

SOIL SURVEY OF THE WAYCROSS AREA, GEORGIA.

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DESCRIPTION OF THE AREA.

The Waycross area is located in the heart of the "wire grass" section of southeast Georgia, about 60 miles inland from the coast, and covers the main part of Ware County. The thirty-first parallel of north latitude forms the southern boundary of the area and separates it from Charlton County and a southern extension of Ware County. Clinch County lies on the southwest, and Coffee County on the west and also north of that portion extending westward on the south side of the Satilla River and Red Bluff Creek, which separate this westward extension from it. Appling County forms the extreme northern boundary and Pierce County the entire eastern boundary. The eastern boundary north of the river has been made a straight north and south line, and within the area is

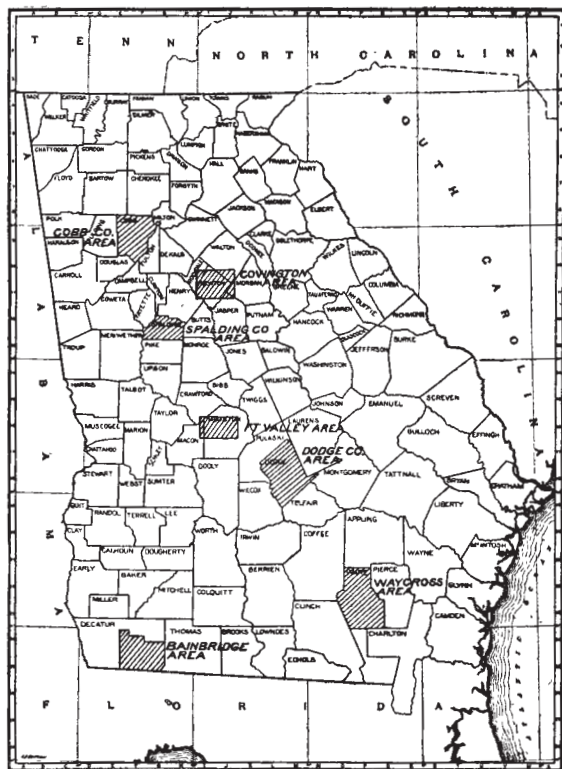


FIG. 9.—Sketch map showing location of the Waycross area, Georgia.

included a part of the territory of Pierce County. The Satilla River forms the northeastern boundary between Pierce and Ware counties for about 8 miles, the remainder of the northeastern boundary being formed by a line along the Atlantic Coast Line Railroad tracks east of Waycross.

The general topographic features of the region in which the area is located are those of a low-lying level plain. The highest point—150 feet—which could be accurately located is at Glenmore, in the southwestern part of the area. It is likely, however, that the elevation of some of that part of the survey north of the Satilla River will exceed this figure. The elevation of the lowlands and of Okefenokee Swamp in the southern part of the area is of course somewhat less. The elevation at Waycross is 137 feet, and a few miles distant where the Atlantic Coast Line Railroad crosses the river the elevation is 65 feet. Thus it is seen that there is no considerable variation in the elevation of the different parts of the area. The narrow bottom lands along the river are frequently overflowed, the gradient of the river not being sufficient readily to remove the surplus water after heavy rains. On each side of the river and its larger tributaries erosion has developed a more varied topography than is possessed by the greater part of the area, the small streams having cut their way back into the low plateau and given rise to a more rolling topography and a greater variation in soils. These rolling areas are better drained than the interstream areas and the undivided plateau.

In the southern and southwestern parts of the area characteristic "palmetto flatwoods" form the interstream areas. Drainage lines are here ill defined in many parts, and where established have little fall. The differences in elevation in these flatwoods are slight and each heavy rain overtakes the ability of the water courses to remove the excess of surface water. In most parts of this region the chief means of drainage is lateral seepage, and when the water courses are overflowed this process is practically at a standstill and the soils of the whole region become saturated. An important variation in the characteristic flatwood region occurs in the vicinity and to the north of Manor. This consists of slight elevations above the general level, which are indicated on the soil map as a separate soil type. Throughout this region there occur numerous large and small bays or basin-like depressions, the opposite of the low elevations. These vary in extent from a few square rods to several square miles, the largest being Cluffs Bay, lying northwest of Ruskin.

The principal drainage system is formed by the Satilla River. This river rises in Irwin County and after flowing across Coffee County joins Red Bluff Creek about 2 miles from the extreme western boundary, then flows in an easterly direction to Waltertown. From Waltertown it flows southeast, forming part of the northwestern boundary line of the county. The northern part of the area is drained entirely by tributaries of the Satilla, the largest and most important being Seventeen Mile Creek and Hog Creek. From the south and southwest it receives Perch Creek, Coxs Creek, Kettle Creek, and a few

others. In the northeastern part is Little Hurricane Creek, which also belongs in the Satilla system. Big Creek, in the eastern part of the county, is another branch of the Satilla.

The drainage of the southern and southwestern parts of the area is into Okefenokee Swamp, thence by the St. Marys River into the Atlantic Ocean and by the Suwanee River into the Gulf of Mexico. The largest streams emptying into the swamp are Double Branches, Gum Swamp Black River, Alligator Creek, Camp Branch, and Suwanee Creek. All these flow through the flatwoods in shallow troughs, not having developed any real channel. They divide and reunite in many places, the interstream areas being only slightly above the streams themselves. The northern end of Okefenokee Swamp occupies a considerable area in the southeastern corner of the survey. It is mapped as Swamp and will be further discussed under that head.

The early settlers of the county were largely hunters and fishermen and were mostly Georgians. At a later period many settlers came in from the Carolinas and some from the other Southern States. Practically no foreigners have settled in the county and until within the last few years settlers from the Northern States have been few. The population in 1830 was only 1,205. From this time to the period immediately preceding the civil war there was a gradual increase, but between 1850 and 1870 there was a considerable decline. Since 1870 there has been a healthy growth, the population about doubling each decade. The present population of the county is about one-third colored, and is estimated to be about 18,000, an increase of 5,000 since 1900. This rapid increase has been largely in Waycross instead of the country districts, the growth of this town as a railroad center causing a rapid influx of population. More land is, however, being cleared and brought under cultivation each year. The best settled portion of the country district is the rolling land along the streams and in the vicinity of Manor. The interstream areas and the flatwoods in the southern part of the area are sparsely settled and but little cultivated.

Ware County was formed from Irwin County in 1824 and named for the Hon. Nicholas Ware, then representing Georgia in the United States Senate. The county seat was located at Waresboro. The county has since lost a large portion of its original territory by the formation of Clinch County in 1852 and Pierce County in 1857.

Waycross, the county seat and largest town, is a thriving city of about 8,000 inhabitants. It is a railroad center, being the meeting point of five lines of the Atlantic Coast Line Railroad, radiating in as many directions, and a branch of the Atlanta, Birmingham and Atlantic Railroad. Here are located a car and manufacturing company's plant, employing several hundred men, the general hospital of

the second division of the Atlantic Coast Line, a large steam-pressure turpentine extracting plant, and several smaller enterprises. There is now (April, 1906) in process of construction the repair shops of all of the lines of the Atlantic Coast Line south of Savannah. It is said that these shops will be the largest in the South, costing about \$500,000, and will employ from 1,500 to 2,000 men. Manor, Millwood, and Waresboro are towns of a few hundred population, located in some of the best farming sections of the county, and are important country trading points. Bickley, in the northwestern part of the area, the only post-office not on the railroad, is located in a good farming section. Fairfax and Beach are sawmill towns. At these and other points both in the interior and on the railroads are located numerous turpentine stills. The operation of these stills, the cutting of railroad cross-ties, firewood, etc., are extensively carried on.

Ample transportation facilities are afforded for all parts of the area. The Atlantic Coast Line has lines to Savannah and the markets of the North, to the coast at Brunswick and Jacksonville, to the interior of the State at Albany, and to Montgomery and the West and Florida west coast points by the same line as far as Dupont. On all of these lines fast and efficient schedules are maintained, especially over the main line to Savannah and the North. As all these lines belong to the same system there is an utter lack of competition. The northern part of the area is traversed by a branch of the Atlanta, Birmingham and Atlantic Railroad, which makes connections at Nichols for Brunswick, Atlanta, and Birmingham.

