

Issued June 18, 1914.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE NORTH CAROLINA DEPARTMENT OF AGRICULTURE,
W. A. GRAHAM, COMMISSIONER; B. W. KILGORE, STATE CHEMIST
AND DIRECTOR TEST FARMS.

SOIL SURVEY OF PENDER COUNTY,
NORTH CAROLINA.

BY

W. EDWARD HEARN, LEWIS A. HURST, AND R. B. HARDI-
SON, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND
L. L. BRINKLEY AND S. O. PERKINS, OF THE
NORTH CAROLINA DEPARTMENT OF AGRICULTURE.

W. EDWARD HEARN, INSPECTOR SOUTHERN DIVISION

[Advance Sheets—Field Operations of the Bureau of Soils, 1912.]



WASHINGTON:
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1914.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,

Washington, D. C., November 8, 1913.

SIR: In the extension of the soil survey in the State of North Carolina work was undertaken in Pender County. This work was done in cooperation with the North Carolina Department of Agriculture, W. A. Graham, commissioner, and the selection of this area was made after conference with State officials.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1912, as authorized by law.

Very respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Pender County sheet, North Carolina.

SOIL SURVEY OF PENDER COUNTY, NORTH CAROLINA.

By **W. EDWARD HEARN, LEWIS A. HURST, and R. B. HARDISON**, of the U. S. Department of Agriculture, and **L. L. BRINKLEY and S. O. PERKINS**, of the North Carolina Department of Agriculture.

DESCRIPTION OF THE AREA.

Pender County, N. C., is in the southeastern part of the State, bordering the Atlantic Ocean for a distance of more than 12 miles. It is bounded on the north by Duplin County, on the west by Sampson and Bladen Counties, on the south by Columbus, Brunswick, and New Hanover Counties, and on the east and southeast by Onslow

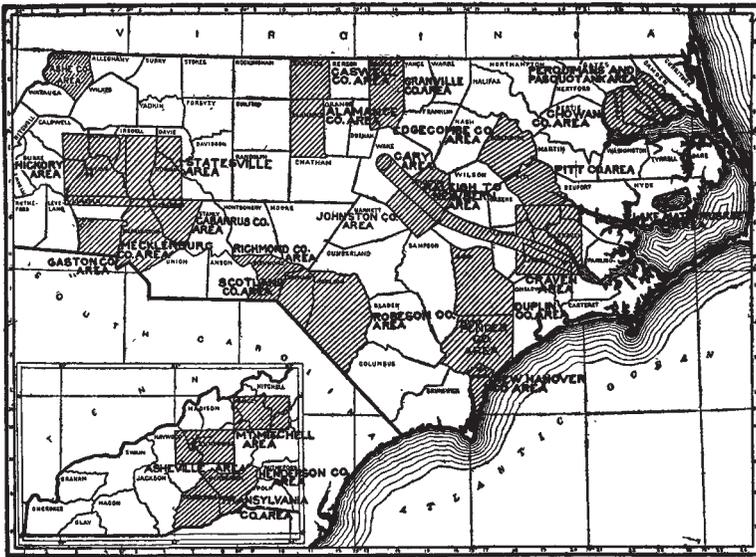


FIG. 1.—Sketch map showing areas surveyed in North Carolina.

County and the Atlantic Ocean. The county has a somewhat irregular outline, parts of the southwestern, southern, and northern boundaries being formed by the Cape Fear River, the Northeast Cape Fear River, and Rock Fish Creek, respectively. The county is about 25 miles across from north to south and 43 miles from east to west. It contains 857 square miles, or 548,480 acres. The line between Pender and Onslow Counties is in dispute and it is located on the soil map according to the best information obtainable.

Pender County has a level to undulating or gently rolling surface, and includes areas of swamp and ridges and knolls of sand. The topography is generally uniform. Angola and Holly Shelter Bays comprise a large part of the northeastern and eastern sections of the county. The county includes broad areas of high, level land, such as the savannas west of St. Helena, Burgaw, and Van Eden, and to the northwest of Willard. In the vicinity of Willard, Watha, Burgaw, Atkinson, Currie, and in many other places there are level or undulating to gently rolling areas which become somewhat more rolling as the streams are approached. The flat bottom lands and swamp areas extend along the rivers and larger creeks. The largest of these occur along the Cape Fear River and the southern part of the Northeast Cape Fear River. In the western, southern, and extreme eastern parts of the county and also along the Northeast Cape Fear River low ridges and knolls are of frequent occurrence. The larger streams between Burgaw and Willard flow through comparatively deep channels, having rather steep banks in some places. Along the rivers and larger creeks there are some prominent bluffs which are used as boat landings.

At a short distance to the east of Burgaw and Rocky Point there is a noticeable bluff line, and all the country between this bluff and the Northeast Cape Fear River, on account of its uniformly flat surface, has every appearance of being a second-bottom area which might have been formed by the river. While this is quite possible, the area is most likely a marine terrace.

The county has a gradual slope to the south and southeast. The highest elevations are in the northwest. At Atkinson the elevation is 63 feet; at Willard 51, and at Castle Hayne, just across the southern boundary, it is 20 feet. The southward slope of Angola Bay is from 1 to 3 feet to the mile, the elevation being 32 feet on the northern boundary of the county and 16 feet near Crooms Bridge.

Pender County is well situated for general farming. Its one great need is adequate drainage, and its position above sea level is favorable to its reclamation.

The most important problem over a greater part of Pender County is that of the drainage of the land at low cost. Through the establishment of several drainage districts large outlet canals, such as that in the Canetuck section, could be so constructed that the individual landowners could, by digging small ditches, drain their lands into these canals. There is no natural surface drainage in Angola and Holly Shelter Bays, and practically none in the savanna areas and the Portsmouth types. Most of the small streams have their origin at the borders of these areas. Much of the Swamp type as

mapped is covered with fresh tidewater, and no drainage of such areas can be established at any reasonable cost.

The Northeast Cape Fear River enters the county near the middle of the northern boundary and flows in a general southerly direction across the county to the New Hanover County line and thence westerly along this line for a short distance, turning south from the county. The Cape Fear River flows along the southwestern border for a distance of several miles. The Black River follows a southeasterly course across the western end of the county, joining the Cape Fear just before the border of the county is reached. The Wilmington & Norfolk Branch of the Atlantic Coast Line Railroad passing through Burgaw approximately marks the divide of the drainage of the county. Practically all of the area to the east of this railroad is drained by the Northeast Cape Fear River and by its tributaries, including Rock Fish, Burgaw, Angola, Moores, Holly Shelter, Shaken, Merricks, and Harrison's Creeks. To the west of this railroad the Cape Fear and Black Rivers, together with Long, Moores, Colvins, Rileys, Turkey, Sills, and Sawyers Creeks, furnish the drainage outlets.

Pender County was established about 1876 from a part of New Hanover County. Settlement began in this region prior to the Revolutionary War. Most of the settlements seem to have been made near the navigable streams. The population of the county is given in the 1910 census as 15,471. In 1900 it is reported as 13,381, and in 1890 as 12,514. The white population is largely of English descent, with a few Scotch. There is a colony of about 500 Italians at St. Helena, and several Dutch families at Van Eden. There is a large colored population, centered mainly around Burgaw and the sawmills in the county.

Probably not more than 15 per cent of the total land area in Pender County is under cultivation. There is much good land in the county which could be drained easily and used for farming, and with comprehensive drainage systems to reclaim the large tracts of swampy lands the county could support many times the present population. The most thickly settled sections are around Rocky Point, Maple Hill, Willard, Atkinson, Currie, Burgaw, Watha, St. Helena, and along the sound. Between Maple Hill and the Wilmington & Newbern Railroad, including Holly Shelter Bay and Angola Bay, and throughout the savanna areas there are no inhabitants. This is due mainly to the poor drainage, but in part to the low productiveness of the soils.

Burgaw, the county seat, situated near the center of the county, is the principal town. It has a population of about 1,000. Rocky Point is the next largest town in the county, and Atkinson, Watha, Willard, Hampstead, and Currie are also important towns.

The transportation facilities of Pender County are very good. Three branches of the Atlantic Coast Line Railroad from Wilmington cross the county. The Wilmington & Norfolk Branch extends through the middle of the county, the Wilmington & Newbern Branch parallels the coast in a northeasterly direction, and the Yadkin division crosses the western end of the county in a northwesterly direction. Solid express trains and refrigerator trains are operated during the trucking and shipping season. Burgaw and Rocky Point are within 36 hours of New York and nearer to other good markets. The Cape Fear, Black, and Northeast Cape Fear Rivers, and Long and a few other creeks are navigable, much timber and freight being transported on these waters. Competing water freight rates can be obtained from many points in the county to Wilmington, and from there the merchandise can be transported up the streams into the county. The railroads and the navigable streams together afford ample facilities for the transportation of all products.

Some attention is being given to the construction of public roads through a part of the county. Good roads can be built at very small expense throughout most of the county, as the character of the soil is such that by ditching on both sides and throwing the sandy clay into the middle of the road, rounding it off gently so as to allow good surface drainage, an excellent roadbed is secured. The rural delivery of mail is in operation over the greater part of the county. Telephone lines are in use in some sections. The farm houses are generally well built and kept in good condition, and good schoolhouses and churches are supplanting the older structures. Much improvement has taken place in the county during the last few years. Up-to-date farm machinery is being more extensively used. One of the test farms of the North Carolina department of agriculture is located just north of Willard.

Burgaw and the other towns afford good markets for cotton and farm produce. Practically all of the truck crops are shipped to northern markets, mainly to New York, Philadelphia, Baltimore, and Washington. Peanuts are shipped to Wilmington. The commission merchants send their buyers into the county during the shipping season and purchase the various products from the farmers at the railroad stations.

CLIMATE.

The figures in the following table, compiled from the records of the Weather Bureau station at Wilmington, New Hanover County, about 20 miles from the center of Pender County, are indicative of the general climatic conditions of this county:

Normal monthly, seasonal, and annual temperature and precipitation at Wilmington, New Hanover County, N. C.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	49	78	10	3.1	3.3	7.1	0.1
January.....	47	80	9	3.6	1.4	2.4	0.1
February.....	49	80	5	3.4	3.3	1.6	1.0
Winter.....	48			10.1	8.0	11.1	1.2
March.....	55	87	20	3.6	3.6	4.5	0.1
April.....	61	90	28	2.8	1.6	6.6	0.0
May.....	70	97	38	4.0	2.3	2.4	0.0
Spring.....	62			10.4	7.5	13.5	0.1
June.....	77	100	51	5.6	3.2	7.5	0.0
July.....	80	103	58	6.7	3.0	9.4	0.0
August.....	79	99	56	7.0	2.4	10.5	0.0
Summer.....	79			19.3	8.6	27.4	0.0
September.....	74	96	42	5.4	3.6	20.1	0.0
October.....	64	92	32	3.9	3.2	6.7	0.0
November.....	55	83	20	2.4	3.8	4.9	T.
Fall.....	64			11.7	10.6	31.7	T.
Year.....	63	103	5	51.5	34.7	83.7	1.3

There is an annual mean temperature of 63° F., with extremes from 5° to 103°, while the annual rainfall averages 51.5 inches, with a precipitation of about 35 inches during the driest and about 84 inches during the wettest year recorded. The rainfall is well distributed for plant growth, being heaviest during June, July, and August. The snowfalls are light and usually of short duration. The average date of the first killing frost in the autumn is November 15, and of the last in the spring March 27. The date of the earliest killing frost recorded in the fall is October 16 and the latest in the spring May 1.

