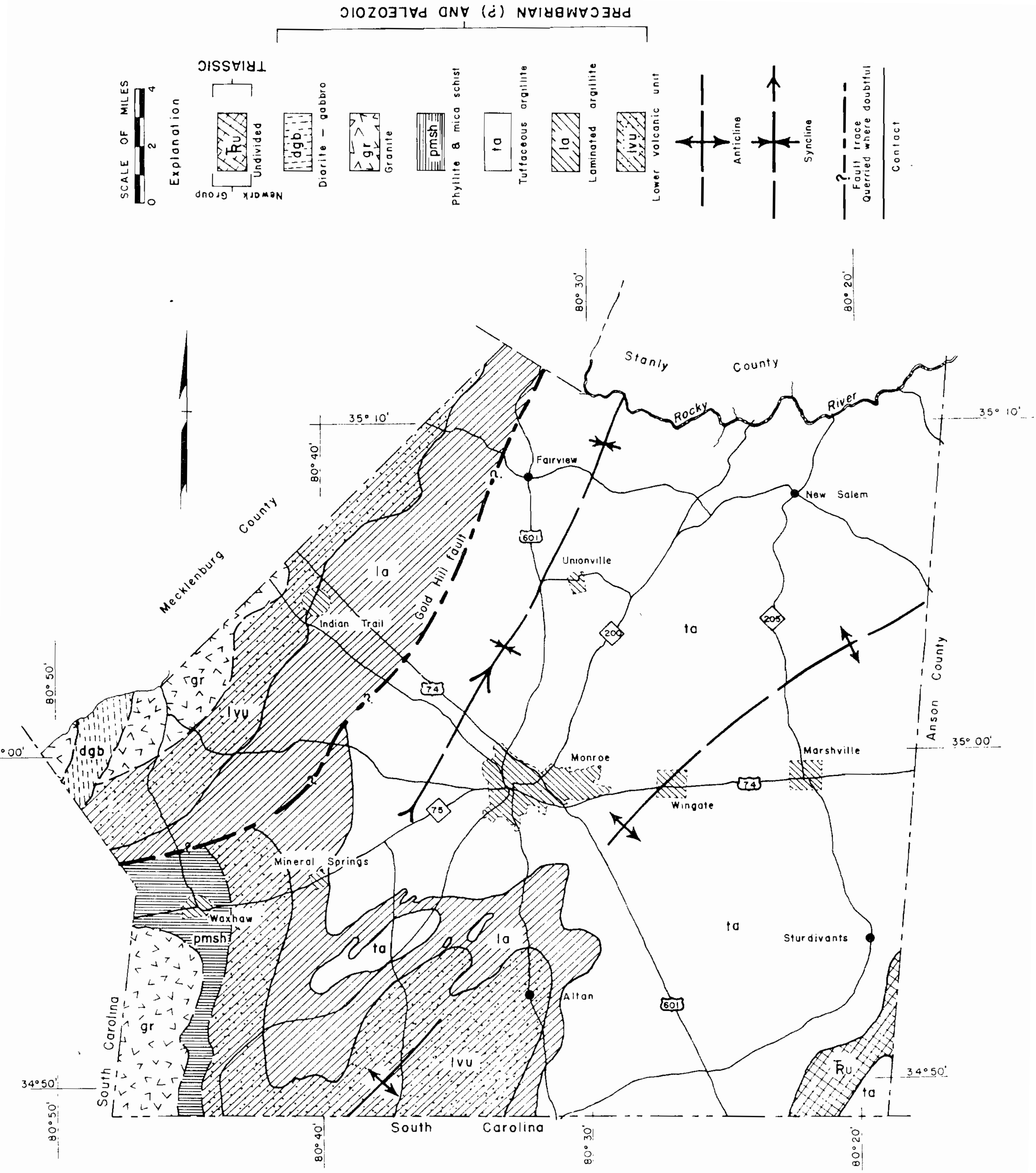
Table 16. Summary of Data for Wells in Union County

According to rock type

Type of rock	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
Granite	1	134	-	100	0.74
Phyllite and mica schist	4	225	2½-90	46	0.20
Tuffaceous argillite	87	138	½-75	11	0.08
Laminated argillite	24	114	1½-75	17	0.15
Lower volcanic unit	18	128	1-60	12	0.09
All wells	134	135	1-100	14	0.10

According to topographic location

Topographic location	No. of wells	Average depth (feet)	Yield (gallons per minute) Range	Average	Per foot of well
Hill	82	129	3/4-75	14	0.11
Flat	17	169	½-100	15	0.09
Slope	14	105	1-14	6	0.06
Draw	5	76	5-30	14	0.18



Base map adapted from
N. C. State Highway Commission

Figure 11. Geologic map of Union County.