The county roads are far above the average for a "piney-woods" section. In the last few years the county officials have taken advantage of a State law allowing them to employ the county convicts for public-road improvements. Already many of the main roads have been straightened, cleared, and graded, and many of the larger streams bridged. This road-building work is still in progress, and it is likely that many of the roads mapped in this survey will be changed as the work progresses. These good roads enable the farmer to reach the market at Waycross easily and also to haul his produce to railroad points for shipment to the coast or to the northern cities.

CLIMATE.

The climate of Ware County is similar to that of southern South Carolina, southeastern Georgia, and northeastern Florida. The winters are mild and open, snow rarely falling, and the summers are long and hot. Farm work can be carried on during the whole of the year, and no shelter for stock is necessary.

The following table gives the normal monthly and annual temperature and precipitation as recorded by the Weather Bureau station at Waycross.

Normal monthly and annual temperature and precipitation.

Month.	Waycross.		Month.	Waycross.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	° F.	Inches.		° F.	Inches.
January.....	50.0	3.17	August.....	81.5	6.16
February.....	52.6	3.82	September.....	76.7	4.85
March.....	59.4	4.44	October.....	68.1	2.93
April.....	65.9	2.80	November.....	57.9	1.40
May.....	74.8	2.75	December.....	51.5	3.82
June.....	80.3	5.14	Year.....	66.7	46.73
July.....	82.2	5.45			

From this table it is readily seen that the rainfall is ample and is evenly distributed through the year, the greatest precipitation occurring during the summer months or growing season. The summer is practically eight months long, there being five months of excessively hot weather. July is the hottest month, with a normal temperature of 82.2° F., while May, June, August, and September are only a few degrees cooler. The extreme heat is tempered to a large extent by the movements of air currents, and oppressive nights are almost unknown. The winter months are not cold, although the humidity makes the cold more penetrating than the same temperature at higher altitudes. January, the coldest month, has a normal temperature of 50° F. The growing of winter truck crops, such as lettuce, radishes, onions, etc., can be carried on successfully during the winter.

The following table gives the dates of the first killing frosts in fall and the last in spring:

Dates of first and last killing frost.

Year.	Waycross.		Year.	Waycross.	
	Last in spring.	First in fall.		Last in spring.	First in fall.
1889.....	Mar. 9	1898.....	Apr. 8
1900.....	Mar. 4	Nov. 10	1903.....	Feb. 19	Nov. 19
1901.....	Mar. 17	Nov. 17	1904.....	Feb. 14	Nov. 15
1902.....	Mar. 20	Nov. 28	Average.....	Mar. 9	Nov. 18

From this table it is seen that killing frosts are likely to occur during four months of the year, from the middle of November to the middle of March. This period is very frequently shortened in the spring from ten to forty days, and only once in the last seven years has it been lengthened. The earliest frost occurring in the fall was on November 10, 1900, the latest in the spring was on April 8, 1898. The average length of the growing season for tender vegetation is two hundred and fifty days, or from March 9 to November 18.

AGRICULTURE.

The first settlers in this section of the country gave but little attention to agricultural pursuits. Game and fish were abundant, cattle and hogs could live the whole year on the open range without feeding or attention, and a living was secured with little effort. Each family cleared a small patch for growing corn and a few vegetables. Their life was simple and their wants few and easily supplied. The mild climate did not call for any great expenditure for clothing, the only necessity supplied by the outside world, and this was paid for by the sale of hides and furs. Land was worth almost nothing, there being no way of marketing the now valuable pine timber.

Rice was introduced at an early day and was considerably grown until recent years. The quality is said to have been all that could be desired, but the low yields, 224 pounds per acre in 1899, and the cheapness of the product on the market caused the acreage to decline until now there is practically none grown. About twenty years ago quite extensive pear orchards were set out near Waycross, but just as they were coming into bearing at five years of age the blight struck them, and since then they have received no care. They still bear considerable fruit, however, in spite of the blight and lack of care. The Le Conte is more affected by the blight than the Kieffer. A nursery was established at Waycross, but because of the danger of spreading the blight and scale it was destroyed by the authorities.

The growing of Sea Island cotton was commenced some time prior to the civil war, and although the acreage has never been large it has been the chief money crop of the area. In recent years the acreage has been materially increased. Sugar cane was also introduced at an early day. The growing of truck crops has never received any serious consideration.

The agricultural practices have been crude until recent years and there is still much room for improvement. The fields of the early settlers were seldom if ever cleared of stumps. One mule was used in the preparation and cultivation of the fields. The surface was scratched rather than plowed, and the crops seldom received proper care and attention. Although some of the fields have been cleared of stumps, there are many which have not. There are some farm implements of the latest improved pattern in use, but the greater number of farmers still use the old-fashioned inefficient, one-horse implements, even on fields free from stumps, where the former would be of far more service.

The principal crops grown are corn, cotton, sugar cane, sweet potatoes, and vegetables. Although having the largest acreage, corn is

not a money crop, being grown only to feed the stock used in tending the land. It is not possible to grow corn for the market, since the cost of raising it on these light soils of low productivity equals or exceeds the ordinary market price. Of all the crops grown cotton is the chief money crop. The long-staple Sea Island variety has been grown to a much larger extent than the short staple. The climate of the region is considered ideal for its production. The yields with proper fertilization are considered satisfactory and the quality is good. There has been a gradual increase in the acreage in the past few years, but this season (1906) there is a tendency to plant more of the Upland short-staple cotton, owing to the relatively high price of the latter. There is still plenty of room to increase the production of the long staple, and it would seem that with the limited area in this country in which it can be successfully grown the future development of this section will depend largely upon its production.

Although the soils are light and naturally of low productivity for such crops, the growing of sugar cane for the manufacture of table sirup is of considerable importance. Dr. H. W. Wiley,^a Chief of the Bureau of Chemistry, of this Department, says:

In one particular industry Florida and the southern parts of Georgia and Alabama stand preeminent, and that is in the manufacture of table sirups from sugar cane.

The Waycross area is in the heart of that section of Georgia referred to. The soils of this section produce a growth of cane which makes a sirup of exceptionally fine flavor. The analyses of juices from 22 samples of cane from Ware County gives results (basing computations on data afforded by the same publication) as follows: Sucrose, 13.425 per cent; reducing sugar, 1.12 per cent; purity, 81.1 per cent. Ninety-nine samples from Georgia, including the 22 from Ware County, analyzed: Sucrose, 13.3 per cent; reducing sugar, 1.30 per cent; purity, 79.3 per cent.

By comparison it is seen that the cane from Ware County has a slight advantage both in sugar content and purity.

On these light soils the cane reaches an earlier maturity than that grown on the rich alluvial soils of Louisiana. Consequently it has a higher sugar content but a relatively higher percentage of reducing sugar. This, however, is an advantage in the manufacture of sirup, as the reducing sugar tends to prevent crystalization. Doctor Wiley concludes that although the sugar content of the cane grown in this section is high, the manufacture of sugar would not prove profitable on account of the short manufacturing season.^b

^a Bulletin No. 70, Bureau of Chemistry, U. S. Department of Agriculture.

^b For a full discussion of cane growing and sirup manufacture, see Bulletins Nos. 70, 75, and 93, Bureau of Chemistry, U. S. Department of Agriculture.

The sweet potatoes and other truck crops produced find a ready market and are no small item in the farmer's income.

There is no recognition of the adaption of different soils to special crops except in a very general way. Corn and cotton produce better on those soils having a heavier subsoil and they are more generally used for these crops, probably not so much because of the difference in soils as for the better drainage. But little cotton is planted on the Portsmouth fine sand for the same reason. In fact the location of fields and the distribution of crops bears more relation to drainage than to the differences in the soils themselves.

In general no regular rotation of crops is practiced, though some of the more progressive farmers are beginning to recognize its importance. One farmer suggests a four-year rotation as follows: Sugar cane, potatoes, corn with cowpeas or velvet beans, and cotton. This includes all of the general farm crops grown and is to be commended, though it would be better to give the land exclusive occupation by some legume at least once in four years. When sugar cane is grown there is always a rotation, as it is rarely planted on the same field two years in succession. Corn can not be grown after cane, and cotton does not do well, so the cane field is usually planted to potatoes and is then used for other crops.

The methods in use are characteristic of a low, flat country, and have been developed through the necessity of securing drainage, for which reason ridge cultivation is most commonly used. Land is cheap and consequently little care is taken to maintain its productivity.