The climate of Pender County, which borders the seacoast, is more favorable for agriculture than that of the near-by interior counties. The winters, as a rule, are not very cold, and the summers are not excessively hot. The sea breezes temper the heat of the summer months. The wind is prevailingly from the southeast.

The climate is such that a large variety of crops can be grown, and from two to three crops may be made annually. It is well suited to

winter cover crops, and cattle can be grazed practically the entire year. The substitution of bored and driven wells for the earlier dug wells of shallow depth is improving the healthfulness of this section.

AGRICULTURE.

The first crops grown in the region about Pender County were corn, sweet potatoes, peas, and some wheat and oats. A little rice was grown, but never on as extensive a scale as in New Hanover County. Even before the Civil War peanuts were grown along the coast. Cattle, hogs, and sheep were raised. A large part of the county was forested with longleaf pine, and the production of naval stores early became important. Turpentine was begun about 1868 and continued on a large scale until 1885, attaining its highest development about 1875. The rosin industry was also important for a time, and following the turpentine and rosin industries lumbering began to assume some importance. The logs were rafted down the Northeast Cape Fear River and other streams into the Cape Fear River and thence on to Wilmington, where they were sawed. These occupations were profitable, as the cheapness of lands permitted large individual holdings. Some revenue was derived from fish and oysters. The growing of cotton did not become important until about 1880.

The 1880 census reports a production of 159,064 bushels of corn, 2,269 bushels of oats, 835 bales of cotton, 248,622 pounds of rice, 116,559 bushels of sweet potatoes, and 7,851 bushels of cowpeas in Pender County. By 1900 the production of corn had increased considerably, while the production of oats had materially declined. Cotton had also declined, and rice was not grown at all. A large quantity of peanuts was produced, in addition to some beans, peas, tobacco, sorghum, and other crops of minor importance.

According to the census of 1910, 197,925 bushels of corn were produced from 15,292 acres, 188,826 bushels of sweet potatoes from 1,999 acres, 161,354 bushels of peanuts from 5,305 acres, 1,271 bales of cotton from 2,233 acres, 14,973 bushels of Irish potatoes from 214 acres, and 19,600 pounds of tobacco from 23 acres. The production of peas and sorghum is also of some importance. The growing of strawberries and other truck crops has developed rapidly during the last 15 years.

Perhaps no county in North Carolina has a greater diversification of crops than Pender County. In addition to the staple crops, many truck crops are grown, which bring in money at a season of the year when it is most needed by the farmers. Cotton is the staple and money crop and is grown extensively. Corn is grown in all parts of the county, and has a larger total acreage than any other crop. Peanuts, which are grown in large quantities along the sound and east

of Rocky Point, are also a good money crop. Bright tobacco is grown to only a small extent, but the soil, climate, and the price received favor an increase in its production. The first tobacco was planted in 1890. Strawberries constitute the leading truck crop, while lettuce and a few tomatoes and radishes are also grown. Most of the strawberries, cucumbers, and beans are grown in the Rocky Point section, which has attained a wide reputation for the production of excellent berries. Sweet potatoes are grown in all parts of the county with good results. Watermelons, cantaloupes, Scuppernong and Misch grapes, peaches, apples, and all kinds of garden vegetables are produced successfully. Some oats and chufas and a large quantity of cowpeas are grown annually.

Strawberries are the main truck crop. Most of the berries are grown around Rocky Point, and smaller quantities in the vicinity of Burgaw, St. Helena, Watha, and Willard. The principal varieties grown at present are the Thompson, Heflins, and Klondike. The Missionary is being grown to some extent and is giving good results. The Thompson is the standard for the Rocky Point section. The soils having dark-gray and black fine or very fine sandy loam surface with yellow and gray subsoils are best suited for strawberries. The plants are either set in July or August for summer setting or the last of March for spring setting. If set in summer about 14,000 plants are commonly put on an acre; if set in spring only 5,000 are necessary. The 5,000 plants set in spring will require working during the summer, but the crop of berries the following spring will be nearly double that of the summer setting, and besides the plants will spread to a full stand and equal the 14,000 plants set in summer. The rows are usually 3 feet apart. It is a crop that requires heavy fertilization and considerable care. Many of the farmers buy a complete fertilizer, say 4-4-8, and use 1,000 pounds per acre. This is given in two applications—one-half in the fall and one-half in February. Some apply lime at the rate of 1,000 pounds per acre. A few growers mix their fertilizer, using cottonseed meal, kainit, and acid phosphate. Three crops of berries are sometimes obtained from one setting, but the more usual plan is to plow the beds up after two crops are harvested. After berries, corn or sweet potatoes are the crops usually planted. The vines are plowed under in May, which gives time for a crop of corn the same season. The summer setting usually yields from 80 to 100 crates in the following spring, while the spring setting produces from 100 to 140 crates.

Lettuce, while grown only to a limited extent, is an important crop. Experience has shown that the best soils for the production of this vegetable are the well-drained areas of the Norfolk fine sandy loam and Norfolk fine sandy loam, deep phase. The seed is sown between the

middle of September and the middle of October. The plants are transplanted in rows 1 foot apart, being set 10 inches in the rows between November 1 and December 1. Before the plants are set the soil is plowed, thoroughly pulverized, manured, and a ton of fertilizer analyzing 7-5-9 is added per acre and well mixed in the soil. When the plants are about half grown another application of the same kind of fertilizer is used as a top dressing. If the lettuce does not respond freely to these fertilizers 100 pounds of nitrate of soda is also given.

The plants receive frequent and shallow cultivation with hand implements. Most of the beds or fields of lettuce are covered in winter with cotton cloth or canvas. The cost of this cover, including the boards and slats, is \$500 an acre. This cover, however, lasts for five or six years. The yearly cost of production, counting cover and fertilizer and also labor, is around \$250 per acre. An acre of lettuce will return from \$600 to \$1,000, depending on the yield and price.

Irish potatoes for early shipment yield from 40 to 100 barrels per acre and sell anywhere from \$2 to \$7 a barrel. These are fertilized with 1,200 to 2,000 pounds of a 4-4-8 fertilizer.

String beans, another truck crop grown to some extent, yield from 30 to 75 baskets per acre, selling at \$1 to \$2.50 a basket. This crop annually receives from 600 to 800 pounds of 4-4-8 fertilizer and satisfactory results are obtained.

Cucumbers produce from 150 to 300 baskets per acre and sell at from \$1 to \$1.50 per basket. These are also fertilized with 600 to 800 pounds of 4-4-8 fertilizer. The bulk of these truck crops is grown in the vicinity of Rocky Point.

Peanuts are a splendid crop and one which can be grown without much care, with light fertilization, and with a minimum expenditure for labor. The two essential requirements of the soils for the production of paying crops are good drainage and a sufficiency of lime. The Norfolk soils need lime for this crop and some fertilizer. A fertilizer analyzing 8-2-10, applied at the rate of about 200 pounds per acre, is used. In some of the Pender soils where the limestone is nearer the surface no lime or fertilizer is necessary. The yields range from 25 to 75 bushels per acre, depending on the variety, soil, and fertilization. The Virginia, North Carolina, and Spanish are the main varieties. The North Carolina brings the best price, while the Virginia is the heaviest yielder. It requires more lime for the Virginia than for the North Carolina variety. The Spanish variety is the hardiest and will grow best under all conditions. The peanut vines are used for roughage and these make an excellent hay, which is relished by the stock.

A large number of cattle and hogs, together with a few sheep and goats, are raised. These roam at large over the county, except in the Rocky Point section, where the stock law applies. Some oystering and fishing are carried on along the coast, the products being shipped from Hampstead.

The well-drained sandy loam, fine sandy loam, and very fine sandy loam of the Norfolk series are admirably suited to the production of Irish potatoes, tobacco, peanuts, corn, cotton, oats, forage crops, garden vegetables, Scuppernong and Misch grapes, peaches, and pecans. The Portsmouth sandy loam, fine sandy loam, and very fine sandy loam are, when well drained, adapted to corn, cotton, Spanish peanuts, oats, cucumbers, cabbage, onions, and especially to strawberries. The Parkwood soils are well suited to peanuts, cotton, beans, Irish potatoes, corn, and vegetables. The truck crops, as a rule, are well cultivated. In general farming much of the land, particularly the heavier types, is plowed too shallow.

Most of the truck crops are grown during late winter and early spring and gathered in time for a staple crop to be grown during the summer, and frequently another in the fall. In this way the land can be made to produce from two to three crops annually. Corn is a good crop to follow Irish potatoes and beans. Some farmers grow cotton after beans and before potatoes. Peanuts and corn are good crops to alternate, allowing the hogs to harvest the nuts. A successful 3-year rotation consists of oats, sowing vetch the first year, second year corn and cowpeas, and the third year cotton. Bur clover and crimson clover are good winter cover crops, being sown in September. These crops mature about the first or the middle of May, and where turned under in the spring increased yields of corn are secured.

The difficulty of securing labor for farm work is becoming greater every year. Formerly there were plenty of farm hands, but there has been a general movement to the towns during recent years, and many of the colored hands are employed at the sawmills, where they receive higher wages than the farmers can afford to pay. Most of the farm labor now is drawn from the negro population. The laborers are paid \$20 a month and given a house to live in. Where hired for short periods they receive \$1 a day. For picking cotton, from 50 cents to \$1 a hundred pounds is paid, the higher price prevailing near the close of the season. Strawberries and beans are picked at so much per quart or crate.

According to the 1910 census, 1,637 of the 1,938 farms of the county are operated by the owners. On the remainder of the farms the tenant system generally prevails. The landowner furnishes the stock, feed for stock, and implements and receives one-half of the crop. Some owners furnish the land and all of the fertilizer used

and receive half of the crop produced. Occasionally strawberry and truck land is rented for cash, and to the east of Rocky Point land for general farming purposes is rented for about \$5 an acre. In a few cases land is rented for one-third to one-fourth of the crops produced, the trucker furnishing everything except the land.

In the early history of the county large holdings of 800 to 3,000 acres or more, generally near the navigable streams, were common. The 1910 census reports the average size of the farms in Pender County as 134.6 acres.¹ Most of the truck farms are small, some containing only 15 to 20 acres. In exceptional cases farms comprise 1,000 acres or more. Of the 266,974 acres in farms, 51,885 acres are improved.

Land values in Pender County vary widely, ranging from \$2 to \$100 an acre. The bay land and some of the Leon sand can be purchased at very low prices. The highest priced land is that near Rocky Point and Willard, where the best improved land is held at about \$100 an acre. According to the 1910 census the average value per acre of land in Pender County is \$7.80.

Several general needs of the soils of Pender County may be referred to. The light color of the Norfolk soils indicates a deficiency of organic matter. The incorporation of this constituent either by growing and turning under leguminous crops or by applying barnyard manure is highly beneficial. As there is an abundant supply of pine needles, which make excellent bedding for stable or barnyard, large quantities of manure can be made on the farms. All of the heavy soils of the county need deeper plowing and more thorough pulverization than they now receive before the crops are planted. It is generally necessary in the cultivation of crops to give considerable attention to moisture conditions and to the destruction of weeds and grasses. When the seed bed has been properly prepared, shallow and frequent stirring of the soil gives best results in that the dust mulch serves to hold the moisture and the tender feeding roots of the plants are not broken. The soils of Pender County occupy such favorable topographic positions and, as a rule, are of such friable character that modern farm machinery can be used extensively. One of the first requirements for the production of good crops is to have a well drained, warm soil, and this condition can be secured as a rule by open ditches or tile drains. Where stumps are left in the field they not only take up space but interfere materially with cultivation.