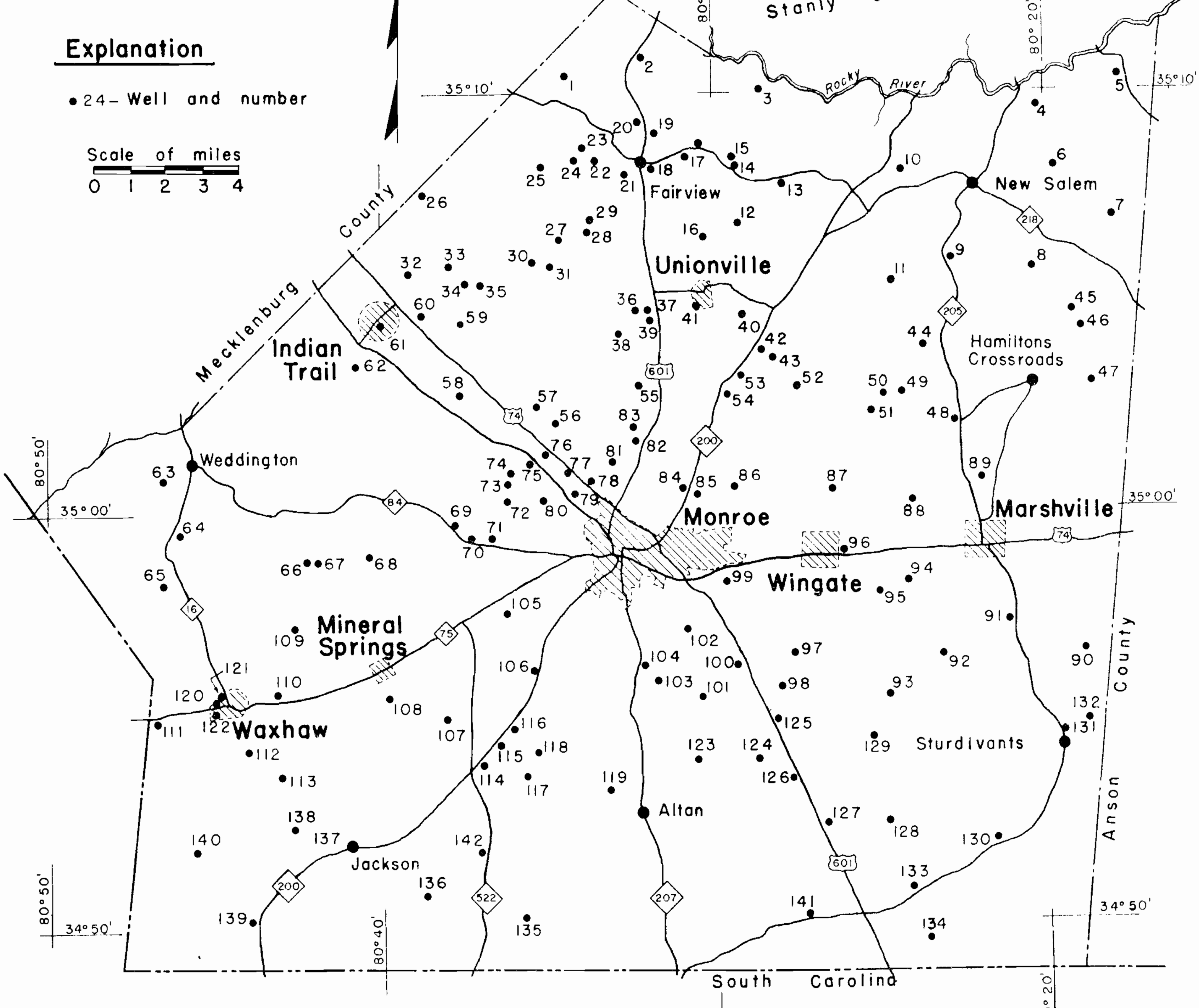


Figure 12. Map of Union County showing the location of ground-water supplies.