Labor for farm work is very difficult to secure. The manufacture of turpentine and rosin, the cutting of railroad ties, lumber, and wood, and the railroad shops at Waycross absorb all of the available labor. These industries can afford to pay higher wages than the farmer can possibly pay, consequently the farmer must content himself with growing only what he can tend with his own family. Labor is both white and colored and is not very satisfactory.

The land area of Ware County is given by the Twelfth Census as 432,640 acres, of which about one-third is classed as farm land and two-thirds as wild land. Only 19,939 acres of farm land is classed as improved land, or less than 5 per cent of the whole county.

The average size of the farms is 210.1 acres, and 67.3 per cent of them are operated by the owners. A small percentage of the farms are owned by negroes. The average value of improved land as given for taxation purposes in 1900 was \$1.86 per acre and for wild land \$0.18 per acre. A large number of the fields are well fenced, the best patterns of patent woven-wire fencing being used. A great deal of this fencing is now being done around new fields and in replacing the poor pine-rail fences.

In the last few years there has been considerable buying of land and prices have advanced sharply, in some cases several hundred per cent. One man now controls more than 50,000 acres, much of which was secured at a very low figure. A few years ago "land lots" (a land lot contains 490 acres) favorably located could be bought for from \$250 to \$500. Some of these lots not so favorably located are now held at \$4 an acre. Around Waycross land is held at prices prohibiting its use for agricultural purposes. A great deal of the flatwood region is at present valuable only for the timber or the turpentine that may be secured from it.

In the improvement of the agriculture of the area the matter of winter grazing is of the utmost importance. During the late fall and winter the native grasses become dry and have very little nutritive value. The cattle run on the free range and are neither sheltered nor fed. The mildness of the winters makes shelter unnecessary, but many of the cattle are scarcely able to survive the winter on the poor feed they are able to pick from the dried grasses and consequently, if they do not starve to death, they are reduced to mere skeletons and are hardly able to move about. In most parts of the area it would be possible to provide against this by planting oats, rye, or velvet beans to furnish winter grazing.

The fields should be cleared of stumps and improved implements used. By so doing the acreage cultivated could be increased, better yields obtained, and the labor problem partially solved. Some of the farmers have recently built comfortable houses and there is no reason why all should not have them. The material for building is close at hand and they can be built very cheaply. Improvement of the corn and cotton seed by proper selection should receive attention from every farmer. In this way the yield secured from the light soils of low productivity could be appreciably increased.

SOILS.

The soils of the Waycross area fall into two series of the Atlantic Coastal Plain—the Norfolk and the Portsmouth. They have been mapped as six different soil types, four of the former and two of the latter series, together with three nonagricultural types, Sandhill, Meadow, and Swamp.

The following table gives the name of each soil type and its actual and relative extent:

Areas of different soils.

Soil.	Acres.	Percent.	Soil.	Acres.	Percent.
Portsmouth fine sand.....	205,568	52.7	Norfolk fine sandy loam.....	11,328	2.9
Portsmouth fine sandy loam.	43,840	11.2	Meadow.....	10,624	2.7
Norfolk sandy loam.....	30,208	7.8	Sandhill.....	5,888	1.5
Norfolk sand.....	27,904	7.2			
Norfolk fine sand.....	27,776	7.1	Total.....	390,080
Swamp.....	26,944	6.9			

These soils are derived from the Columbian and the Lafayette formations. The thickness of the Columbian formation is variable, but it is rather thin and superficial as a whole, since the Lafayette is exposed in many cuts only a little beneath the surface. The unconsolidated material of these two formations taken together is of considerable thickness. A well at Waycross passed through 333 feet of unconsolidated Columbian, Lafayette, and older deposits, at which depth a cherty limestone rock, probably the Vicksburg-Jackson, was encountered. It is believed, however, that the depth of these formations is considerably less in the northern part of the area.

The Norfolk soils are the result of the establishment of better drainage and the consequent greater erosion. The two sandy loams of this series are the results of erosive agencies cutting through the superficial Columbian sands and the commingling of the materials of both the Columbian and Lafayette formations. The Norfolk soils are the trucking soils of the Atlantic coast and are widely distributed. The soils of the Portsmouth series are composed of the Columbian sands, with scarcely any modification, except what has resulted through the accumulation of organic matter. Drainage has not become well established, and the consequent accumulation of decaying vegetation has made the surface soil dark colored. These soils are of wide extent and usually but little cultivated. Swamp represents a still more imperfect condition of drainage and a consequent greater accumulation of organic matter in various stages of decomposition. Sandhill is quite likely wash material deposited at a time when the river was at a considerably higher base level than now, while Meadow is the present river bottom and overflow land. In addition to the fact that they are derived from two distinct though somewhat similar geological formations, the soils of the Waycross area are separated into two series, because of the difference in drainage conditions and of their different value for agriculture. Their separation into types just pointed out depends upon differences in texture. These two series of soils occur throughout the greater part of the Atlantic and Gulf coastal plains.

NORFOLK SAND.

The surface soil of the Norfolk sand as it occurs in this area is a gray or brown medium to coarse sand, with a depth of about 7 inches. It is almost always loose and incoherent, and a good tilth is easily secured. The subsoil from 7 to 36 inches is a loose incoherent yellow sand, usually coarser and lighter in texture than the soil. The color is sometimes brown, and whether brown or yellow is often mottled with red in its lower depths. The structure is generally more open than that of the soil—the latter showing the binding effect of the accumulation of small quantities of organic matter—and offers little resistance to the movement of the ground water. In both soil and

subsoil there is usually a noticeable quantity of fine quartz gravel and very coarse sand, which are left on the surface when the finer particles are washed away by heavy rains, and make the soil appear coarser than it really is. This coarse material is either pink or white in color and the particles are angular in shape. In many places where this soil borders on the sandy loam and also in some of the isolated areas the subsoil becomes slightly sticky at 36 inches, a sandy clay being found at no great depth below. In other places the whole section is a loose sand to a considerable depth. That body of Norfolk sand mapped in the southeastern part of the area differs from the typical section in that there is developed in the subsoil the brown crust characteristic of the Portsmouth fine sand.

The largest areas of the Norfolk sand occur in irregular shaped bodies along the river and its tributaries, and are associated with the Norfolk sandy loam on the one side and the Portsmouth fine sand on the other. There are also several isolated bodies located southwest of Waresboro, along the old stage road. The isolated areas are almost level and slightly higher than the surrounding country. The topography of those areas lying along the stream courses is almost level to slightly rolling. The topographic position insures adequate drainage, and this with the open texture and structure of the soil and subsoil makes the Norfolk sand a warm, early soil, and one susceptible to drought. On the level areas of the type skillful management in the way of drainage would insure a better control of the moisture conditions, and render it possible to maintain a fair moisture content until late in the season.

The isolated areas owe their origin directly to the deposition of the coarser materials in local areas at the time of the laying down of the surface materials whose weathering gives rise to the soils of the area. The remainder of the type has been developed largely by erosion and the establishment of better drainage conditions.

The native vegetation originally consisted of long-leaf yellow pine with some oaks, with a thin sod of wire grass and an underbrush of palmetto and gall-berry bushes.

The Norfolk sand is peculiarly adapted to the growing of early truck crops rather than the general farm crops. Such crops as lettuce, radishes, peas, beans, early Irish potatoes, cantaloupes, watermelons, strawberries, etc., should do well and prove profitable with good care and judicious fertilization. In fact any crop which must be liberally fertilized and forced to an early maturity would do well on this soil.^a

^a Large samples of this soil from the neighborhoods of Waycross, Braganza, and Waretown were the subject of a study by the wire-basket method to determine the local manurial requirements of this type of soil. Two of the samples were collected from fields that had been cleared for about sixty years, one of them, although at present idle, had been for many

Corn and cotton are about the only crops now grown to any extent, and in favorable seasons with liberal applications of fertilizers make satisfactory yields. Corn will yield from 8 to 20 bushels, with an average of about 15 bushels. Long-staple cotton will make an average yield of about one-fourth bale and the short staple about one-half bale. Cane is grown to some extent and makes about 200 gallons of sirup per acre. Cowpeas and peanuts are grown, but are rarely harvested, the stock being turned into the fields.

The Norfolk sand is usually plowed only a few inches deep and thrown into ridges to give surface drainage. These ridges are used as a seed bed and shallow cultivation always practiced. The corn and cotton stalks are usually gathered in the spring and burned. This practice should be followed only in case it is desired to destroy injurious insects, since by this practice the farmer is robbing his soil of the humus which it greatly needs. Instead, the stalks should be cut with the cotton chopper and later plowed under with the growth of grass and weeds. This, with the application of litter and composted matter from the barnyard, will give the light soil a more loamy texture and increase its ability to withstand drought.