The soils of the county are capable of producing corn, oats, and cowpea hay in more than sufficient quantities for local use, and there is no reason why the farmers should continue to import these

¹The census tabulated each tenancy as a farm.

products. The most certain form of agriculture is that based on a rotation including a leguminous crop and a variety of farm crops, so that if the season is adverse to one crop the others will provide some revenue. Great improvement could be made in the live stock by giving greater attention to breeding and keeping the animals in pastures instead of permitting them to run at large, intermixing with scrub cattle.

The natural advantages of Pender County have never been fully appreciated, and only a beginning has been made in developing the agricultural resources. Cheap lands of good quality, a mild climate, and accessible markets make the county an excellent region for farm investments, particularly for the man of small capital wishing to take up the production of some of the more intensively cultivated crops.

SOILS.

Pender County lies wholly within the Coastal Plain region of North Carolina. The Postpliocene deposits¹ cover this section. Formations of Eocene age lie only a few feet below the surface in the vicinity of Rocky Point, eastward to Lanes Ferry, and in a few other localities in the eastern part of the county. Limestone rock outcrops on the west side of the river at Lanes Ferry, and underlies the country between the Ferry and Rocky Point. The limestone was formerly quarried near the Ferry and shipped by water to various points for building material. Evidences of greensand are noticeable in a few places in deep stream cuts in the east-central part of the county. This material is not rich enough in its elements of plant food nor does it occur in sufficient quantities to be worked as a source of fertilizer. Throughout the eastern half of the county beds of marl are of frequent occurrence. The most prominent of these are in the vicinity of Maple Hill, Lillington Estate, and west of Lanes Ferry. This marl is commonly encountered at 2 to 5 feet below the surface, the bed ranging from 3 to 8 feet in thickness. It is mainly a friable white shell marl, containing from 20 to 90 per cent of lime. Some blue marl is also encountered. In these areas there are many old pits, showing where the marl has been dug in former times for use in the fields. Some of it is now dug and spread on the land with beneficial results. At a short distance northwest of Lanes Ferry the marl and limestone are encountered at a depth of only a few inches. Underlying the Norfolk soils, particularly near Burgaw, a fairly good brick clay is encountered.

¹Kerr's Geology of North Carolina.

The soils of Pender County are derived from the unconsolidated sands, clays, and gravel of sedimentary origin which were brought down from the Piedmont and Appalachian regions and deposited when the present area was a part of the sea floor. This material has been more or less altered by stream, wave, and wind action, and through organic agencies.

Twenty-three soils are mapped in Pender County. The classification of the different types is based primarily upon differences in topography, drainage, color of the soil and subsoil, texture and structure, crop adaptation, and process of formation. In Pender County there are two extensive and important soil series, the Norfolk and the Portsmouth. The Parkwood series is also prominent, but the types constituting it occupy a comparatively small total area.

The Norfolk series comprises the soils having gray to light-colored surface soils, underlain by yellow sandy clays and sands. These occupy level to rolling areas and are the best drained soils in the area.

The Portsmouth soils are derived from the same materials as the Norfolk, but have been modified by very different conditions since emergence from the sea. They occupy flat areas in the uplands that have been in a semiswampy condition for a long time, thus favoring the accumulation of large quantities of vegetable matter, which is one of the features that distinguish these from the Norfolk soils. The swampy condition has also prevented weathering through aeration. The soils are dark gray to black, with gray mottled with brown and yellow sandy clay or sand subsoils.

The main distinguishing feature of the Parkwood series is the underlying limestone and marl material which influences the subsoils of these types.

The large areas of Muck which occupy Angolæ and Holly Shelter Bays have resulted from the decay of vegetable matter. The Congaree silt loam and Swamp areas are of alluvial origin, and are constantly being added to by the material which is brought down, reworked, and redeposited by the streams. The Leon sand and Coastal beach have been formed by wave and wind action, and are subject to frequent change in the position of the surface material. The other types mapped are associated with the Norfolk and Portsmouth series.

Many of the soils mapped in Pender County are widely distributed throughout the Coastal Plain region. The names given to the various types are those already applied to similar soils previously mapped in this section of the country.

The following table shows the relation of the various types and their characteristic features:

Origin.	Material.	Drainage.	Color.	Types.		
Sedimentary from Coastal Plain deposits.	Unconsolidated sands and clays.	Well established for most part.	Gray to yellowish gray and white soils. Yellow friable sandy clay or sand subsoils.	Norfolk sand. Norfolk sandy loam. Norfolk fine sand. Norfolk fine sandy loam. Norfolk very fine sandy loam.		
		Poorly established	Gray to black surface soils, gray mottled with yellow and brown sandy clays and brown sand subsoils.	Portsmouth sand. Portsmouth sandy loam. Portsmouth fine sand. Portsmouth fine sandy loam. Portsmouth very fine sandy loam. Portsmouth loam.		
		Well established...	Gray to white soil and white to yellowish sand subsoil.	Leon sand. Coastal beach.		
		Poorly established	Gray surface soil, gray mottled with yellow and brown sandy loam subsoil.	Plummer fine sandy loam.		
		Fairly good, for the most part.	Gray to yellowish-gray and black soils, gray and ochreous yellow mottled with dark drab and blue subsoils.	Parkwood coarse sandy loam. Parkwood fine sandy loam. Parkwood loam. Parkwood clay.		
		Poorly established	Black soil; black subsoil.	Hyde sand.		
	do.....	Black soil and subsoil.	Muck.		
		First bottom alluvium subject to overflow.	Material almost wholly from Piedmont Plateau. Coastal Plain material.	Wet land, frequently overflowed.	Light-brown soil and subsoil.	Congaree silt loam.
				Covered with water the greater part of year.	Grayish-brown to black, undifferentiated soils of variable texture.	Swamp.
				Overflowed at every tide.	Dark-gray to drab soil.	Tidal marsh.
Recent marine deposits.	Coastal Plain reworked and redeposited in quiet water.					

The following table gives the names and extent of each soil mapped in the county:

Areas of different soils.

Soils.	Acres.	Per cent.	Soils.	Acres.	Per cent.
Portsmouth very fine sandy loam . . .	77,952	14.2	Portsmouth sandy loam	11,264	2.1
Swamp	68,544	12.5	Hyde sand	9,792	1.8
Muck	68,096	12.4	Tidal marsh	9,472	1.7
Portsmouth fine sand	63,744	11.6	Congaree silt loam	8,448	1.5
Norfolk fine sandy loam	41,600	7.6	Plummer fine sandy loam	4,416	.8
Norfolk fine sand	35,392	6.5	Parkwood fine sandy loam	3,648	.7
Norfolk very fine sandy loam	31,488	5.8	Parkwood coarse sandy loam	2,944	.5
Portsmouth fine sandy loam	27,968	5.1	Parkwood loam	2,816	.5
Leon sand	18,560	3.4	Coastal beach	2,304	.4
Portsmouth sand	18,304	3.3	Parkwood clay	384	.1
Norfolk sandy loam	15,360	2.8			
Norfolk sand	13,696	2.5	Total	548,480
Portsmouth loam	12,288	2.2			

NORFOLK SAND.

The surface soil of the Norfolk sand is a light-gray or yellowish-gray sand extending to a depth of about 6 to 8 inches. The subsoil to a depth of 36 inches or more is a yellowish to light-brown sand to loamy sand. Both the soil and subsoil have a loose, open structure. On a few slopes the subsoil is yellowish brown to reddish in color. Bordering the other types the subsoil becomes sticky at about 30 inches, passing into a sandy loam or sandy clay. A few small, rounded, brown gravel are sometimes seen in both the soil and subsoil. Spots of light-brown loamy sand are of frequent occurrence through the areas of this type and east and southwest of Rocky Point there occur areas of a light-brown coarse sand. By far the greater area, however, follows the description first given.

The Norfolk sand occurs in the southern and southwestern parts of the county. There are no extensive developments, but several small areas are mapped. The type occupies low ridges and knolls and level to gently rolling areas. Owing to its loose, open structure and comparatively high position, the natural drainage is good. The soil warms up quickly in the spring and can be cultivated immediately after an ordinary rain.

This soil is derived from the coarser materials contained in the deposits which have been separated from the finer through the action of the waves and wind. It is quite deficient in humus, except in those areas where intensive cultivation and the rotation of crops have been practiced. Some longleaf and loblolly pines, old-field pines, small scrubby oaks, sweet-gum bushes, and a few persimmons constitute the forest growth. Wire grass is present in local areas.

The Norfolk sand is considered the earliest trucking soil along the Atlantic seaboard. It is well adapted to all early truck crops, dewberries, grapes, and peaches. East of Rocky Point beans and Irish potatoes are successfully grown. Watermelons and cantaloupes do well. Cotton and corn make large yields when following a heavily fertilized crop of Irish potatoes or beans, or where organic matter is directly applied to the soil. Sweet potatoes give good returns. The soil needs more humus, which can be largely supplied by growing soy beans, vetch, and cowpeas. Rye does well on this type and makes good grazing for cattle. Some peanuts are grown with profit. The soil is very easily tilled and does not require deep plowing, but frequent and shallow cultivation in order to form a mulch to prevent the evaporation of the soil moisture.

The Norfolk sand has a value of \$5 to \$25 an acre.

NORFOLK FINE SAND.

The surface soil of the Norfolk fine sand is a light-gray to yellowish-gray, mellow fine sand to a depth of 6 to 8 inches. In local areas along the creeks and rivers and on a few knolls the surface is whitish, yellowish, or brownish in color, while in a few of the flatter and wooded areas the soil to a depth of a few inches is dark gray. The differences in color are usually due to variation in the content of organic matter or to the staining of the quartz sand by iron or other minerals. In places it is difficult to draw any sharp boundary between this soil and the Leon sand. The subsoil to a depth of 36 inches or more consists of a pale-yellow, loose, incoherent fine sand. Orange-colored sand is encountered in a few places, and bordering the sandy loam areas a slightly sticky sand or light sandy loam occurs at 30 to 36 inches.

On the Sound the soil is a light-gray fine sand, somewhat finer in texture and more loamy in character than in the inland areas. The subsoil is light gray to yellowish in color. This phase is stronger and more productive than the typical soil.

The Norfolk fine sand is extensively developed in the extreme southeastern part of the county. Fairly large bodies occur along the Sound and along Harrison's Creek, north of Maple Hill, in the vicinity of Crooms, Smiths, and Bannermans Bridges, and extending down Northeast Cape Fear River. This soil occurs in more numerous spots and small bodies than any other type mapped in the county.

The surface of the Norfolk fine sand is somewhat varied in character, but it occurs mainly as low ridges, knolls, and gently rolling areas. Level and undulating areas are common, and these are occasionally marked by depressions of Portsmouth fine sand. The type ranges in elevation from a few feet above sea level on the Sound

to the highest points in the county. The natural surface drainage of this soil, owing to its position and open texture, is generally good, and on some of the knolls it is excessive, but the soil holds moisture fairly well, and some of the best crops are secured during dry seasons.

This type is derived from marine material which has been reworked by wave and stream action. Along the Northeast Cape Fear River the original deposits have been greatly modified by stream currents. On the coast it is the most recent formation in the county and has undergone but little change since its deposition.

Shortleaf, loblolly, and a few longleaf pines, together with a few small oaks along the coast, live oak, sweet gum, and dogwood constitute the forest growth.