Base map adapted from
N C State Highway Commission

Table 17. Records of Wells in Union County

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
1	3.3 Mi. NW of Fairview	Reese G. Felk	Drilled	100	6	26	Laminated argillite	-------	40	-----	Flat	
2	3 Mi. N of Fairview	Mrs. W. T. Clontz	--do--	82	6	46	--do--	-------	10	-----	Knoll	
3	4 Mi. NE of Fairview	R. G. Brooks	--do--	74	6	25	Tuffaceous argillite	25-30	25	-----	Hill	
4	2.9 Mi. WNE of New Salem	C. C. Austin	--do--	195	6	29.5	--do--	-------	1.25	-----	Knoll	
5	5.3 Mi. NE of New Salem	J. G. Baucom	--do--	90	6	27	--do--	-------	2	-----	Hill	
6	2.4 Mi. ENE of New Salem	F. F. Rushing	--do--	186	6	20	--do--	12	5	-----	Knoll	
7	4.1 Mi. ESE of New Salem	Mrs. Hamp Brewer	--do--	116	6	31.8	--do--	35	17	-----	Hill	
8	2.8 Mi. SE of New Salem	Vance Branswell	--do--	120	6	32	--do--	-------	5	-----	Slope	
9	2.1 Mi. SSW of New Salem	G. V. Griffin	--do--	60	6	-------	--do--	-------	4-5	-----	Hill	
10	2.1 Mi. W of New Salem	Bobby H. Brock	--do--	126	6	35	--do--	-------	3	-----	Slope	
11	3.6 Mi. SSW of New Salem	Perry Brooks	--do--	104	6	127.5	--do--	-------	4.75	-----	Knoll	
12	3.0 Mi. SE of Fairview	Aubrey Haigler	--do--	120	6	21	--do--	-------	8	-----	Slope	
13	3.9 Mi. E of Fairview	D. N. Simpson	--do--	178	6	25.5	--do--	24	5	-----	Flat	
14	2.6 Mi. E of Fairview	Ellis P. Austin	--do--	41	6	18.9	--do--	-------	20	-----	Hill	
15	2.4 Mi. ENE of Fairview	Bill Austin	--do--	38	6	15	--do--	-------	20	-----	--do--	
16	2.5 Mi. SE of Fairview	Raymond L. Benton	--do--	71	6	23	--do--	-------	20	-----	Knoll	
17	1.2 Mi. ENE of Fairview	Justice P. Baucom	--do--	52	6	15.4	--do--	-------	30	-----	Draw	

Table 17. Records of Wells in Union County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
18	At Fairview	Agnes W. Connell	Drilled	92	6	35	Tuffaceous argillite	------	35	-----	Knoll	
19	1 Mi. N of Fairview	J. Labon Williams	--do--	180	6	35.5	--do--	28.3	20	-----	Hill	
20	1.3 Mi. NNW of Fairview	G. N. Thompson	--do--	300	6	26.5	--do--	------	1.5	-----	Flat	
21	0.6 Mi. SSW of Fairview	Florence Connell	--do--	124	6	10	--do--	------	8	-----	Knoll	
22	1.4 Mi. W of Fairview	Earl Duncon	--do--	98	6	32	Laminated argillite	------	20	-----	Flat	
23	1.8 Mi. WNW of Fairview	Jimmy W. Duncon	--do--	150	6	47	--do--	30	9	-----	--do--	
24	2.0 Mi. W of Fairview	Jim Fisher	--do--	330	6	40	--do--	------	1.5	-----	Hill	
25	2.9 Mi. W of Fairview	Elmer Deese	--do--	75	6	26.5	--do--	------	25	-----	--do--	
26	6.3 Mi. WSW of Fairview	J. B. Hooks	Dug	53	36	-------	Rocks of Lower volcanic unit	31.0	3	-----	--do--	
27	3.2 Mi. SW of Fairview	Mrs. A. C. Rowell	Drilled	150	6	29	Laminated argillite	------	1.5	-----	--do--	
28	2.4 Mi. SSW of Fairview	Melton D. Ormond	--do--	300	6	40	Tuffaceous argillite	------	1.5	-----	--do--	
29	2.1 Mi. SSW of Fairview	Judge Rudy	--do--	200	6	20	--do--	------	1	-----	Flat	
30	4.5 Mi. ENE of Indian Trail	J. H. Cunningham	--do--	96	6	88.75	Laminated argillite	40	20	-----	Hill	
31	4.0 Mi. SSW of Fairview	Alfred N. Price	--do--	103	6	21.5	--do--	100	32	-----	Flat	
32	1.5 Mi. NNE of Indian Trail	E. M. Strand	--do--	105	6	50	--do--	------	20	-----	Hill	
33	2.4 Mi. NNE of Indian Trail	Gene Baker	--do--	90	6	23	Rocks of Lower volcanic unit	------	12	-----	--do--	