Though a large proportion of the type has been cleared and brought under cultivation, its cultivated area can be materially increased. The Norfolk sand is considered one of the best soils of the area, but it is not as strong and productive for corn, cane, and cotton as the associated Norfolk sandy loam. On the other hand, it is far more desirable than the Portsmouth fine sand, as is evidenced by the clearings in many places extending only to the boundary between the two types.

The price per acre of the type is difficult to ascertain, as other types are always included with it in a land lot and it is never sold alone.

years continuously cropped, and had formerly been treated with a compost of barnyard manure, muck, etc., and the other had lately received light applications of commercial fertilizer carrying a small percentage of nitrogen and potash with rather more phosphoric acid, but no stable manure had been used nor had green manuring been practiced. Of the remaining field no history could be obtained.

The results of the tests point strongly to the necessity for the employment of fertilizers well supplied with nitrogen and potash-bearing material. Nitrate of soda used singly showed a most positive increase, and when used in combination with sulphate of potash an improvement was noticed over the nitrate alone. Acid phosphate singly or in combination was of little or no benefit. Lime used alone gave fairly good results, and when used in combination with a complete fertilizer the results were largely increased, yet not equal to the effect produced by the use of stable manure alone or cowpeas to which lime had been added, the two last giving equal results and clearly indicating the value of nitrogen, especially when supplied in the form of humus-forming materials to soils of this character.

In this test wheat plants were used as an indicator, and the results are held to be strictly applicable only to the fields from which the samples were taken, although it is believed that they apply to similar crops upon this soil type throughout the area.

The following table gives the average results of mechanical analyses of the Norfolk sand:

Mechanical analyses of Norfolk sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
14393, 14590.....	Soil.....	1.8	26.5	15.6	33.2	13.9	3.2	3.1
14394, 14591.....	Subsoil.....	2.7	23.6	15.3	35.7	16.1	3.2	3.1

NORFOLK SANDY LOAM.

The Norfolk sandy loam is the most important soil of the area. The surface soil varies in depth from 6 to 24 inches, averaging about 18 inches. It consists of a gray medium to coarse sand often containing a considerable quantity of fine rounded and angular quartz gravel and very coarse sand and almost always a high percentage of iron concretions. These are usually about as large as acorns, but there are a few locations where they are as large as a man's fist. The more shallow soil is found along the steeper slopes, and where the type becomes more gently rolling and level it is almost always deeper. The subsoil at 18 inches is usually a heavy, sticky, sandy loam which quickly grades into a dense, yellow sandy clay. Sometimes the deep subsoil is mottled with brown, red, and yellow.

The texture of the soil makes it easy to till and insures good surface drainage, the open structure makes it an early warm soil with a free movement of the soil moisture, and the texture and structure of the subsoil aid in the conservation of the soil moisture.

The Norfolk sandy loam is found only in the rolling, broken country bordering the Satilla River and its larger tributaries, principally Seventeen Mile, Hog, Little Hurricane, Perch, Coxs, and Kettle creeks. Its topographic features and location along the streams insures excellent natural drainage. The surface is gently rolling to almost hilly, and artificial drainage is unnecessary except for small local areas in the more gently rolling portion.

The type, like the associated Norfolk sand, has been developed by erosive agencies. In the development of drainage channels and in the dissection of the plain much of the finer material has been removed, leaving the coarser as a mantle covering the heavier sandy clays existing at varying depths under the whole area.

The body of the soil is composed almost wholly of silica, the gray color being due to the accumulation of a small quantity of humus. The yellow, brown, and red colors of the subsoil are due to the oxidation of different forms and combinations of iron salts.

The forest growth, now largely removed, consisted of longleaf yellow pine and a few oaks. The pines were among the largest of the whole section. In virgin fields there is a thin sod of wire grass. There are also a few palmetto and gall-berry bushes.

This is one of the strongest soils in the area. It is better adapted to the growing of corn, sugar cane, and cotton than are the other soils having sand subsoils. The use of fertilizers gives better and more lasting results, as leaching is not so rapid, owing to the more impervious character of the subsoil. Cantaloupes, watermelons, cucumbers, cabbage, peas, tomatoes, and vegetables would all do well on this type, but in view of the large areas of other soils which are adapted to these crops its use for them is inadvisable. Because of the limited area in the United States in which the long-staple or Sea Island cotton can be grown, it should be devoted to the production of that important staple. Of all the soils mapped in the area it is best adapted to pears, plums, peaches, and small fruits, the light, warm soil with good drainage making it especially desirable for these products. They have never been grown on a commercial scale, but the few peach trees planted to supply the home demand are said to produce an early fruit of excellent quality. There have been some extensive orchards recently planted on this type and on the Norfolk sand in the vicinity of Walerstown. The results from these will serve to show whether it will be advisable to extend the industry.

The ridge cultivation so commonly used in the area is not universally practiced on the Norfolk sandy loam, as the drainage question is not so troublesome. When corn is planted, the rows are about 8 feet apart, with either peanuts, velvet beans, or cowpeas planted between. Corn yields about 20 bushels per acre. The peanuts are not harvested, but furnish feed for the hogs. They are estimated to yield about 40 bushels. Oats are sown broadcast in the fall and ripen in May. They are never thrashed, but the estimated yield is about 20 bushels. Sweet potatoes yield from 150 to 300 bushels. Sugar cane will make from 400 to 500 gallons of an excellent quality of sirup. Long-staple cotton is grown to a large extent and yields from one-third to one-half bale per acre. The upland or short staple yields about twice as much as the long staple. To produce these yields the use of fertilizers is considered absolutely necessary.^a

^a The manurial requirements of the Norfolk sandy loam found in the Waycross area were determined by a study made of three large samples obtained from points near Waresboro, Waycross, and Elsie.

One sample is from an uncultivated field near the latter place, the other two are from fields that have been under cultivation for many years, upon one of which no stable manure has been used nor has green manuring been practiced, but during the last few years small amounts of commercial fertilizer of a low grade have been applied. The remaining field has received some barnyard manure, as well as commercial fertilizer, and

As stated at the beginning of this chapter, the Norfolk sandy loam is the most important and one of the strongest agricultural soils in the area. This is shown by the general prosperity of the farmers who till this soil and the better condition of the fields and neater appearance of the farmhouses. Here are found the best homes and the most progressive farmers of the county. The fields are generally free from stumps, well cultivated and cared for, and tilled according to the best system of farming practiced in the area. The type is held in high esteem, as it produces better crops and is less likely to suffer from extremely wet or dry seasons than most of the other soils. It is also easily tilled and better results from the use of fertilizer are secured.

The type is so located that its price is not affected by anything except its agricultural value. Although a good percentage of it is cleared and cultivated, there is still a considerable acreage unimproved which can be secured at reasonable prices. The cultivated area is being extended gradually each year.

The following table gives the results of mechanical analyses of samples of the fine earth of the soil and subsoil of the Norfolk sandy loam:

Mechanical analyses of Norfolk sandy loam.

Numbers.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
14201, 14586.....	Soil.....	3.6	16.6	7.2	32.8	23.9	5.6	6.6
14202, 14587.....	Subsoil.....	2.6	15.8	10.1	25.9	17.2	4.8	23.3

NORFOLK FINE SAND.

The soil of the Norfolk fine sand consists of a fine to very fine gray sand about 7 inches deep. It has a soft velvety feel, yet is decidedly a fine sand, there being less than 10 per cent of silt and clay and less than 5 per cent of material coarser than fine sand. The structure of this soil is more compact and closer than is usually the

velvet beans have been grown but not plowed under. Peanuts have also been grown, yielding about 40 bushels per acre. The yield of corn is about 20 bushels. Oats are also grown, but the yield could not be learned.

Using nitrate of soda, sulphate of potash, acid phosphate, and lime, singly and in various combinations, the greatest increase was from the complete fertilizer and lime. Of the single elements nitrate of soda gave a good increase, and sulphate of potash also increased the yield, but acid phosphate was of no benefit. The combination of nitrate of soda and sulphate of potash proved an excellent treatment, but did not equal the increase derived from the use of stable manure which was superior upon this soil to any fertilizer tried.