The Norfolk fine sand is particularly well suited to the production of early truck crops, melons, cantaloupes, peanuts, Scuppernong and Misch grapes, sweet potatoes, and garden vegetables. The yields of these depend to a great degree on the quantity of fertilizer used and also on the humus content of the soils. Cotton produces from one-fourth to two-thirds bale per acre, corn 8 to 30 bushels, and peanuts 30 to 75 bushels of the Virginia variety or 20 to 50 bushels of the North Carolina variety. Peanuts constitute the principal crop grown along the coast. An excellent quality of nut is produced, and the vines make good hay. Corn gives good yields where the soil is supplied with humus and liberal quantities of fertilizer are used. This crop yields better along the coast, when it is rotated with peanuts, than in any other section of the county. Melons, grapes, and sweet potatoes do well.

The soil is very easily tilled, since it is loose, open, and usually quite free from grasses and weeds. It is naturally deficient in humus, and when this is supplied either in the form of coarse manures or green crops turned under larger yields are obtained. The peanuts are limed, and a complete fertilizer, generally an 8-2-2 or 8-3-3 mixture, is used. From 200 to 300 pounds are applied per acre.

The Norfolk fine sand in many places is considered poor and unproductive, but along the coast and in a few other places where it has been handled properly good crops are obtained. The price of this land varies from about \$5 to \$50 an acre, depending on the improvements and location.

NORFOLK SANDY LOAM.

The soil of the Norfolk sandy loam consists of 6 to 8 inches of gray to yellowish-gray sandy loam or loamy sand, passing usually into a pale-yellow sandy loam, which extends to a depth of 10 to 24 inches. Some variations in the soil occur. In the vicinity of Keiths Church it has a light-brown to darker brown surface, while along the Northeast Cape Fear River it is a light brown in color and a loamy sand in

texture to a depth of 18 to 24 inches. In places, particularly southwest of Rocky Point, a light-brown coarse sandy loam is encountered. These variations, however, are all of minor importance.

The subsoil is a yellow, friable sandy clay extending to a depth of 36 inches or more. In the flatter areas, where drainage has been inadequate, the lower part of the subsoil is mottled with gray. On a few of the slopes a reddish-yellow to brownish sandy clay is encountered, which has resulted from better aeration and drainage and consequent more complete oxidation. Such spots would be mapped as the Ruston sandy loam if they were of sufficient size to be shown on the soil map.

This type has its development largely in the western part of the county. The most prominent areas are in the vicinity of Currie and Murphys Store. Some small bodies occur southwest and northeast of Rocky Point.

The Norfolk sandy loam occupies level, flat, undulating, and gently rolling areas, the topography of which is well suited to general farming. The natural drainage is fairly good, and only the more level areas require ditching. Open ditches are very satisfactory, the banks standing up well on account of the clay subsoil. The soil absorbs rainfall well, and by reason of its clayey foundation retains this moisture for the growing crops.

This soil type is a sedimentary type derived from marine deposits. Originally the deposits contained much more fine material in the surface, but this has been carried away in suspension during periods of reworking by the waves or in the drainage water since final emergence. It is believed the subsoil represents the original texture of the deposits.

There is very little organic matter in the surface soil, except in the wooded and in a few of the flatter areas. The soil is mellow and loose and one of the easiest in the county to till.

A part of this type remains in forest, the growth consisting of merchantable longleaf and loblolly pine. In some places old-field pine, and a few oak, sweet gum, persimmon, and dogwood trees are found.

In general, the Norfolk sandy loam is one of the best soils in Pender County. It is exceptionally well suited to the production of cotton, peanuts, bright tobacco, cowpeas, crimson clover, grapes, peaches, sweet potatoes, and garden vegetables. Corn also does well. This is probably the best Irish potato soil in North Carolina. Cotton produces from one-half bale to 1½ bales per acre and corn from 15 to 40 bushels. The soil is adapted to peanuts, but only a few are grown. The Scuppernong and Misch grapes, peaches, sweet potatoes, Irish potatoes, cowpeas, and early corn give profitable returns. All of the crops are fertilized, and under the prevailing methods of culti-

vation the yields depend largely on the quantity of fertilizer applied. Crimson clover is an excellent winter cover crop, and a fine crop to precede corn. A rotation of crops, including cowpeas and crimson clover, and the addition of barnyard manure has been found very beneficial in cultivating this soil.

The Norfolk sandy loam can be bought at \$10 to \$50 an acre.

NORFOLK FINE SANDY LOAM.

The surface soil of the Norfolk fine sandy loam generally consists of a gray to yellowish-gray, mellow fine sandy loam to a depth of about 6 inches, where it grades into a pale-yellow fine sandy loam, which continues to depths of 15 to 24 inches. The soil of the deeper areas is commonly a loamy fine sand, while that of the shallow areas is a fine sandy loam. In small spots on the slopes the sandy mantle has been largely washed off, leaving "gall spots." Where the soil has been cultivated for a long time and no humus added it has a whitish color. Along Northeast Cape Fear River in local areas the surface soil is brownish gray in color, and extends without change to a depth of 15 to 30 inches, the subsoil being a yellowish-brown sandy clay. Along Rock Fish Creek and in places along Northeast Cape Fear River this type includes small bodies of second-bottom land which resembles the Kalmia fine sandy loam.

The subsoil of this type is a yellow, friable fine sandy clay, which extends to a depth of 36 inches or more. In local areas on slopes it is tinged with red, becoming mottled at 30 inches. Again where the drainage is poorly established, mottling of gray and yellow is characteristic of the subsoil at lower depths. Near the sound a salmon-colored to red fine sandy clay subsoil is encountered on the elevated and better drained areas. Spots of Ruston fine sand too small to be separated are included with this type.

No extensive areas of this soil are mapped, although small areas are distributed throughout the county. It is developed around Costins Store, Atkinson, Long Creek, Rileys Creek Church, Hills Chapel, Willard, north of Maple Hill, between Maple Hill and Bannermans Bridge, and west of Harrisons Creek.

The surface of the Norfolk fine sandy loam varies from level and undulating to gently rolling, becoming more rolling as the streams are approached. The topography of all of the type, with the exception of a few hillsides, is favorable for agriculture. Surface drainage is generally good, and it is only the flatter and more level areas that require artificial drainage. Local ditches or tile drains will serve every purpose. Tiles are being installed advantageously on the State test farm.

The Norfolk fine sandy loam is derived from marine deposits. Erosion and seepage waters have modified the surface soil consid-

erably, washing the sandy covering from some slopes and on others removing only the finer material, leaving a deep, loose sandy soil. The soil in the level and forested areas is slightly darker than that encountered in the fields which have been cultivated for some time. Practically all of this soil near the Sound is under cultivation, and, as a rule, it is one of the most easily tilled soils in the country.

The principal growth of the forested areas consists of shortleaf and longleaf pine, a few oak and hickory near the streams and on the ridges, and some sourwood, dogwood, and holly.

This soil type is admirably adapted to a number of truck crops, such as lettuce, Irish potatoes, strawberries, radishes, cucumbers, beans, English peas, cauliflower, tomatoes, and watermelons and cantaloupes, and to tobacco, peanuts, cowpeas, vetch, crimson clover, grapes, pecans, peaches, cotton, corn, and oats.

The yields of cotton range from one-half bale to $1\frac{1}{2}$ bales per acre. Corn produces 15 to 30 bushels per acre, but much larger yields can be obtained. Irish potatoes produce from 60 to 125 bushels and tobacco from 700 to 1,000 pounds per acre. Oats do well, but the crop is generally fed in the sheaf, so that the yield of grain can not be estimated. Peanuts give good results, but are not grown extensively. Cucumbers are grown near Ashton and Rocky Point. Some lettuce is grown, especially on the State test farm and near Willard. A few beans, Irish potatoes, and strawberries are grown for early shipment. Sweet potatoes, crimson clover, cowpeas, peaches, watermelons, cantaloupes, and Scuppermong and Misch grapes give excellent returns.

Just before the beans and Irish potatoes are harvested for early shipment corn or cotton is usually planted between the rows. Corn does particularly well following the truck crops. Irish potatoes receive from 600 to 1,000 pounds of 5-7-8 fertilizer per acre and tobacco about 400 pounds of an 8-3-3 mixture and 100 pounds of selenite. Lettuce requires heavy fertilization, as well as beans, cucumbers, strawberries, and other truck crops. Cotton usually receives an application of about 400 pounds per acre. For corn, from 200 to 300 pounds of an 8-3-3 mixture is generally applied.

Most of this type is deficient in humus, but this can be supplied easily and cheaply by growing and turning under crimson clover, bur clover, vetch, rye, and cowpeas, or by the addition of barnyard manure. The incorporation of organic matter in this form improves the texture of the soil, causing it to be more loamy in character, and also supplies nitrogen. Such a practice eliminates the necessity of purchasing this constituent in commercial fertilizers and results in building up the soil in a way that can not be done with commercial fertilizers alone.

The Norfolk fine sandy loam is considered one of the best all-around soils in the county. In areas more remote from towns and

transportation facilities it sells at \$10 to \$25 an acre, while near Willard and other towns it is held at \$50 to \$80 an acre.

NORFOLK VERY FINE SANDY LOAM.

The surface soil of the Norfolk very fine sandy loam consists of a light-gray to yellowish-gray, mellow very fine sandy loam, ranging in depth from 6 to 15 inches. In areas where the soil is more than 8 inches deep a pale-yellow very fine sandy loam is encountered below that depth, extending to the sandy clay subsoil. On a few slopes where erosion has been active there are small spots of yellow to reddish-yellow loam. Throughout the type there are level areas which have a gray surface soil, grading into a lemon-yellow very fine sandy loam, which extends to a depth of 24 inches. The variations in color of the surface soil are due to the amount and condition of organic matter it carries. In some of the more uniform and typical areas there is a rather sharp line between the soil and subsoil.

The subsoil of the typical areas to a depth of 36 inches or more is a yellow very fine sandy clay or clay loam. It normally is mottled with gray at 30 to 36 inches in the level areas where the internal drainage is imperfect. On some of the undulating to gently rolling areas, however, the subsoil has a distinctly yellow color to a depth of several feet. Along Horse Branch and near Rhynes Crossroads and on several of the streams, particularly those between Burgaw and Willard, the subsoil is salmon red or reddish yellow in color. Here oxidation, through aeration and drainage, has proceeded to an advanced stage. There are, however, only small strips of such material, and it was not practicable to separate these on the soil map. The soil of such spots is generally considered slightly stronger than the average, and it approaches the Ruston fine sandy loam.

The Norfolk very fine sandy loam, although inextensive, is an important type. It occurs in bodies and narrow strips; mainly in the central and northern parts of the county. Some of the more typical areas are situated around Burgaw, on the road leading from Burgaw to Willard, to the northwest of Willard, along Horse Branch, and to the east of Watha.

For the most part the type occupies level, undulating, and gently rolling areas. Near some of the streams, especially those between Burgaw and Willard and Horse Branch, the surface becomes rolling and hilly as the bottom land is approached. All of the type, with the exception of the large, flat areas, has good surface drainage. In the flat areas open ditches or tile drains are necessary. The crop-producing power of this soil depends largely upon its drainage and aeration.

This soil is derived from marine deposits. It is composed mainly of very fine sand, silt, and clay, and its fineness of texture indicates

that it was laid down in comparatively quiet water. Since its deposition it has undergone but slight changes, except on the steeper slopes where, through erosion, the more sandy covering has been removed, leaving the yellowish to reddish-yellow loam exposed. Such eroded areas are locally called "gall spots," and usually in such places the soil shows the effect of increased aeration and oxidation. Under a few bodies of this type marl occurs at a depth of 6 to 8 feet. Only in the more level areas is there sufficient vegetable matter to give the soil a dark color.