Table 17. Records of Wells in Union County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diam-eter (in)	Depth of casing (ft)	Water-bear-ing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topo-graphy	Remarks
34	2.4 Mi. [illegible] of Indian Trail--	Grady Byrum-----	Drilled	[illegible]	6	30	Laminated argillite--	-------	10	-----	Hill----	
35	2.0 Mi. NE of Indian Trail--	Annie & Robert Long----------	--do---	[illegible]	6	20	--do----------	-------	12	-----	Flat----	
36	2.1 Mi. W of Unionville----	Troy Benton-----	--do---	[illegible]	6	[illegible]	Tuffaceous argillite--	-------	[illegible]	-----	--do----	
37	1.8 Mi. W of Unionville----	Archie Lee Fritz	--do---	[illegible]	6	[illegible]	--do----------	50	10	-----	--do----	
38	2.7 Mi. SW of Unionville----	Carl Edwards----	--do---	[illegible]	6	37.3	--do----------	-------	3	-----	Hill----	
39	1.8 Mi. SW of Unionville----	Thomas Croutch--	--do---	103	6	20	--do----------	-------	25	-----	Knoll---	
40	1.2 Mi. SSE of Unionville----	E. C. Avatin----	--do---	71	6	22.5	--do----------	28	------	-----	--------	
41	At Unionville---	Unionville Vol. Fire Dept.----	--do---	150	6	------	--do----------	17	------	------	Hill----	
42	2.2 Mi. SE of Unionville----	Calhoun Baucom	--do---	150	6	43.7	--do----------	-------	20	-----	Knoll---	
43	2.5 Mi. SE of Unionville----	Harold Brantly	--do---	50	6	24.3	--do----------	-------	5	-----	Slope---	
44	3.3 Mi. WNW of Hamiltons Cross Roads---	Ernest Roy Griffin-------	--do---	182	6	30	--do----------	-------	3	-----	Hill----	
45	2.3 Mi. NNE of Hamiltons Cross Roads---	N. E. Helms-----	--do---	150	6	40	--do----------	-------	8	-----	Slope---	
46	2.1 Mi. NE of Hamiltons Cross Roads---	Earl F. Goodman	--do---	180	6	25	--do----------	-------	1	-----	Hill----	
47	1.7 Mi. E of Hamiltons Cross Roads---	Hoyle Edwards--	--do---	300	6	31.5	--do----------	8	2	-----	--do----	
48	2.4 Mi. WSW of Hamiltons Cross Roads---	R. D. Stator---	--do---	62	6	-------	--do----------	20-30	20	-----	--do----	