These tests were made with wheat plants, and while the results apply strictly to that crop, they are doubtless applicable upon this type of soil to all crops found in this area.

case with a sand. In its virgin state and in uncultivated fields it packs on the surface, yet a good tilth is always easily secured. The gray color is caused by the accumulation of a small quantity of humus at the surface which helps to give it the compact surface structure. Wherever loose incoherent areas occur the gray color appears only at the immediate surface.

The subsoil has almost exactly the same texture as the surface soil, but the color is generally a light yellow. At 30 to 36 inches the material is often mottled with brown and red and contains small, soft, iron concretions. Wherever this mottled color is found the subsoil becomes more silty and sticky, a sandy clay being found not far below.

The largest and most typical area of the Norfolk fine sand occurs around the city of Waycross in a large body which lies back from the bluff along the river bottoms and extends from Waltertown to the eastern edge of the area. There is also an area of considerable importance on the extreme eastern edge of the survey along Big Creek, besides several small isolated bodies in other parts of the country.

The topography of this type is nearly level to gently rolling. Along the streams are located the more rolling areas, while back from them the type is either level or slightly undulating, the soil in the shallow depressions or hollows being a little darker in color and a little more loamy in texture.

The drainage is usually good, except for the shallow depressions just mentioned. The texture and structure of the Norfolk fine sand are such that the movement of the soil moisture in any direction is easily effected. In time of drought crops on this soil are not as readily affected as on the coarser soils of the area, the finer texture and closer structure being favorable for the upward movement of soil moisture by capillary attraction. Likewise the texture and structure are favorable to the removal of excess water by seepage. The fine sandy clay usually occurring immediately below the subsoil makes an excellent reservoir for the storage of the soil moisture.

The Norfolk fine sand is a sedimentary soil, and is formed by the weathering of a comparatively shallow deposit of extremely fine siliceous material laid down immediately preceding the elevation of the country above sea level.

The original forest growth, which has been almost entirely removed, consisted of longleaf yellow pine, with some cypress in the depressions. Where the soil is less compact the pines are more scattering, and there is also a growth of scrub oak. The virgin fields are covered with wire grass and some palmetto and gall-berry bushes.

This type would make the best trucking soil of the area. It

is especially adapted to the growing of such crops as lettuce, radishes, cabbage, cucumbers, onions, early Irish potatoes, strawberries, etc. With the warm soil of the best drained areas and the mild winter climate prevailing lettuce, radishes, onions, etc., could be grown and marketed during the winter months, when they command high prices in the northern markets. The cucumbers, strawberries, potatoes, etc., could also generally be placed on the market early enough to bring satisfactory prices.

An attempt has been made to grow Irish potatoes, but after two seasons' trial it has been abandoned. This crop should receive further attention and a more thorough trial than can be given in two seasons. Instead of confining the attention to one crop a number of the crops mentioned should be grown, so if the price of one of them is low there will still be something to market at a profit. The greatest difficulty in marketing these crops in this vicinity is the long haul to the markets and the high express and freight rates. This can be overcome somewhat by shipping in carload lots. Cotton, sweet potatoes, corn, and cane, besides vegetables for home use and the local market, are the crops grown. The long-staple cotton yields not more than one-third of a bale per acre. Corn will yield from 12 to 20 bushels. Sugar cane does well with judicious fertilization.^a

Without fertilization of any kind cane will produce from $2\frac{3}{4}$ to $5\frac{1}{4}$ tons. With the use of various fertilizers the yields vary from the maximum without fertilization to 29 tons. Irish potatoes yield from 40 to 60 bushels when well fertilized and can be marketed early in May. Sweet potatoes are planted after the Irish potatoes are harvested, and yield from 100 to 200 bushels without additional fertilization.^b A few pecan groves are in bearing and excellent yields are obtained from them.

^aSee Bulletin No. 93, Bureau of Chemistry, U. S. Department of Agriculture, page 39. These plats were located on the Norfolk fine sand.

^bSamples of this soil were taken from points in the area near Braganza and Waycross, the former from the least productive part of a field that has been under cultivation for about twenty-five years, the last nine years being constantly planted to corn, yielding from 5 to 8 bushels per acre. Of the two from near Waycross, one was from a field cleared only a few years ago and at present in a good state of cultivation. In 1905 it received a light application of low-grade fertilizer, but no manure has been used; the other has grown corn with and without fertilizer, the yields being 15 bushels when 200 pounds of low-grade fertilizer was applied and 6 bushels when no application was made. Green manuring does not appear to have been practiced, nor has any barnyard manure been applied in either case.

With these soils the results of a test by the wire-basket method demonstrate the value of nitrogen in increasing their productive capacity, nitrate of soda alone giving an increase equal to any combination, except when it was used with both acid phosphate and sulphate of potash. Sulphate of potash and acid phosphate singly had but little effect. Lime used alone gave fairly good results, but did not appreciably aid the complete fertilizer. Again

The cultural methods in use are similar to those employed throughout the region, the land being thrown up in ridges upon plowing. This method is to be commended for wet seasons, but in general more level cultivation is to be desired, especially during dry seasons. Shallow surface cultivation is usually given the growing crops, but this is seldom carried on after the crops are well started. The need of shallow cultivation for dry seasons and during droughts can not be too strongly emphasized. It makes a dust mulch which prevents the loss of soil moisture by evaporation, and when practiced a good moisture content is almost sure to be found within reach of the roots of the growing crops. One farmer reports having saved a crop of corn by this method when his neighbors' crops were ruined by a protracted drought.

The agricultural condition and value of the Norfolk fine sand can not be attributed so much to its characteristics as a soil type as to its location in the area. In the vicinity of Waycross it is held at prohibitive prices for general agriculture, \$100 an acre for unimproved land not being uncommon. From 4 to 5 miles from the city it is held at from \$10 to \$25 an acre, according to the amount of timber that can be cut from it. Some of the finest buildings seen in the area are located on this type in the vicinity of Waycross.

The appended table gives the average mechanical analyses of representative samples of soil and subsoil of the Norfolk fine sand:

Mechanical analyses of Norfolk fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
13968, 14492.....	Soil.....	0.3	2.0	2.6	53.0	34.6	4.9	2.4
13969, 14493.....	Subsoil.....	.2	1.3	2.0	51.8	37.1	3.9	3.3

NORFOLK FINE SANDY LOAM.

The soil of the Norfolk fine sandy loam is very similar to that of the Norfolk fine sand. The type is really the Norfolk fine sand with a heavy subsoil within the 3-foot section. The soil is a fine to very fine sand of a gray color and a depth of 6 inches. From 6 to about 16 inches the texture remains the same, but the prevailing color is a light yellow. The point of contact between the soil and the upper subsoil is sharply defined by this change in color. The subsoil from 16 to 36 inches consists of either a heavy fine sandy loam or a sticky fine sandy

the necessity for humus is pointed out by the superiority of the effect of either cowpeas with lime or stable manure, both producing considerably larger yields than any other form of fertilizer used.

These tests are held to be applicable only to the soils used and with wheat, the indicator employed, but the results may be found to be reliable for this type of soil in this section.

clay, having a yellow color. It usually grows heavier with increase in depth and is often mottled with iron stains. Both soil and subsoil contain a rather high percentage of small iron concretions, giving rise to the local term "pebbly land." The texture and structure of the soil is such that it warms up early, is well drained, and easily tilled. The subsoil is dense and prevents the passage of the soil moisture to any great depth. On this account crops do not suffer from drought as quickly as they do on those soils having a sand subsoil. Many of the areas near Manor differ from the above description in that the soil is deeper, slightly coarser, and more loamy on the surface.

This type occurs in narrow strips bordering the streams in the vicinity of Waycross and in many irregular shaped areas around and north of Manor, with a few small areas in other parts of the county. Their topographic position gives those areas along the streams good drainage. The irregular shaped areas scattered throughout the survey are not so well drained. They occur mostly in the low, flat-wood region and are only a few feet above the general level of the surrounding lowlands, where natural drainage is defective during wet seasons. This is remedied to a certain extent by surrounding the cultivated fields with open ditches. These ditches are often deeper than is necessary and tend to cause excessive leaching. They should be shallow, so as to remove only the excess of water from the surface. By this latter method many of the fields are well drained and in an excellent state of cultivation. The crops stand drought better and the results from fertilization are more lasting and satisfactory.