This type was formerly forested with pine, but only a part of the original growth remains. Some loblolly pine, together with a few oak and hickory trees, constitute the forest growth.

The Norfolk very fine sandy loam is a good general-purpose soil. It is well suited to cotton, oats, corn, and cowpeas, and the lighter and deeper areas to peanuts, tobacco, lettuce, Irish potatoes, and other truck crops.

The yields of cotton range from one-third bale to $1\frac{1}{2}$ bales per acre, depending on the amount of fertilizer applied and the methods of cultivation. Corn produces from 10 to 40 bushels, tobacco from 700 to 1,000 pounds, and Irish potatoes from 40 to 100 barrels per acre. Lettuce does well, oats fairly well, and sweet potatoes, garden vegetables, and grapes give good returns.

This soil is in need of deeper plowing, gradually increasing the depth until a loose, fine seed bed, 8 to 10 inches in depth, is secured. Winter cover crops of rye and crimson clover, and catch crops of cowpeas in the summer are beneficial. These will supply the needed humus, add nitrogen, and enable the soil to produce better yields at a smaller expenditure than if commercial fertilizer alone were depended upon.

A heavy application of a high-grade fertilizer is used for Irish potatoes and lettuce. About 200 to 300 pounds per acre of an 8-3-3 mixture is commonly used for corn, and from 300 to 600 pounds for cotton.

The Norfolk very fine sandy loam sells at \$10 to \$100 an acre, depending on location and improvements.

PORTSMOUTH SAND.

The soil of the Portsmouth sand, to a depth of 8 to 15 inches, consists of a dark-brown to black sand, containing a large quantity of vegetable matter. In a few places a layer of whitish sand, 1 or 2 inches in depth, overlies this black to brown sand. The surface soil is frequently underlain at 8 to 15 inches by a layer of white sand before the typical dark-brown sand subsoil is encountered. In some localities this sand has been cemented with iron, forming a crust which acts as a hardpan. The dark-brown, compact sand usually extends

to 30 inches and occasionally to 36 inches or more. This subsoil is underlain by a white sand at varying depths.

The Portsmouth sand occurs mainly in the southwestern part of the county. It is developed also along the Sampson County line northwest of Atkinson, and in a few other places in the western half of the county. One area is located east of Smiths Bridge, and another north and northeast of Scotts Hill.

The Portsmouth sand, like the other types of the series, occupies flat, level, and slightly depressed upland areas. It occurs generally near the heads of the streams. A part of the type is in a semi-swampy condition and the drainage of the remainder is poor. Artificial drainage is necessary, and this can be provided by open ditches to some extent. It is difficult to keep the ditches open because of the running in of the white sand. The hardpan layer in places hinders drainage operations.

This type occupies what were formerly old bays, and an accumulation of organic matter from the heavy growth of vegetation that flourishes in such areas has modified the texture of the sand. The present growth comprises scattering pine, together with an undergrowth of bay bushes, gallberry, and huckleberry. In a few of the wetter spots the soil supports some cypress and gum trees. Very little of this type has been cleared and only small bodies are under cultivation. Corn is the main crop and low yields are obtained, except when very heavily fertilized and limed. The soil can be made to produce fair yields of corn, cabbage, and cucumbers, and can be used to some extent for grazing. After drainage and aeration this land requires at least 1 ton of lime per acre and liberal applications of phosphoric acid and potash in order to secure profitable crops.

The Portsmouth sand is not considered very valuable for general farming, and it can be purchased at a very low price.

PORTSMOUTH SANDY LOAM.

The surface soil of the Portsmouth sandy loam consists of a dark-gray to black, heavy sandy loam, 8 to 15 inches deep, containing a large proportion of organic matter. Spots of dark-brown sandy loam occur in a few localities, and small bodies of rather coarse sandy loam are not uncommon. The subsoil, to a depth of 36 inches or more in typical areas, is a grayish-drab and yellow mottled, heavy, sticky sandy clay. In places the subsoil is a sticky sandy loam or very light sandy clay of grayish to drab color. Pockets of sand and lenses of clay are occasionally encountered in the subsoil.

The Portsmouth sandy loam is developed only in the western and southwestern parts of the county. The largest areas are those north and northeast of Currie, north of Long Creek, near Lyon Landing, and on the Bladen County line between the Cape Fear and Black Rivers.

The type is confined to flat, level, and slightly depressed areas. On account of its flat position, the surface drainage is poor. Most of the type can be drained by open ditches. In origin and formation it is similar to the Portsmouth fine sandy loam.

The forest growth on this soil consists of loblolly pine, gums, maple, a few oaks, and cypress, with an undergrowth of bay bushes, gallberry, huckleberry, and in many places of briers and creeping vines. The soil is particularly well suited to the production of corn, oats, grasses, strawberries, Irish potatoes, spinach, and Spanish peanuts.

Corn is about the only crop grown on this type, and the yields range from 15 to 35 bushels per acre. The soil lacks adequate drainage, and is in need of lime, deep plowing, more thorough pulverization, and aeration.

The Portsmouth sandy loam is valued at \$5 to \$20 an acre, depending on location and improvements.

PORTSMOUTH FINE SAND.

The soil of the Portsmouth fine sand is a black, loamy fine sand, 8 to 10 inches deep. In local areas the soil consists of a black fine sand to a depth of 3 feet or more and in a few places it is a dark-gray fine sand. A layer of white fine sand, 1 to 2 inches in thickness, usually underlies the black surface soil. The subsoil below the white stratum is a compact, dark-brown fine sand, extending to a depth of 36 inches or more. In local areas this part of the section is cemented with iron, forming a crust or hardpan, which is practically impervious to water, but when brought up with the soil auger it is brittle and friable. Practically all of the type is underlain at 3 to 5 feet by white fine sand locally called "quicksand."

This type includes some variations in depth and color of the material. In a few places a brown to black, loamy fine sand, extending to a depth of 36 inches, is encountered. Again the black surface soil may be only a few inches deep, passing into a white or a black fine sand. In the Holly Shelter Bay section and in a few other places where this type grades into the muck the surface soil, to a depth of a few inches, is mucky to peaty in character.

The Portsmouth fine sand has its greatest development east of the Northeast Cape Fear River in broad continuous areas swinging around Holly Shelter Bay on the north and south and stretching along the Onslow County line. Small areas also occur around Angola Bay. It is developed in wide belts between Shaken and Holly Shelter Creeks, and bodies of the type parallel the Wilmington & Newbern Branch of the Atlantic Coast Line Railroad. A few bodies lie east of Burgaw and south and southeast of Rocky Point. This is the typical "bay land" of the county.

This soil type possesses a uniformly level surface, excepting a few undulating spots near the streams, and is wet at the surface during the greater part of the year. A few streams head in the edge of the type, but no actual drainage ways of any consequence are established through the areas. The soil, however, can be drained so far as securing sufficient fall is concerned. The hardpan layer which occurs in local areas hinders internal drainage. As yet only a few bodies have been sufficiently drained for corn production.

The Portsmouth fine sand is derived from a marine deposit. Its wet and swampy condition has favored the growth of vegetation, and as a result the soil has a high content of organic matter. The vegetable acids have probably dissolved out some of the iron from the surface few inches, depositing it in the underlying stratum and thus forming the brown hardpan soil which occurs at 10 to 24 inches in local areas.

The type is characterized by a dense, almost impenetrable growth of bay bushes, briars, and some huckleberry, with a larger growth consisting of shortleaf and pond pine. The shortleaf pine is most noticeable on the more elevated ridges or plateaus. In such situations some longleaf pine is found, and a little wire grass appears in the undergrowth. In the wetter and semiswampy areas at the head of streams there are a few cypresses and gums.

In the larger areas the Portsmouth fine sand is not very productive and is considered a poor soil, ranking next in value to the Leon sand. In a few areas, particularly where the soil consists of a brown and black loamy fine sand extending to a depth of 3 feet and in spots lying in local depressions, the type is fairly productive. Only small, scattered patches are cultivated.

By heavy liming and the use of fertilizers corn may be successfully grown. Irish potatoes, cabbage, cucumbers, celery, watermelons, and tomatoes should do well. The yields of corn at present are low. Lime or marl is absolutely necessary to correct the acidity before crops may be profitably grown. The soil is uncleared and is used largely as range for cattle and hogs, although the interior and more typical baylike areas afford only meager grazing.

This type is not important as a farming soil, and has a value in places of only about \$2 an acre.

PORTSMOUTH FINE SANDY LOAM.

The surface soil of the Portsmouth fine sandy loam consists of a dark-gray to black fine sandy loam with a depth of 8 to 15 inches. The higher areas which have been cultivated for some time are usually dark gray in color, while the lower lying and semiswampy places have a black surface soil. Commonly below 8 or 10 inches and extending to the subsoil the material is a grayish fine sandy loam. The typical subsoil is a mottled gray and yellow, sticky fine sandy clay or clay

loam. In spots a drab or gray-colored fine sandy loam occurs. Strata of fine sand and also clayey spots are encountered in the subsoil. In a few areas where marl underlies the subsoil the lower part of the 3-foot section is waxy and sticky. Immediately west of Ashton and in many places west of the railroad in that neighborhood the surface soil to a depth of 12 to 18 inches is a black, mucky fine sandy loam and the subsoil is a gray to dark-colored fine loamy sand or sandy loam.

Areas of the Portsmouth fine sandy loam are scattered throughout the western, southern, and east-central parts of the county. Some of the largest bodies lie in the vicinity of Ashton, west of Ashton and Rocky Point, east and northeast of St. Helena, northeast of Burgaw, and in the Maple Hill section.

This type occupies flat, level upland areas and slight depressions. It has practically no surface drainage, but is sufficiently elevated for artificial drainage. Open ditches retain their slope well and will afford adequate drainage for most of the type.

The Portsmouth fine sandy loam is derived from the same material as the Norfolk fine sandy loam, but its semiswampy condition has favored a heavier growth of vegetation and the soil is well supplied with humus. Owing to the poor drainage, oxidation of the iron compounds has not proceeded to an advanced stage, and this accounts for the mottled condition of the subsoil. The higher and better drained areas support some good forests, mainly loblolly pine, while in the more poorly drained areas gums, oaks, maple, pine, bay bushes, and some huckleberry constitute the natural growth. In some of these wet areas the undergrowth is very dense.

The Portsmouth fine sandy loam is well adapted to corn, strawberries, Spanish peanuts, cucumbers, oats, and cotton. A very small percentage of this soil has been cultivated. Corn produces from 15 to 40 bushels and cotton one-third bale to $1\frac{1}{4}$ bales per acre. Oats do well. Strawberries produce about 75 to 125 crates per acre; cucumbers do exceedingly well, and Irish potatoes and cabbage also produce profitable crops.

There is a general need for deeper plowing and the subsoiling of the shallower areas, so as to permit the aeration and warming of the underlying wet clay. The use of lime and the liberal use of fertilizers will give good results. Cucumbers, berries, and Irish potatoes are heavily fertilized, while the corn and cotton crops receive lighter fertilizers.

The value of the Portsmouth fine sandy loam ranges from \$5 to \$50 an acre.

PORTSMOUTH VERY FINE SANDY LOAM.