Table 17. Records of Wells in Union County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diam-eter (in)	Depth of casing (ft)	Water-bear-ing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topo-graphy	Remarks
49	3.7 Mi. W of Hamiltons Cross Roads---	Fred A. Griffin	Drilled	142	6	41	Tuffaceous argillite--	25-30	35	-----	Knoll---	
50	4.2 Mi. WSW of Hamiltons Cross Roads---	Fred A. Griffin	--do----	-----	6	------	--do---------	-------	-----	-----	--------	Observation well.
51	4.6 Mi. WSW of Hamiltons Cross Roads---	George D. Brooks	--do---	93	6	21	--do---------	-------	6	-----	Slope---	
52	3.8 Mi. SE of Unionville----	Johnson Baucom---	--do---	75	6	25	--do---------	20	4	-----	Hill----	
53	2.5 Mi. SSE of Unionville----	Mrs. Buelah Traswell------	--do---	70	6	29	--do---------	-------	6	-----	Knoll---	
54	2.8 Mi. SSE of Unionville----	H. T. Baucom-----	--do---	90	6	29	--do---------	-------	6	-----	Slope---	
55	3.0 Mi. SSW of Unionville----	S. J. Mills----	--do---	203	6	24.75	--do---------	-------	1.5	-----	--------	
56	4.0 Mi. NW of Monroe--------	Floyd Fowler---	--do---	185	6	46.5	--do---------	-------	8	-----	Hill----	
57	4.6 Mi. NW of Monroe--------	Roy Dudy-------	--do---	67	6	30	--do---------	-------	20	-----	--do----	
58	3.0 Mi. SE of Indian Trail--	Howard B. Thomas	--do---	103	6	35	Laminated argillite--	30	9	-----	--------	
59	6.2 Mi. E of Indian Trail--	W. W. Richardson	--do---	100	6	31.5	--do---------	-------	1.5	-----	Knoll---	
60	1.2 Mi. ENE of Indian Trail--	Frank Conder-----	--do---	74	6	32	--do---------	-------	10-15	-----	Slope---	
61	At Indian Trail	J. H. Williams--	--do---	105	6	70	--do---------	------	75	-----	Hill----	
62	1.3 Mi. SSW of Indian Trail--	Gale Helms------	--do--	134	6	90.8	Rocks of Lower vol-canic unit--	35	30	-----	--do----	
63	1.1 Mi. SW of Weddington----	B. S. Reid------	--do---	134	6	124	Granite------	-----	100	-----	Flat----	
64	2 Mi. S of Weddington----	Mrs. Bonnie Sloan--------	--do--	195	6	36	Rocks of Lower vol-	------	1	------	Slope---	