The occurrence of the Norfolk fine sandy loam can be attributed to marine sedimentation. It is likely that the isolated irregular shaped areas represent the tops of low elevations of the heavier sediments covered over with a thin veneer of the fine sands. The areas along the stream courses have been developed by the removal of some of the sandy mantle by erosion, leaving the sandy clay nearer the surface.

The vegetation characteristic of the virgin soil is similar to that of the better drained soils of the area, namely, a forest growth of pine, with some cypress in the low places, and an undergrowth of wire grass, palmetto, and gall-berry bushes. Cleared, uncultivated fields are covered by a thick growth of broom sedge.

The Norfolk fine sandy loam is admirably adapted to the production of the heavier truck crops like cabbage, tomatoes, and Irish potatoes. It is a stronger soil than the Norfolk fine sand, although not quite so early, and better yields of these crops should be secured. Cantaloupes, watermelons, cucumbers, strawberries, etc., should also do well on this soil.

The chief crops grown at present are corn, Sea Island cotton, and sugar cane. Corn is said to yield from 10 to 12 bushels without fertilization and from 15 to 20 bushels with the application of 150 to 300

pounds of a complete fertilizer. This soil is considered very desirable for the long-staple or Sea Island cotton and is said to make an average yield of about two-fifths of a bale of lint cotton with the same fertilization as is used for corn. Yields of one-half bale in favorable seasons or by the more liberal use of fertilizers are not uncommon.^a The short-staple cotton is not grown to any great extent, but when grown under the same conditions as the long-staple yields about twice as great are secured. The short-staple is said to be more liable to damage by disease than the long-staple. Sugar cane is grown to a considerable extent and makes a sirup of exceptionally good quality. About 300 to 500 gallons can be made from 1 acre of cane. Sweet potatoes yield from 300 to 500 bushels. Oats are sometimes grown and make an estimated yield of about 20 bushels. They are never thrashed. Vegetables of all kinds are grown for family use.

The method in use on this type is known as the ridge method. For cotton a few furrows are thrown together with a small turning plow and the seed and fertilizer are put in on top of the ridge thus formed. For corn the ridges are made wider, making the rows about twice as far apart as for cotton, and a row of peanuts or cowpeas planted between the rows of corn. Cotton is usually planted the latter part of March and picking begins the last of July. It is said that the quality of lint is improved by topping the plants. The seed used has been secured from the sea-island district around Charleston, but there is now a tendency among the more progressive farmers to produce their own seed by proper selection, as it is now difficult to secure it from the Charleston region.

The agricultural conditions in the areas of Norfolk fine sandy loam are far above the average for the Waycross area. Many good farmhouses are seen and the cleared fields are usually free from stumps. More fields are being cleared and there is a tendency

^aA study was made of the manurial requirements of this soil, by the wire-basket method, using three large samples collected at points $5\frac{1}{4}$ miles west and 3 miles east of Waycross and 4 miles north of Manor. These fields have been under cultivation continuously for over half a century, though for short periods they have at different times been allowed to lie idle. Cotton, corn, sugar cane, and sweet potatoes have been grown on them for many years without the use of fertilizers, though recently small applications of low-grade fertilizers have been used with some advantage. The fields from which two of the samples were taken have been idle during the past two years, while the third one was in corn in 1903, cotton in 1904, and corn again in 1905, all stalks and refuse being burned each spring.

The results of these tests indicate that stable manure and cowpeas plowed under and limed have an excellent effect in increasing the growth of the crop. When nitrate of soda, acid phosphate, sulphate of potash, and lime were used singly, or in various combinations with one another, an increase was noticed in each instance, the most pronounced being a combination of all, yet it did not equal the growth obtained by the use of the humus-forming material found in the manure or the cowpea vines, lime being added to the latter.

These results are held to be applicable only to the fields from which the samples were taken, but would no doubt apply to the other soils of the same character in this locality.

toward better living and improved agricultural practices. The planters have recognized the value of this soil type in the vicinity of Manor, probably at first because of its better drainage, and later for its better crop-producing power. The greater part of the type is located far enough away from Waycross so that its value is not influenced by the inflated values prevailing in that vicinity. Unimproved areas can be bought for from \$3 to \$5 an acre, while some of the improved land can be secured at very reasonable prices. During the last few years, however, there has been a tendency toward higher prices.

The average results of mechanical analyses of typical samples of soil and subsoil of the Norfolk fine sandy loam are given below:

Mechanical analyses of Norfolk fine sandy loam.

Numbers.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
14395, 14588.....	Soil.....	1.0	5.8	5.1	42.1	35.1	6.3	4.1
14396, 14589.....	Subsoil.....	.6	4.4	4.2	36.5	31.7	6.1	17.9

PORTSMOUTH FINE SAND.

The soil of the Portsmouth fine sand consists of a fine sand from 8 to 16 inches in depth. The soil of a typical section is dark-brown or black in color to a depth of about 6 inches. This is underlain by a gray to dark-colored sand of the same texture. The subsoil consists of a brown fine sand in the upper part of the section, with a light-gray or yellow fine sand underneath. The brown sands of the subsoil are generally in the form of a dense impervious crust, both the brown color and the compact structure being caused by iron salts. The crust is from 4 to 12 inches in thickness and the underlying sands are loose and incoherent. When saturated with water they act like quicksand. Sometimes the dark color of the surface soil is wanting and in many places the brown crust of the subsoil is also absent. These areas usually consist of a loose gray sand which extends to depths greater than 3 feet. In some places at 30 to 36 inches the subsoil becomes sticky and at 36 inches a gray to drab sticky sandy clay is found. The texture of this soil varies considerably. In places it is fine, like the Norfolk fine sand, while in others it is more like the Norfolk sand. The average texture lies between these two types and, but for differences in coloration, surface features, agricultural value, and drainage conditions, the areas of this type could have been correlated with one or the other of them.

The structure of the soil is usually quite loose and pervious, except where the organic content makes it loamy. The brown crust of the subsoil is dense and impervious, holding the water in the subsoil.

The texture is favorable for the movement of the soil moisture by capillary attraction, but the compact stratum prevents it from reaching the surface where it would be available for the use of the growing crops. Where cultivated fields are seen the black color has disappeared, leaving the surface ashy gray in color.

The Portsmouth fine sand is the most extensive soil type of the area and is also the least desirable for agricultural purposes, as is evidenced by the very small percentage under cultivation. It occurs in all parts of the survey, occupying the interstream areas north of the river and a wide extent of territory southwest of a line drawn through Milwood and Waycross. This large area is broken by the indentation of the swamp and by isolated areas of other soils.

The topographic features of the type are best described by the term "palmetto flatwoods." The interstream areas occupy the highest elevations in the county and are nearly level, there being no variation in the topography. The large area in the southern part of the survey varies considerably in elevation, although the differences are not apparent to the eye. The highest part lies west of Waresboro and reaches its greatest elevation on the south side of the river. There is a gradual decline toward the southeast to the level of the swamp, the lowest part of the area, excepting, perhaps, some of the river bottoms. The inclination is so small that it is not noticeable, except for the fact that the streams flow in that direction and empty into the swamp.

Poor drainage has been one of the main factors in the formation of this type. The drainage in the more elevated interstream areas is no better than in the lower parts of the type. The streams have not cut their way back into these areas, and the chief means of drainage is by lateral seepage, which is necessarily slow. The streams flowing through the Portsmouth fine sand in the southwestern part of the survey have not eroded any channels. The elevation above the swamp is so slight and the shallow troughs in which the streams flow are so grown up with timber that erosion does not start. As in the interstream areas, much drainage is accomplished by lateral seepage.

The origin of the Portsmouth fine sand may be traced to shore deposits of marine sediments. These have suffered little modification by subsequent agencies, though since their elevation above the influence of the tides there has been a period of swampy condition during which the organic matter found in the surface soil has been formed. The interstream areas are portions of the undissected plateau in which the drainage has not yet been established. If these plateaus were dissected by erosion, other soils would be developed, as is shown by the soils occurring along the stream systems where erosion has occurred. In the southern part of the area the difference between the base level of the swamp and the streams is so small that

they can not remove any appreciable quantity of material except in solution, which is of no importance in these siliceous soils.

The brown crust found in the subsoil, and so characteristic of the type, is an important feature greatly affecting the agricultural value of the soil, through its influence on the movement of the ground water. Its occurrence is undoubtedly due to some peculiarity of the drainage conditions. Opinions differ as to the feasibility of breaking it up by subsoiling. It might be advisable to experiment with lime, which under certain conditions would tend to disintegrate such a stratum as this, but in the absence of more exact knowledge of the character of the cementing material no definite recommendations can be made.