The surface soil of the Portsmouth very fine sandy loam consists of a gray or dark-gray to black very fine sandy loam, having a depth of 8 to 12 inches. Many areas of this type are locally known as

"savanna land." The larger and more uniform areas are dark gray in color. In some of the lower places and semiswampy areas the soil is almost black, owing to the accumulation of organic matter, which gives a black, mucky, loamy soil. Spots of loam and silt loam and local bodies of fine sandy loam are common. Most of the type contains a large quantity of organic matter and has every indication of being a productive soil. Around Rocky Point the surface soil to a depth of 10 to 15 inches is a black, mellow, fine sandy loam.

The subsoil is a mottled gray and yellow very fine sandy clay to a depth of 36 inches or more. At a depth of about 30 inches the mottlings generally increase, and in many places spots and streakings of red are prominent, the type in such places resembling the Coxville soils. When the gray and yellow mottled material is exposed to weathering it becomes pale yellowish in color, showing only slight mottlings. In local areas the subsoil is a gray very fine sandy loam, and in places small areas of very fine loamy sand and frequently spots of clay loam or clay are encountered.

This type is confined chiefly to the central and northwest-central parts of the county. It occurs in broad, continuous areas of irregular outline beginning south of St. Helena, extending around Burgaw, including Van Eden, and reaching west of Willard to the Sampson County line. This belt is from 5 to 10 miles in width and is only broken by narrow strips and small bodies of other soils. It is typically developed west of St. Helena and Burgaw, around Van Eden, east of Shiloh Church, and at the headwaters of Moores Creek. A few bodies of much smaller extent lie in the southwestern and western parts of the county and to the east of Rocky Point and surrounding that town.

The Portsmouth very fine sandy loam is characterized by uniformly flat to level surface features. It embraces the broad expanses of level land known as savannas. It occupies the highest elevations in the regions in which it is encountered and many small streams have their origin in the edge of it. The drainage of this soil has not as yet been well established. Open ditches have been constructed in some places, especially at Van Eden and St. Helena, and these carry off the excess water satisfactorily, leaving the land in a suitable condition for crop production.

This type has been formed from material laid down in the ocean, and has undergone but slight change, being very uniform in texture in both soil and subsoil. Inadequate drainage has favored the growth of grasses and other vegetation, with the result that a large quantity of organic matter has accumulated in the surface soil. It is said that the open savanna land or treeless prairie was burned off by the Indians from time to time, and no trees were allowed to grow, but the compact structure of the subsoil and the flat surface, which prevent drainage, are probably the main causes of this treeless condition. Poor drainage also accounts for the mottled colorings of the subsoil.

Probably half of the type is included in the open savannas or treeless land. Such areas furnish good grazing for cattle and sheep. In the forested areas shortleaf and longleaf pine constitute the important trees on the better drained and higher areas, while in the wetter areas, particularly at the heads of the streams, a thick growth of gum, cypress, ash, bay bushes, and briers is found. Throughout the savannas there are many species of short grasses, with pitcher plants and other flowering plants.

Corn, oats, cotton, strawberries, cucumbers, potatoes, cabbage, and turnips do well on this soil. Very little of the land is cultivated, but it is being cleared and drained around St. Helena and Van Eden. Corn produces from 15 to 35 bushels per acre. Oats do very well, but only a few are thrashed, most of the crop being fed in sheaf. Cotton produces from one-third bale to 1½ bales per acre. Strawberries give excellent yields. A few grapes are being grown, alsorye and vetch for winter cover crops. Cotton and corn land is given small applications of fertilizer, while with strawberries and other truck crops an acreage application of at least 1,000 pounds of 8-4-4 or other high-grade fertilizer is used.

There is no reason why this soil can not be built up to a high state of productiveness. It is naturally cold and in an acid condition. Its needs are better drainage and aeration, deeper plowing, and more thorough pulverization of the seed bed. The growing of winter cover crops and the application of lime and coarse manures are beneficial.

The improved areas of the Portsmouth very fine sandy loam near towns and shipping points are valued at \$20 to \$50 an acre, and the more remote areas at \$5 to \$15.

PORTSMOUTH LOAM.

The surface soil in typical areas of the Portsmouth loam consists of a black to dark-gray silty loam or loam, ranging in depth from about 10 to 18 inches. The subsoil is a drab or gray mottled with yellow, stiff, sticky clay, extending to a depth of 36 inches or more. Included in this type are several phases of minor importance, which are variable in color, texture, and depth. Around Collys Mill Creek the surface soil is a black loam or silt loam to a depth of about 24 inches. In a few places the soil is a black, heavy loam, containing more than the usual proportion of fine to medium sand. The subsoil of these two phases consists of a drab to black, heavy, sticky, plastic clay. To the south of Van Eden the surface soil is a black silt loam, and overlies a mottled clay loam at about 15 inches. To the southwest of Willard the surface soil is a drab to gray silt loam, ranging in depth from about 8 to 12 inches, and underlain by a mottled gray and yellow clay or clay loam.

The main development of the Portsmouth loam is in the extreme western part of the county. The largest areas are located on the

Sampson County line north and northwest of Atkinson and between the Black and Cape Fear Rivers. Bodies of it are encountered south of Van Eden and southwest of Willard. This type occupies uniformly level, flat, and slightly depressed areas in the uplands. On account of its surface features and the close structure of both the soil and subsoil, the natural drainage is poor, some of the type being at present in a semiswampy condition. Open ditches are used and found very satisfactory, as the banks stand up well. Tile drains would in all probability be very serviceable in reclaiming this type. Its low position and flat surface have favored the growth of vegetation, and through the decay of this the soil in many places has become highly charged with organic matter. The forest growth on the better drained areas is mainly pine, with a few small oaks and gums. The wetter areas support a natural growth of cypress, bay bushes, briers, and reeds.

This soil is admirably suited to corn, oats, and grasses, and to cabbage, cucumbers, and Irish potatoes. Very little of the type has been cultivated, but where cleared, drained, and properly handled it is an excellent corn soil. Like the associated types, the Portsmouth loam is naturally a cold soil, and requires liberal applications of lime, good drainage, deep plowing, and subsoiling to fit it for the profitable production of crops.

The price of land of this type ranges from \$5 to \$50 an acre.

PARKWOOD COARSE SANDY LOAM.

The surface soil of the Parkwood coarse sandy loam is a light-brown medium to coarse sandy loam or loamy sand having a depth of 10 to 20 inches. It contains a few rounded quartz gravel and iron concretions, and in some places a large amount of ferruginous sandstone crusts. The soil of the loamy coarse sand areas is usually from 20 to 30 inches deep. Small bodies of medium sandy loam, practically free from gravel but usually containing iron concretions, are included in this type.

The subsoil to a depth of 36 inches is a brownish-yellow to ochreous-yellow, sticky light sandy clay or a yellowish to grayish mottled, sticky sandy clay. In places the subsoil is a light sandy loam of yellowish or bluish color. Near Rileys Creek and in a few other places a reddish-yellow, sticky sandy clay subsoil, extending to a depth of several feet, is encountered. Gravel is present in the subsoil.

The type is confined to the Rocky Point section of the county, and occurs mainly between Rocky Point and the Northeast Cape Fear River. The surface features vary from flat to undulating. On account of its open structure, the soil has fairly good drainage. Where artificial drainage is necessary a few open ditches serve the purpose.

The Parkwood coarse sandy loam is derived from or is greatly influenced by the underlying marl or limestone. This largely accounts for the sticky character of the subsoil. None of the limestone, however, is within the 3-foot section. In local spots an ironcrust hardpan is encountered. The surface material of this type appears to have been more or less reworked and redeposited by stream action.

Practically all of this type to the east of Rocky Point has been cleared and cultivated. There are a few spots of forested land in this section, and larger areas to the southwest of Rocky Point. The native growth consists of oak, hickory, pine, a few gums, and a small quantity of cypress.

The Parkwood coarse sandy loam is admirably suited to the production of peanuts, string beans, Irish potatoes, and other truck crops, and cotton and corn. Corn produces from 15 to 30 bushels, cotton from one-third bale to 1½ bales, depending on the fertilization, peanuts from 30 to 75 bushels, and string beans about 50 baskets per acre. Irish potatoes do well. The beans and potatoes mature early and bring a fancy price in northern markets. These two crops are fertilized heavily with high-grade mixtures. Corn and cotton are usually planted between the rows of beans or potatoes and by the time the latter crops are gathered the former are large enough to be cultivated, and in this way no time is lost and good yields are obtained. Throughout most of the type the soil seems to contain sufficient lime to adapt it to the production of peanuts.

The Parkwood coarse sandy loam is held at \$20 to \$60 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Parkwood coarse sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
252805.....	Soil.....	9.8	17.0	13.6	35.5	12.5	6.8	5.1
252806.....	Subsoil.....	6.4	12.2	8.6	29.8	9.5	12.1	22.0

PARKWOOD FINE SANDY LOAM.

The surface soil of the Parkwood fine sandy loam consists of a gray to brownish-gray fine sandy loam, having a depth of about 8 to 15 inches. The subsoil of the typical and largest areas is a mottled yellow and gray, sticky sandy clay which is quite tough and plastic in the lower part of the 3-foot section and shows mottling of various shades of drab and blue. Immediately west of Lanes Ferry the soil is a brown fine sandy loam underlain by a yellowish-brown, mottled

with reddish-yellow, sticky, plastic clay, the mottlings being more intense in the lower part of the subsoil. In a few places, particularly near Maple Hill, the soil is a gray medium to fine sandy loam, representing an intermediate grade of material between the Parkwood coarse sandy loam and the Parkwood loam and resembling the Portsmouth fine sandy loam in general appearance. In local areas limestone or marl immediately underlies the subsoil of this type at varying depths. In places this marl or limestone has been dug and used on this and other soils to correct the acidity. The marl and limestone are found near Maple Hill, and Lillington Cemetery and at Lanes Ferry.

Large bodies of this type lie west of Maple Hill, around Lillington Cemetery, west of Lanes Ferry, and south of Players Creek. The type occupies level, undulating to very gently rolling areas. Most of it possesses fairly good surface drainage, but the soil does not drain off as well as the Norfolk types. The close structure of the subsoil does not permit a rapid downward movement of water, holding it at the surface for long periods, so that open ditches are necessary to remove the excess water. The banks of these ditches stand up well.

The Parkwood fine sandy loam is derived from marine sediments, modified in some places by stream action. The subsoil has been influenced by the underlying marl and limestone. Near Maple Hill and Lillington Cemetery marl underlies this type at a depth of 3 to 5 feet. Near Lanes Ferry limestone is encountered at varying depths and outcrops in places near the river.

The greater part of this type is cultivated. The native forest growth consists of oak, hickory, and some pine. The surface soil is mellow and easily tilled. It is especially adapted to peanuts and cotton and also to corn and oats. Cotton produces from 1 bale to 1½ bales per acre, corn 15 to 40 bushels, and peanuts 30 to 50 bushels of the North Carolina variety and 50 to 100 bushels of the Virginia variety. Oats, all garden vegetables, sweet potatoes, and fruits do well. This soil is in need of deeper plowing and better drainage. The subsoil is retentive of moisture, and excess water should be removed and not allowed to stand and puddle the soil. A part of the type contains sufficient lime for ordinary crops, but some areas require additional quantities for the most profitable production of peanuts. In such areas the use of land plaster around the hills improves the yields.

Over most of the type kainit and acid phosphate give best results. Around Maple Hill the 8 per cent acid phosphate and 5 per cent potash mixture is used with very satisfactory results when the soil contains a large percentage of humus.