Table 17. Records of Wells in Union County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
65	3.5 Mi. SSW of Weddington	Albert Leonards	Drilled	103	6	24	Rocks of Lower Volcanic unit	------	1	------	Ridge	
66	4.1 Mi. SE of Weddington	Fleet Harris	--do--	92	6	27	Laminated argillite	------	7-8	------	Hill	
67	4.3 Mi. SE of Weddington	Vance A. Harris	--do--	93	6	52	--do--	------	20	------	Knoll	
68	3.2 Mi. N of Mineral Springs	D. V. Harris	--do--	74	6	38.7	--do--	------	20	------	Draw	
69	4.8 Mi. WNW of Monroe	William Lee Carter	--do--	93	6	50	Tuffaceous argillite	------	6	------	Slope	
70	4.1 Mi. W of Monroe	E. F. Long	--do--	112	6	51.7	--do--	18	14	------	--do--	
71	3.7 Mi. WNW of Monroe	William J. Wolfe	--do--	119	6	45	--do--	------	4	------	------	
72	3.5 Mi. NW of Monroe	Coy Long	--do--	122	6	23	--do--	30	60	------	Hill	
73	3.7 Mi. NW of Monroe	Loy Helms	--do--	48	6	15	--do--	------	7.5	------	Draw	
74	3.9 Mi. NW of Monroe	W. L. Pressley	--do--	80	6	27.5	--do--	------	2.3	------	Hill	
75	3.6 Mi. WNW of Monroe	C. W. Privette	--do--	165	6	37	--do--	30	12	------	Knoll	
76	--do--	Marvin Brooks	--do--	67	----	40	--do--	------	10	------	Hill	
77	2.8 Mi. NNW of Monroe	Richard Austin	--do--	100	6	29.75	--do--	------	8	------	Slope	
78	2.2 Mi. WNW of Monroe	Grover Crach	--do--	87	6	22.5	--do--	------	6	------	Hill	
79	2.2 Mi. NW of Monroe	George E. Williams	--do--	200	6	22.7	--do--	------	20	------	------	
80	2.7 Mi. NW of Monroe	James L. Tucker	--do--	195	6	32.5	--do--	------	1	------	Hill	
81	2.5 Mi. N of Monroe	Dan Barbee	--do--	120	6	25	--do--	------	20	------	------	
82	3.2 Mi. N of Monroe	Andrew C. Fowler	Drilled	64	6	28	Tuffaceous argillite	------	30	------	Knoll	
83	3.5 Mi. N of Monroe	George Eubanks	--do--	63	6	25.5	--do--	------	12	------	--do--	
84	2.5 Mi. NNE of Monroe	George Taylor	--do--	165	6	27.5	--do--	------	4	------	------	
85	2.7 Mi. NE of Monroe	Cyrus F. Edwards	--do--	165	6	------	--do--	------	2	------	Knoll	
86	3.7 Mi. NE of Monroe	John J. Chaney	--do--	300	6	28.5	--do--	------	5	------	--do--	
87	1.9 Mi. N of Wingate	Norman Barbee	--do--	165	6	36	--do--	------	5	------	Hill	
88	2.3 Mi. NW of Marshville	Milton C. Austin	--do--	96	6	17.5	--do--	------	6	------	--do--	
89	1.8 Mi. N of Marshville	A. G. Deese	--do--	107	6	68	--do--	30	3	------	--do--	
90	4.1 Mi. SE of Marshville	John A. Smith	--do--	101	6	22	--do--	20-24	20	------	--do--	
91	2.3 Mi. SSE of Marshville	D. L. Case	--do--	62½	6	30	--do--	14	18	------	--do--	
92	3.3 Mi. SSW of Marshville	Boyce Haney	--do--	90	6	32	--do--	------	50	------	Ridge	
93	4.9 Mi. SSW of Marshville	John Martin	--do--	195	6	43	--do--	5	0.75	------	Hill	
94	2.3 Mi. NSW of Marshville	Ira Walden	--do--	135	6	32	--do--	20	3	------	--do--	
95	3.3 Mi. WSW of Marshville	Otis Smith	--do--	297	6	20	--do--	------	1	------	Flat	
96	0.6 Mi. E of Wingate	J. F. Williams	--do--	236	6	21	--do--	------	2.5	------	------	
97	2.7 Mi. SSW of Wingate	Hilton Brooks	--do--	300	6	30	--do--	------	2	------	------	
98	3.7 Mi. SSW of Wingate	Homer Tarlton	--do--	385	6	26.7	--do--	------	0.5	------	Flat	

Table 17. Records of Wells in Union County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
99	3.1 Mi. SE of Monroe---------	Brady L. Grissom------	Drilled	103	6	40	Tuffaceous argillite--	------	5	------	Hill----	
100	4.4 Mi. SE of Monroe---------	Ben Williams---	--do---	262	6	170	--do---------	------	6.5	------	--do----	
101	4.5 Mi. SSE of Monroe---------	C. R. Baker----	--do---	130	6	31.5	--do---------	21	5	------	Slope---	
102	2.8 Mi. SSE of Monroe---------	John T. Edwards	--do---	73	6	46	--do---------	------	6	------	Hill----	
103	3.7 Mi. SSE of Monroe---------	Unknown--------	--do---	30	4	-------	Laminated argillite--	12.1	-----	------	--do----	
104	3.2 Mi. S of Monroe---------	Sam Hart-------	--do---	180	6	-------	--do---------	35	7	------	--do----	
105	3.6 Mi. SW of Monroe---------	Earl Broom-----	--do---	122	6	36	--do---------	------	6	------	Draw----	
106	4.1 Mi. SW of Monroe---------	George A. Blackwell----	--do--	98	6	65	--do---------	------	5	------	Flat----	
107	2.2 Mi. SE of Mineral Springs	Kenneth A. Bingham------	--do--	127	6	32	--do---------	------	5	------	Hill----	
108	0.8 Mi. SSE of Mineral Springs	J. D. Coble----	--do--	82	6	-------	--do---------	------	5	------	Draw----	
109	2.7 Mi. NW of Mineral Springs	Ovie Helms-----	--do--	199	6	86	Rocks of Lower volcanic unit--	30	60	0	Hill----	
110	3.2 Mi. WSW of Mineral Springs	Jimmy G. Carpenter-----------	--do--	150	6	52	--do---------	------	2.5	------	--do----	
111	2.2 Mi. WSW of Waxhaw---------	Ihrett R. Simpson------	--do--	150	6	108	Phyllite & mica schist-----	------	2.5	------	--do----	
112	1.4 Mi. SSE of Waxhaw---------	Church---------	Dug---	------	60	-------	--do---------	18.62	-----	------	Flat----	
113	2.5 Mi. SE of Waxhaw---------	Ervin Massey---	Drilled	125	6	-------	Rocks of Lower volcanic unit--	35	12	------	Hill----	
114	3.8 Mi. SE of Mineral Springs	Claude C. Broom	--do---	94	6	68	--do---------	33	6-7	------	--do----	