The native vegetation is very characteristic and peculiar to this type alone. Where the soil is typical there is a growth of longleaf yellow pines which do not look as thrifty as on the other soils. The tap roots of these pines are usually blunted, not being able to penetrate the compact stratum of the subsoil, which accounts for the stunted growth of the trees. On the other types of soil and where this crust is absent in this type the tap roots extend downward to considerable depths, sometimes as far as 10 and 12 feet. In addition to the pines the surface is covered with a low, stunted growth of gall-berry bushes and a short-stemmed saw palmetto, together with some wire grass. Old cleared fields soon become sodded with a thick growth of broom sedge.

From practically all of the Portsmouth fine sand the timber has been cut, although there is some remaining suitable for the manufacture of lumber and considerable that is valuable for making railroad cross-ties. It would seem that, considering the low agricultural value of this type of soil, a large part of it should be reforested. If the fire were kept out this would be accomplished by nature. Abandoned fields soon grow up thickly with young pines that can be boxed for turpentine in about twelve years. At the present price of turpentine and rosin this would be profitable. The woods are burned over each winter or spring and all of the young trees killed, so that there is no prospect of reforestation unless some means for protecting the young growth is found.

The light truck crops are best adapted to this soil, but its wet condition prevents their being grown in season to be marketed at profitable prices. Of all the crops now grown, corn seems best suited to this soil, although the yields are small. Ten to twelve bushels per acre is the maximum yield, even with the use of fertilizer. Cotton is grown to some extent, but usually does not do well. Oats are sometimes grown, but are never thrashed. Cowpeas and velvet beans are grown by some of the farmers and produce considerable forage. Sweet potatoes do very well in favorable seasons. Those areas where the heavier materials are found in the lower part of the subsoil are the most desirable.

The methods in use soon exhaust the organic matter which gives the soil its dark color, and the cultivated fields have an ashy-gray color. The growing of cowpeas and velvet beans for green manuring and the plowing under of the cornstalks and other litter, instead of burning them, should be practiced on this soil. By doing this the organic matter content and the loamy texture of the soil can be maintained indefinitely.^a

The agricultural conditions prevailing in the areas of Portsmouth fine sand are the poorest in the survey. The houses are poorly built log structures and the cleared fields are small. Even where the settlements are very old the clearings are not large. By far the larger part of the type is wild and unimproved land, not more than 1 per cent being cleared. The price of these lands does not depend upon their agricultural value, but upon their timber and turpentine resources.

The average results of mechanical analyses of samples of both soil and subsoil of the type are given in the table which follows:

Mechanical analyses of Portsmouth fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
14391,14594.....	Soil.....	1.2	9.0	10.7	51.5	20.7	4.7	1.3
14392,14595.....	Subsoil.....	.7	8.9	9.0	48.0	24.4	4.9	3.2

PORTSMOUTH FINE SANDY LOAM.

The Portsmouth fine sandy loam consists of an accumulation, in low, swampy areas, of organic matter in various stages of decomposition, commingled with an appreciable quantity of fine sand to

^a Large samples of this type were obtained from three localities in this area, from which the manurial requirements of the soil were determined by the wire-basket method.

These samples were taken from fields that were representative of the type and of its productive qualities under the customary farming practice of the region. But little could be learned of the history of the fields, but it was enough to discover that the yields had been low and that but little fertilizers and manure had ever been used upon them. The common practice of burning the refuse of the previous crop had been followed, and green manuring had not been practiced.

In the tests applied, the advisability of growing legumes and plowing them under with an application of lime was well established, this treatment giving most excellent results, as did also the use of stable manure. Both of these treatments gave much better results than followed the use of a complete fertilizer, either with or without the addition of lime. Lime alone gave very good results, but not equal to nitrate of soda, the effect of which salt was also clearly seen when used in combination with either acid phosphate or sulphate of potash, or with both. The individual effect of sulphate of potash was small and of acid phosphate very feeble. Wheat being used as an indicator in these tests, the results are held to be applicable only to the fields from which the samples were taken, and to that or similar crops, but it may be stated that the results agree well with the experience of farmers generally on this type of soil.

a depth varying from a few inches to 2 feet. The color is usually black, but is sometimes a rusty brown. The soil is compact and heavy and when wet has the appearance of Muck, but upon drying out the color becomes lighter and the sandy texture more apparent.

The subsoil of a typical section is a drab to gray slightly mottled sandy clay. It is sticky and plastic, and when exposed to the air bakes into hard clods. Usually the upper part of the subsoil is more sandy, forming a stratum of fine white or gray sand a few inches in thickness between the surface soil and the real subsoil. Sometimes this stratum of sand is of greater thickness and forms the subsoil throughout the 3-foot profile.

This soil is found in all parts of the area in large and small basinlike depressions and in narrow strips along the stream courses. The most important and largest areas are Cluffs Bay, northwest of Ruskin; Musket Bay, between Waycross and Waresboro; and a smaller bay about $2\frac{1}{2}$ miles south of Waycross. Many of the circular basinlike areas of this soil consist of only a few square rods or acres and could not be shown on the soil map, although the above description holds good for them.

The topographic features of the Portsmouth fine sandy loam are very uniform and the natural drainage exceedingly poor. Occupying, as it does, the small swamps and swampy areas along the streams, there is no variation in topography. The greater part of the year this type is covered by water. Only in dry times are these areas free from water. In most cases there is no natural outlet, and drainage is accomplished only by seepage and surface evaporation.

The origin of this soil, the result of the configuration of the low, flat country it occupies, can be traced back to the time when the whole region covered by the present survey was occupied by a shallow sea and the surface deposits were shifted about by wave and tidal movements. At that time the eddies and currents scoured out the superficial sands in places, leaving the basinlike depressions and shallow troughs now occupied by the stream courses in the flatwoods. Where the sand deposits were thin the typical subsoil is now found, and where it was of greater depth the sand subsoil phase now exists. When the region was elevated and tidal influences ceased, the drainage conditions became responsible for the formation of the soil covering of the type. Drainage was, as it still is, exceedingly poor, and after the salt had been leached out and these areas became freshwater swamps, they were filled with a luxuriant growth of water-loving vegetation. The decay of successive growths of this vegetation has given rise to the accumulated vegetable mold, while the slight wash from the surrounding country has probably contributed the content of fine sand.

The native vegetation is still such as requires wet conditions. There is a forest growth consisting mostly of cypress, with a few pines, bays, gums, etc., and an undergrowth of water-loving shrubs and grasses. Generally the trees are hung with Spanish moss and afford a pleasing change in the landscape after the sameness of the piney woods. There is still considerable fine cypress timber in these swamps, and some pine on those areas bordering the streams.

None of the Portsmouth fine sandy loam is cleared and under cultivation. When cleared and drained it will make an excellent soil for potatoes, cabbage, onions, blackberries, and in fact all kinds of garden truck. Great care must be exercised in the handling of this soil, as the organic matter will be easily exhausted, leaving the soil almost sterile. When brought under cultivation the humus content should be maintained by the turning under of green crops and the application of composted barnyard refuse. In this way its fertility and productivity can be maintained indefinitely. The present value of the type is based entirely upon the timber growth and the ease with which it can be removed. Its value is never considered from an agricultural point of view.

Below are given the average results of the mechanical analyses of typical samples of the soil and subsoil of this type:

Mechanical analyses of Portsmouth fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
14223, 14506.....	Soil.....	0.2	1.4	2.2	34.2	24.8	23.9	12.7
14224, 14597.....	Subsoil.....	.1	1.1	2.4	35.4	23.0	17.4	20.1

SANDHILL.

On each side of the Satilla River and on the eastern side of the large streams in the northern part of the area there occur numerous areas which have been mapped as Sandhill. This consists of a deep, loose, incoherent sand. The texture varies from fine to coarse, and is very similar to that of the Norfolk sand, though the structure and depth are so different that a separate classification is necessary. A cut where a tramway crosses a small isolated area of it shows the uniform texture and loose, incoherent structure extending to a depth of 18 or 20 feet. In the river bottom there are a few isolated areas or islands of Sandhill which rise to a height of about 20 feet above the level of the bottoms.