The Parkwood fine sandy loam ranges in value from \$30 to \$100 an acre.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of this type are given in the following table:

Mechanical analyses of Parkwood fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
232809.....	Soil.....	0.6	1.8	3.9	25.0	39.2	25.7	3.8
232810.....	Subsoil.....	.6	1.6	2.8	26.1	28.8	22.8	17.2
232811.....	Lower subsoil.....	2.0	4.5	4.2	15.5	11.2	36.2	26.4

The following sample contained more than one-half of 1 per cent calcium carbonate (CaCO₃): No. 232811, 64.11 per cent.

PARKWOOD LOAM.

The surface soil of the Parkwood loam consists of a dark-gray to almost black loam or heavy sandy loam, with a depth of about 10 to 15 inches. A few iron concretions and occasionally iron crusts are seen on the surface. This type is inextensive, and as mapped represents a soil condition rather than a type of distinct texture and color characteristics. In a few places patches of a dark-brown loam or heavy sandy loam occur. East of Burgaw and in other places spots of brown to gray loam with a mottled sticky clay subsoil are encountered.

The subsoil to a depth of 36 inches is a bluish to drab-colored and sometimes mottled-yellow, sticky, heavy clay, which is plastic, but contains considerable sand. In a few places it is a brownish-yellow, sticky clay. Numerous mottlings of ochereous yellow are present throughout the subsoil.

This type occurs mainly northeast, southeast, and southwest of Rocky Point. A few small bodies are developed east of Northeast Cape Fear River, where they are closely associated with the Parkwood fine sandy loam around Lillington Cemetery, south of Players Creek, and southeast of Bannermans Bridge.

The type occupies low, flat areas, parts of which have been cleared, drained, and used for crop production. A part of the type remains in a semiswampy condition, especially during the wet season. Open ditches are necessary to furnish adequate drainage for the higher areas. Some of the lower lying areas require diking as well as ditching.

The Parkwood loam is a marine deposit which has been modified in places by river sediments. Part of it is derived from the underlying marl and limestone, and all of it has been modified by these materials, especially in the subsoil portion. Marl or limestone

underlies practically all of the type. The limestone outcrops in several places, particularly on the banks of the streams.

The low position and semiswampy condition have favored the growth of vegetation, and this accounts for the black color, which results from the large content of partially decayed organic matter incorporated with the soil.

The native forest consists principally of deciduous species, mainly oak, gum, and hickory, with considerable beech and a few pine. In some of the wetter areas cypress is found. A rank growth of sedges occurs in a few places, and where the limestone is near the surface Johnson grass grows luxuriantly.

The darker areas of the Parkwood loam are well suited to corn, oats, and grasses, and where well drained to alfalfa. The lighter areas are adapted to peanuts, cotton, and beans. Corn produces from 30 to 75 bushels per acre. Peanuts do well on the better-drained areas, where from 30 to 75 bushels per acre are obtained. Cotton yields are good where there is adequate drainage. Most of the soil is well supplied with lime. The use of fertilizers composed of acid phosphate and kainit gives excellent results. Crop yields can be increased by deeper plowing, more thorough pulverization of the soil, and better drainage. Naturally the Parkwood loam is one of the strongest soils of Pender County.

This land sells for \$20 to \$75 an acre.

In the following table the results of mechanical analyses of samples of the soil and subsoil of this type are given:

Mechanical analyses of Parkwood loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
232803.....	Soil.....	4.5	10.2	8.8	18.4	18.0	27.5	12.8
232804.....	Subsoil.....	9.1	13.8	11.1	15.6	8.9	15.4	26.1

PARKWOOD CLAY.

The surface soil of the Parkwood clay consists of a black or dark-brown clay or clay loam, ranging in depth from about 10 to 20 inches. The subsoil is predominantly a heavy, sticky, impervious clay of drab or bluish color, faintly mottled in places with shades of brown or yellow. In local areas the surface soil is underlain at about 10 to 15 inches by a soft white marl or limestone. In places the surface soil carries a noticeable quantity of sand, but never in sufficient quantities to change the texture of the type.

This type is typically developed in one small area near Rocky Point. The surface is generally flat, and a part of the type is poorly drained.

The Parkwood clay owes its origin mainly to the weathering of marl and limestone. In places the limestone outcrops along the drainage ways, and some of it has been quarried. The soil is highly calcareous, and this probably accounts for its strong and productive character. Johnson grass is indigenous and grows luxuriantly upon this soil. Corn is the principal crop grown and good yields are obtained. Alfalfa gives excellent returns. This type is well suited to corn, alfalfa, and grasses.

PLUMMER FINE SANDY LOAM.

The surface soil of the Plummer fine sandy loam consists of a gray to dark-gray loamy fine sandy or fine sandy loam, with a depth of about 8 to 20 inches. The subsoil is a mottled gray and yellow fine sandy clay or a gray fine sandy loam. Included in this type are many small bodies of a gray loamy fine sand, underlain by a gray or yellowish-gray loamy fine sand. These occur mainly along the creeks, and are closely associated with the Norfolk fine sand. On the flatter and poorly drained situations the gray color predominates throughout the soil and subsoil, and in many places the subsoil is quite heavy and sticky.

The Plummer fine sandy loam covers a small total area in Pender County. It is confined to the northeastern part of the county, being well developed to the northwest and east of Maple Hill. Many small strips and bodies are encountered along Shaken and Holly Shelter Creeks.

The type occupies the flat, level, piny woods areas, having a slightly undulating to gently rolling character near its streams. The surface drainage is poor in the larger and flatter areas. Smaller areas near the streams are as a rule fairly well drained. Open ditches would be adequate for the drainage of most of the type. Only a small proportion of the Plummer fine sandy loam is cultivated. The remainder is forested with a scattering growth of shortleaf pine, together with some sweet gum, small oaks, a few large bay trees, and a scattering of cypress. The pitcher plant is a characteristic plant over a part of the type.

The Plummer fine sandy loam is adapted to peanuts and melons, and where properly handled to corn and cotton. Under the present methods of cultivation the yields of corn and cotton are rather low. Better drainage, liming, and the incorporation of organic matter are essential to the improvement of the type.

Land of this type of soil sells for \$5 to \$15 an acre.

MUCK.

The material classed as Muck has been referred to as Peat by some writers. This material consists of a black vegetable matter, only partially decomposed, and containing many roots and small fibers,

and varying in depth from 1½ to 7 feet, with an average of about 3 feet. The interior of Angola Bay is composed almost entirely of mucky and peaty material, while the marginal areas contain more mineral particles. The ground is spongy and shakes when walked upon. A stick or soil auger can be easily pushed through the material to a depth of 3 to 5 feet. Holly Shelter Bay is similar in many respects to Angola Bay, except that the peaty material is not quite as deep or as uniform throughout the bay. While there are a few small, low ridges of sand in Angola Bay, these are much more numerous in Holly Shelter Bay. Many small Swamp areas occur in these bays but it was not practicable to separate them. In many places, especially around Holly Shelter Bay, no definite boundary lines could be drawn between the Muck and the Portsmouth fine sand, on account of the thick undergrowth and swampy conditions, which render such areas almost impenetrable. In Angola Bay many cypress and juniper logs were encountered at depths of 3 to 7 feet during the construction of the road across the bay. The mucky material is usually underlain by a white or light-gray fine sand, and in a few places by clay or marl.

There are two very large and continuous areas of this soil in Pender County, one in Angola Bay and the other in Holly Shelter Bay. Each of these comprises an area of several square miles. There is also a small body east of Roan Island.

The surface of the Muck is uniformly flat and comparatively level. In Angola Bay the elevation at the Duplin County line is 32 feet and at Crooms Bridge 16 feet, giving a fall of nearly 3 feet to the mile from north to south. There is also a very gradual slope to the east. Holly Shelter Bay has a slight slope to the east and south. Angola Bay was burned over in places in 1904 to a depth of 18 inches, and in spots holes were burned out several feet deep. Throughout the area there are many small tussocks which were not burned and stand out prominently. No natural drainage channels have been established. Only a few streams have their origin in the bays, and these rise mainly near the edge. The only drainage is effected through the two ditches bordering the one road which traverses Angola Bay. The flow through these ditches indicates that the middle of the bay is much higher than the edge. In ordinary seasons the water table is near the surface, and after heavy rains the surface is covered with water for a few days. A survey of a part of Angola Bay has been made by the Office of Experiment Stations, Drainage Investigations, United States Department of Agriculture. As a result of this work it was estimated that the main drainage of this bay could be accomplished by large canals at a cost of \$2.40 per acre.

The areas now occupied by the Muck were formerly old bays which supported a growth of juniper and cypress, and have since been filled in by the decay of sphagnum mosses, grasses, and the leaves, twigs,

roots, and limbs of trees and shrubs. The Muck in the interior of the bays contains practically no mineral matter, but this material increases as the edges of the bays are approached. The decomposition of the vegetable matter has proceeded to a rather advanced stage, though the material is still somewhat fibrous and peaty in character in many places.

None of the Muck has been cleared, except a small spot on the southwest side of Angola Bay. The principal growth in the bays is bay pine, together with bay bushes, mainly hull bay, which constitutes probably one-half of the undergrowth, with many ferns and vines. Near the borders, where there is considerable fine sand or clay in the soil, rushes and switch cane grow.

Muck, when properly fertilized, is well suited to the production of onions, cabbage, beans, potatoes, and celery. Corn can be produced and also the grasses, but the land is not well adapted to general farming. The Muck contains little if any lime and is acid in character.

When the Muck is drained and dried out it burns readily. The greater part of the Muck type belongs to the State Board of Education of North Carolina. It has been offered for sale at a very low price. In its present condition it has no agricultural value, and its forest growth would hardly pay for the clearing of the land. There is no doubt that it can be drained, but this is a large undertaking and would require considerable capital.

HYDE SAND.

The Hyde sand in typical areas consists of a black, mucky, loamy fine sand with a depth of 36 inches or more. A small quantity of white sand, from which the organic matter has been leached out, occurs on the surface. In two or three bodies northeast of Burgaw the soil is a black to dark-brown, loamy, mucky sand, with a depth of 20 inches, passing into a dark-brown, loamy sand. In the western part of the county the soil is commonly a black, mucky sand for 10 to 15 inches, underlain by a brown fine sand, which is sometimes underlain by a grayish or white sand. Again, in spots, from 6 to 10 inches of Muck is encountered, overlying a brown fine sand. Generally the sand particles are of the fine grades, but in local areas they are coarser than this. Underlying the mucky sand at 3 to 5 feet, a white sand is generally encountered.

This type has a small extent in the county, and its separation from the Muck and Portsmouth fine sand is difficult. It is developed in several bodies in the extreme western end of the county, southeast and southwest of Currie, and northeast of Burgaw. There are a few other patches, particularly near Angola Bay.

The surface of the Hyde sand is uniformly level and flat. It is wet and soggy and poorly drained, the water table being near the

surface. Its position is such that it can be artificially drained. This type comprises former swamp or bay areas which have been filled in by decayed vegetation mixed with considerable mineral matter. Bordering Angola Bay some marl occurs under a part of this type. The native growth consists of gums, a few pines, and cypress, with a thick undergrowth of rushes, bay bushes, and vines.

Only a few patches of this soil have been cleared and drained. Where it has been reclaimed and limed it is well suited to corn, celery, Irish potatoes, cabbage, and onions. In addition to lime it requires fertilization for profitable crop production. It is a mellow, light soil and is easily tilled with any kind of machinery. Corn is grown to some extent, and yields from 20 to 40 bushels per acre are obtained. A luxuriant growth of grass develops on the land which has been cultivated and abandoned.