Table 17. Records of Wells in Union County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
115	3.8 Mi. SE of Mineral Springs	Bundy Belk-----	Drilled	128	6	105	Rocks of Lower volcanic unit--	40	20	------	Hill----	
116	3.9 Mi. ESE of Mineral Springs	W. I. Helmer---	--do---	[illegible]	6	-------	--do---------	40	6	------	--do----	
117	5.0 Mi. SE of Mineral Springs	Charles H. Biggers-------	--do---	76	6	-------	--do---------	------	12	------	--do----	
118	4.8 Mi. SE of Mineral Springs	Evelyn Cleaton--	--do---	105	6	55.5	Laminated argillite--	------	30	------	--do----	
119	1.2 Mi. NW of Alton---------	Morrison Cowick	--do---	100	6	58	Rocks of Lower volcanic unit	------	12	------	Flat----	
120	At Waxhaw--------	Town of Waxhaw #1-----------	--do--	250	8	80.5	Phyllite & mica schist-----	------	50	------	Slope---	
121	--do-------------	Town of Waxhaw #2-----------	--do--	200	8	84.5	--do---------	------	40	------	--do----	
122	--do-------------	Town of Waxhaw #3-----------	--do--	301	6	67	--do---------	25	90	------	--do----	
123	2.2 Mi. NE of Alton---------	Bruce Thomas---	--do--	85	6	28	Laminated argillite--	------	20	------	Hill----	
124	3.5 Mi. ENE of Alton---------	J. L. Baker----	--do--	125	6	34	Tuffaceous argillite--	------	7	------	--do----	
125	4.5 Mi. NE of Alton---------	Johnie P. Aycock	--do--	76	6	41.5	--do---------	------	10	------	--do----	
126	4.3 Mi. ENE of Alton---------	Willard Starnes	--do--	303	6	20	--do---------	------	1.5	------	Flat----	
127	5.2 Mi. ESE of Alton---------	Zeb M. Thomas--	--do--	125	6	59	--do---------	------	4	------	Hill----	
128	5.5 Mi. SW of Sturduvants---	George A. Rushing----------	--do--	122	6	28.5	--do---------	------	5	------	Flat----	
129	5.5 Mi. W of Sturduvants---	John T. Deese--	--do--	105	6	33	--do---------	------	3	------	Hill----	
130	3.3 Mi. SSW of Sturduvants---	Mott Walters---	--do--	165	6	70	--do---------	------	1.5	------	Flat----	

Table 17. Records of Wells in Union County (Continued)