It is not easy to place any value on this soil, as it is seldom sold except in conjunction with the adjoining types. It has a value of probably about \$10 to \$30 an acre for improved land and \$5 an acre for the uncleared areas.

CONGAREE SILT LOAM.

The surface soil of the Congaree silt loam is a light-brown to light-chocolate, heavy silt loam extending to a depth of 6 to 8 inches. Throughout the type there are small, low ridges and knolls of light-brown to pale-red fine sand or fine sandy loam. The subsoil to a depth of 36 inches is a heavy silty loam, slightly darker in color and somewhat more sticky than the soil. Both the soil and subsoil are fairly uniform in texture. The subsoil in places is underlain at 30 to 36 inches by a gravelly stratum. Finely divided particles of mica are a characteristic of this type.

The Congaree silt loam occurs in the extreme southwestern part of the county, being confined exclusively to the bottoms along Cape Fear River, where it occupies a continuous strip varying in width from one-half mile to 1½ miles. It also comprises Roan Island. It has a flat and level surface broken only by sloughs parallel with the river and very low knolls and ridges. The depressions contain stagnant water in dry seasons. All of this type is subject to heavy and protracted overflow with every freshet. Its drainage and reclamation is impossible, except by constructing high dikes to prevent inundation during floods and by installing pumping plants to remove the waters accumulating from rains.

This soil is of alluvial origin and has been formed from material brought down from the Piedmont Plateau region of the State and deposited by Cape Fear River. This accounts for the uniformly fine texture of the soil and the presence of mica, which has come from the weathered product of gneiss and schist rocks of the plateau region.

Practically all of this soil is heavily forested with sweet gum, black gum, pine, ash, with some cypress and oak. The soil in its present condition is only valuable for its timber. The larger areas are grazed during the drier seasons. With reclamation the type is capable of producing excellent crops of corn, oats, and grasses.

LEON SAND.

The Leon sand is a loose, incoherent white sand of fine to medium texture, with a depth of 36 inches or more. In a few depressions and flatter spots the surface for the first few inches is gray to black, while on some of the ridges a slightly brownish tinge is observed. In local spots, particularly in the flat areas near Smiths Bridge and in the western part of the county, the sand is medium to coarse in texture. The surface soil in many places has been bleached, and at a distance has the appearance of snow. The flat spots are soggy, and in such places the structure is more compact.

While there is no extensive development of the Leon sand in Pender County, there are many small areas in the western, southern, and eastern sections. It occurs between the Northeast Cape Fear and the Cape Fear Rivers, along the New Hanover County line, and extends southeast of Long Creek. The type is also developed in numerous bodies on the east side of the Northeast Cape Fear River, being quite conspicuous east of Lanes Ferry, and in spots along the Wilmington & Newbern Branch of the Atlantic Coast Line around Topsail and Woodside.

The characteristic topography of the Leon sand is formed of ridges, knolls, and rolling areas which in many instances rise from 5 to 20 feet above the surrounding soils. There are a few flat areas, such as that near Smiths Bridge. Drainage is well developed, owing to the open texture of the soil and its rolling surface. The soil is very droughty.

A part of the Leon sand closely resembles an old shore line, and the material was evidently deposited by wave and wind action. In many places it has been modified by the action of streams.

At present the vegetation consists of a few scattering longleaf pines and a fairly thick growth of scrub oak, mainly the forked-leaf variety, which nearly always designates the Leon sand and indicates a poor soil. The large, tall bunches of wire grass which cover a part of the type tend to prevent wind erosion. Wild pea vines grow in a few places.

The Leon sand has but little agricultural value in its present condition. It has no fixed selling price, although it has sold in recent years at a very low figure. Grapes, peaches, garden vegetables, early truck crops, and, under proper conditions of soil management, corn can be grown. By applying large quantities of coarse manures, turning under cowpeas and vetch, and growing rye for a year or two enough

humus can be incorporated in the soil to hold moisture in sufficient quantities to permit the profitable use of fertilizers. In this way the soil can be built up at least temporarily for the production of crops.

COASTAL BEACH.

The Coastal beach consists of white to light-gray or light-brown, clean, fine sand, with a depth of several feet. It is very uniform in texture, containing in some places as much as 96 per cent fine sand. It is open, loose, and dunelike, and is held together in some places by tufts of marsh grass. A few shells are scattered through this sand.

Coastal beach is developed in narrow strips from 100 yards to one-fourth of a mile in width, and lies between the ocean and the sound. It is not continuous, being broken by two comparatively narrow inlets. It ranges in elevation from a few feet to about 40 feet above sea level, the highest and widest part of the type being that off Sloop Point. At this place it supports a growth of live oaks covered with Spanish moss, dogwood, and other trees, together with an undergrowth of bushes and grasses. This growth is unusual for the Coastal beach type.

The materials forming Coastal beach are of very recent origin from a geologic standpoint. It is a marine deposit of sand, laid down in the shallow waters at the edge of the ocean and afterwards washed up by waves and tides. Since it has been thus thrown up it has been modified by wind action. The surface is broken and irregular, consisting of ridges, knolls, and depressions. The crest of the ridge is being changed more or less by the action of winds and tides. The type has no agricultural value.

SWAMP.

The material mapped as Swamp is variable in character. It has resulted from overflows, inadequate drainage, and sedimentation. In some of the larger areas the soil is a dark-gray or drab to black loam or sandy loam, underlain by material which is slightly lighter in color and of variable texture. In many spots the type consists of a mucky loam to a depth of about 2 feet. A part of the Swamp is locally called "mud flats," and in these places the soil is a drab to black silty loam. The subsoil in places is a bluish to black silty loam or clay. Where it is developed in the more sandy areas of the county the Swamp is a black or dark-colored sandy loam or loamy, mucky sand. The coloring of practically all of the areas of Swamp is due to the organic matter content. Small, low ridges of sand occur in places, particularly along the Northeast Cape Fear River.

The Swamp type is developed along all of the streams except the Cape Fear River, the largest bodies being situated along the Black and Northeast Cape Fear Rivers, and Holly Shelter, Shaken, Moores,

Angola, Long, Rileys, Turkey, Harrisons, and Burgaw Creeks. There are bodies of this type in Green and Gum Swamps. In some places the Swamp has a width of from 1 to 2 miles.

This type is confined to the first bottoms of streams, and the surface is practically level and flat, having a gradual slope with the direction of the streams. Near the head of some of the creeks the type is several feet above sea level, but the largest bodies bordering the rivers and some of the creeks are but slightly elevated above the fresh-water tides. The Swamp is wet and a part of it is inundated practically all of the time. Only the higher areas can be drained and reclaimed by ditching. The lower-lying areas would have to be diked and the water pumped off.

This soil is alluvial in origin and consists of material which has been brought down from the surrounding soil areas and deposited by the streams. Its wet and swampy condition has favored the growth and decay of vegetable matter, which accounts for the large amount of organic matter present. The Swamp is being changed and modified continually through the deposition of material by the streams.

Only in a few places has this Swamp land been cleared and cultivated. Most of it is heavily forested with large black and sweet gums, together with some cypress, white oak, ash, hickory, poplar, and a few pines. In its present condition the main bodies are nonagricultural. There are, however, a few spots which can be drained and reclaimed and cultivated. Clearing the land is quite expensive, as the hickory, oak, and cypress stumps are difficult to remove. Where reclaimed this is a very productive and lasting soil, and one especially suited to the production of corn and grasses. The few bodies now cultivated produce heavy yields. Most of the Swamp is desirable only for its timber, which is steadily increasing in value.

TIDAL MARSH.

The Tidal marsh comprises the shallow sounds and numerous narrow channels, together with broad expanses of typical salt marsh lying between the mainland and the beaches. The soil is a bluish-drab loam or heavy sandy loam or clay to a depth of a few inches, where it passes into a bluish to steel-colored clay loam extending to depths of 3 feet or more. In some places a gray to drab-colored sand is encountered at about 30 inches. Lime nodules and large quantities of shells are present in many places.

The areas of Tidal marsh in Pender County vary from $1\frac{1}{4}$ to nearly 2 miles in width. The vegetation consists of a luxuriant growth of salt or marsh grass. Most of the type is inundated at normal high tide, and any wind or storm tide completely submerges even the tallest grass. This grass furnishes some grazing for Shetland ponies. No attempt has been made to reclaim any part of this land. It would

be necessary to dike these areas against sea water and to establish drainage outlets in order to effect their reclamation. In addition it would be necessary to remove the excess of salt. The soil if reclaimed would be well adapted to such crops as cabbage, rice, hay, and corn.

SUMMARY.

Pender County lies in the southeastern part of the State, bordering the Atlantic Ocean for about 14 miles and extending inland for about 43 miles. It is one of the larger counties of the State, containing 857 square miles, or 548,480 acres.

The elevation of the county varies from sea level to about 65 feet. The surface consists of level and very gently rolling areas, with dominantly flat, broad upland areas, some of which are locally termed "savannas," and bays, and pocosons. The Cape Fear, Black, and Northeast Cape Fear Rivers, with their numerous tributaries, furnish fairly good drainage outlets.

With the exception of a large colony of Italians at St. Helena and a small Dutch settlement at Van Eden, the population is mainly of English descent. A population of 15,471 is reported for Pender County in the 1910 census.

There are large undeveloped areas of good soil in the county which can be brought under cultivation at a small expense through the inauguration of an extensive system of drainage. In other prominent bodies, mainly the bays and pocosons, the soil would not be very productive if reclaimed.

The county is supplied with good facilities for transportation, both by rail and water.

The climate is mild and well suited to the production of cotton, corn, tobacco, and early truck crops.

The soils of Pender County are derived from the materials which were brought down from the Piedmont and Appalachian regions and deposited while this section was beneath the sea. Since its emergence weathering, erosion, and drainage have resulted in the formation of three important soil series, including a total of 23 separate types.

The Norfolk series comprises the light-colored soils with yellow friable subsoils. These soils have a wide distribution over the county and possess the best drainage of any of the types mapped. They are adapted to cotton, corn, tobacco, peanuts, cowpeas, crimson clover, sweet potatoes, grapes, tree fruits, small fruits, and a large variety of truck crops.

The Portsmouth types have dark to black surface soils and mottled gray and yellow subsoils. A part of this series remains in a semi-swampy condition, the surface drainage being poorly established. Strawberries make their best development upon the sandy loams,

while cucumbers, corn, Spanish peanuts, oats, cotton, and other crops do well.

The Parkwood soils occupy a relatively small area in the vicinity of Rocky Point and east of that town. The surface soils are light to dark in color and the subsoils are mottled yellow, olive, and gray, with bluish areas in a few places. These soils are particularly suited to the production of peanuts, corn, string beans, Irish potatoes, oats, and cotton.

The various other soils comprise a large total area, including the pocosons or bays, but are relatively unimportant agriculturally in their present undrained condition.

Cotton, corn, peanuts, and other general farm crops are produced. In addition to these staple products, strawberries are grown commercially, and a few Irish potatoes, cucumbers, string beans, some lettuce, radishes, and other truck crops are also grown for shipment. Rocky Point is the main shipping station for the truck, particularly for strawberries, although some of these products are shipped from Burgaw. The growing of peanuts is the most important industry along the coast.

There is a wide variation in the prices asked for the different soil types in the county. Large areas of Muck, Leon sand, and some of the Portsmouth fine sand can be bought at \$2 per acre up, while the best improved Norfolk and Parkwood soils and some of the Portsmouth soils near the towns are held at \$20 to \$100 an acre. Good farming land 4 to 10 miles from the towns can be purchased for about \$10 an acre.



[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture "

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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