Well No.	Location	Owner	Type of Well	Depth (ft)	Diameter (in)	Depth of casing (ft)	Water-bearing material	Water level (ft)	Yield (gpm)	Draw-down (ft)	Topography	Remarks
131	0.5 Mi. N of Sturduvants---	Clyde Rushing--	Drilled	65	6	56	Tuffaceous argillite--	25	6	------	Flat---	
132	1.0 Mi. NNE of Sturduvants---	J. L. Griffin, Jr.----------	--do--	[illegible]	6	40	--do---------	18	6	------	Hill---	
133	5.9 Mi. SW of Sturduvants---	W. T. Simpson--	--do---	[illegible]	6	80	--do---------	10	5-6	------	--do---	
134	6.7 Mi. SW of Sturduvants---	Richard Dennis	--do---	101	[illegible]	51.7	--do---------	------	75	------	--do---	
135	4.5 Mi. SSW of Alton---------	Jack Baker------	--do---	75	6	49	Rocks of Lower volcanic unit	------	9	------	Knoll--	
136	2.5 Mi. ESE of Jackson-------	Kenneth Carter	--do---	[illegible]	6	67.5	--do---------	------	25	------	Hill---	
137	0.9 Mi. W of Jackson-------	D. F. Hubbard--	Dug---	30	36	-------	--do---------	20	------	------	-------	
138	1.8 Mi. WNW of Jackson--- ---	--do-----------	Drilled	139	6	-------	--do---------	69	2	------	-------	
139	3.5 Mi. SW of Jackson-------	F. W. Staton---	--do--	33	6	-------	--do---------	12	5-6	------	Slope--	
140	4.5 Mi. W of Jackson-------	Walkup Plantation---------	Dug---	------	48	-------	Granite------	[illegible]	-----	------	-------	
141	5.5 Mi. SE of Alton---------	Beulah School--	Drilled	------		------	Tuffaceous argillite--	[illegible]	-----	------	Flat---	
142	3.6 Mi. E of Jackson-------	Billie D. Whitley------	--do--	200	6	31	Rocks of Lower volcanic unit	------	3	------	-------	

Table 18. Chemical analyses of ground water from Union County

(Well numbers correspond to well numbers in table of well data)

Parts per million

Well No.	Date of Collection	Silica (SiO_2)	Iron (Fe) in Total	Calcium (Ca)	Magnasium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as ($CaCO_3$)	PH	Water Bearing Material
1	11/61	------	.13	37	42	18	.3	218	6.6	79	-------	266	7.5	Laminated argillite-------
9	1/62	------	3.5	25	6.5	8.8	.6	54	61	1.3	.2	90	6.3	Tuffaceous argillite------
26	11/61	------	.28	2.6	.5	7.5	.3	24	3.2	3.6	-------	8	6.1	Rocks of Lower volcanic unit-------------------
38	11/61	------	.04	8.0	6.3	14	.7	26	12	23	-------	46	6.1	Tuffaceous argillite-----
41	1/62	------	.07	9.9	3.5	7.5	.1	34	2.8	7.5	15	39	6.4	--do---------------------
60	11/61	------	.06	5.6	2.7	5.0	.2	33	4.2	2.0	-------	25	6.4	Rocks of Lower volcanic unit
61	11/61	------	.02	7.7	1.8	7.1	2.2	46	2.4	1.8	-------	26	6.6	Granite------------------
64	11/61	------	.01	58	10	10	.5	220	5.4	8.4	-------	166	7.3	Laminated argillite-------
87	1/62	------	.07	75	26	15	.4	177	106	55	.1	295	7.2	
91	1/62	------	1.1	32	8.1	13	.6	68	39	22	.4	113	6.6	Tuffaceous argillite-----
103	11/61	-------	.06	11	8.2	15	.3	22	3.0	88	-------	62	6.0	Laminated argillite------
112	11/61	------	.09	6.7	2.3	7.3	1.8	49	4.2	2.6	-------	26	6.4	Rocks of Lower volcanic unit--------------------
120	7/49	44.	.58	13.	4.5	12	-------	63	1.8	15	1.9	51	6.4	Phyllite & mica schist --
121	7/49	35.	.27	11.	4.2	9.5	-------	69	3.5	3	.3	45	6.6	--do---------------------
122	3/62	41.	.19	11.	4.5	8.6	1.1	64	5.0	4	2.1	46	6.5	--do---------------------
129	1/62	------	.02	19	4.8	4.4	.1	79	6.0	3.5	1.6	68	6.7	Tuffaceous argillite------
131	11/62	------	.16	20	12	12	1.1	130	2.8	11	-------	98	6.9	Rocks of Lower volcanic unit------------------
135	11/61	.28	4.6	2.4	7.8	.7	-----	36	1.0	4.2	-------	22	6.2	Rocks of Lower volcanic unit------------------

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