The color and texture to depths greatly in excess of 3 feet are uniformly light yellow or brown, except for a tinge of gray in the first inch. There is no very coarse material and very little of the finer grades. On the surface, rains have washed out the coloring of

the sand, leaving it a glistening white. There is no sod covering, the surface being just as loose and incoherent as any part of the whole profile.

The texture and open structure of the whole section is favorable for the free movement of water, and it becomes deficient in moisture even immediately after heavy rains. The water table is always maintained at a depth too far down to be available for any of the farm crops. The structure and texture are not suitable for the movement of soil moisture upward by capillarity in sufficient quantities for the use of growing plants, and consequently the type is of no agricultural value.

Sandhill is covered with a stunted growth of scrub oaks of different species, with a few stunted pines and some wire grass and palmetto. A little grazing is secured early in the spring when the scant vegetation first starts.

The following table gives the results of mechanical analyses of typical samples of Sandhill:

Mechanical analyses of Sandhill.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
14598.....	Soil.....	0.7	17.7	23.9	46.7	6.0	2.2	2.1
14599.....	Subsoil.....	5.3	24.4	15.3	29.7	17.1	4.6	2.9

MEADOW.

As stated in another part of this report, there are narrow areas of bottom land on each side of the Satilla River. These lowlands have been mapped as Meadow. The soil of these river bottoms varies from a loose wash sand to a rather heavy loam or clay loam, according to the conditions of sedimentation when they were laid down. The sand areas occur near the river bank, and are deposited by the more swiftly moving waters in flood time, while the heavier soils are the result of deposition from quieter waters when the bottoms are overflowed. The sand is similar to the Sandhill, except that it occupies smaller areas and is nowhere so deep and uniform in texture. The heavier soil is found in the depressions, and is usually dark colored.

Along the low bluffs at the outer edge of the bottoms there are usually narrow, swampy areas similar to the Portsmouth fine sandy loam. These wet areas are due to springs along the bluff, seepage from higher levels, and the overflow from the river. They lie a little lower than the areas between them and the river, and have no drainage to the river.

The low, swampy portion supports a forest growth of cypress, pine, bays, gums, etc., and an undergrowth of water-loving bushes and grasses. The higher land between them and the river has a forest growth of pine, with some palmetto.

The areas of Meadow are frequently overflowed, and have no agricultural value aside from the grazing which they afford.

SWAMP.

The northern end of the Okefenokee Swamp is included in the survey, and occupies the entire southeastern corner. The whole swamp is about 30 miles wide and 40 miles long, extending to the Florida line on the south. There are two outlets—the Suwanee River to the Gulf of Mexico and the St. Marys River to the Atlantic Ocean. There is said to be an open channel, or run, from Double Branches to the Suwanee.

Along the edge of this swamp there is a thick growth of cypress and some pines, all veiled heavily with the gray hanging Spanish moss. The timber becomes thinner away from the edge, until the trees are very scattering and are hardly more than stunted shrubs. The water is generally shallow. There are narrow channels called "runs" which are more open and deeper than the rest of the swamp. These runs vary in width from a few yards to a few rods. Sometimes there are more open spaces of deeper water called "lakes." The surface of these lakes and runs is usually covered with a growth of lilies and other aquatic plants, forming a thick mat. Along the margins are many small cypress trees and bushes. The country on each side of them looks like a low flooded marsh with a tree here and there. Around these cypress trees there is a clump of huckleberry bushes, while the intervening space is covered with a luxuriant growth of aquatic vegetation. In other places there are extensive beds of aquatic vegetation. In still other places there are extensive beds of ferns. These open and almost treeless areas are called "prairies." Along and in the runs there is a tangled mass of roots and plant stems, overlying a deposit of organic matter which seems to be in a condition approaching peat. A pole can be easily thrust through it to the solid sandy bottom. Outside these runs on the prairies it is likely that oxidation has proceeded more rapidly, as the water level fluctuates, leaving them dry at times, and a stratum of muck has been formed.

Twice during the past nine years the water has been so low in this swamp that in many places fire burned out the organic matter, exposing a white sand underneath. The Swamp is of no value except for the timber along its edge.

DRAINAGE.

Owing to the low elevation and undeveloped condition of the drainage systems, a large part of the area is flat and very poorly drained. This accounts for the occurrence of the two soil types belonging to the Portsmouth series. All of the other soils are fairly well drained, except for the areas occurring in the flatwood region and along its border.

The northern end of the Okefenokee Swamp lies so little below the level of the flatwoods that their drainage presents a difficult problem. With the present condition as regards drainage, it is not likely that any extensive agricultural development will take place in this part of the area.

Levels which have been ascertained show that the swamp is far enough above sea level to insure its complete drainage. This would reclaim thousands of acres of rich valuable soil in the area surveyed and much more to the south of this area. By the drainage of the swamp the outlet of the streams flowing into it would be lowered, and they would then furnish adequate drainage to the flatwoods through which they flow. These stream courses are now covered with a thick growth of cypress, bays, gums, etc., and no distinct channels have been formed. Nevertheless, there is a considerable current, even with the obstruction offered by the timber. It is feasible to cut out the timber and clear a channel in all of these streams. If this were done, giving the water an unobstructed course in one place instead of letting it spread out over the whole narrow bottoms, the current would become more rapid; and even with the present fall the streams would soon erode a channel sufficiently deep to carry all of the water, except during heavy rains. This would reclaim the narrow areas of rich black soil along the streams. Lateral drainage ways could then be cut back into the interstream areas in the low places and the excess of water quickly removed. Shallow surface ditches should then be opened into both the main and lateral channels to remove the surface waters from the cultivated fields after heavy rains. Great care should be used in the construction of these drains to prevent over-drainage and excessive leaching, as this would be about as harmful as the poor drainage now existing.

The system outlined above would lower the water table by several feet and also aid greatly in the movement of the ground waters by lateral seepage. It is thought that the establishment of better drainage conditions would also have some effect upon the dense impervious brown crust of the subsoil of the Portsmouth fine sand, which seems to bear some relation to the movement and position of the underground water table. This plan of aiding nature in the establishment of better drainage conditions applies also to the interstream areas north of the river.

SUMMARY.

The Waycross area lies in southern Georgia, about 60 miles from the Atlantic coast and wholly within the physiographic province known as the Coastal Plain.

The population is mainly native born, about one-third belonging to the negro race. The area is sparsely settled, and agriculture, while making progress, is only in the first stages of development so far as the utilization of the soil resources are concerned. Less than 5 per cent of the land is in cultivation.

The soils are confined to two series, viz, the Norfolk and the Portsmouth, and these have no representatives of a heavier texture than a fine sandy loam. In addition to the series types there are considerable areas of the nonagricultural types, Sandhill, Meadow, and Swamp. One of the Portsmouth series, the Portsmouth fine sandy loam, which covers a wide extent of territory, is also nonagricultural in this survey, because of the existing poor drainage conditions. The principal crops grown are corn, cotton (Sea Island and Upland), sugar cane, sweet potatoes, and vegetables. The largest acreage is in corn, the product being all consumed locally. Cotton is the money crop. The quality of the Sea Island lint is said to be excellent, and its production on an increased scale would seem to be one of the agricultural opportunities of the area. Cane sirup also stands out as a special industry to be fostered, while the growing of early truck could without doubt be built up as it has in other parts of the South.

In the production of the foregoing crops the soils of the area will be found to have different values. So far as determined, the Norfolk fine sand, by reason of texture, drainage conditions, and location with regard to transportation facilities, is the most desirable early truck soil. Texturally the Norfolk sand is also desirable for these crops, but in the Waycross area it is not as accessible to the railroad as the first-named type, nor are the drainage conditions as favorable. The Norfolk fine sandy loam and Norfolk sandy loam are the soils used for the production of Sea Island cotton, and judging from the quality of the product they are well adapted to this crop. Sugar cane is also an important crop for these types of soil, and their special use lies in the production of these two crops, under some system of rotation with corn, potatoes, and velvet beans or cowpeas. Small fruit and peaches may also prove profitable.

The Portsmouth fine sandy loam, by reason of lack of drainage, is at present poorly adapted to any crops over much of its area. Where drainage can be established or on the areas naturally better drained at present the soil should prove excellent for truck growing. The Portsmouth fine sand, where drainage is adequate, is better suited for the early truck crops than for general farm crops. Much of the type

should be reforested. The conditions in the survey suggest the advisability of extending the production of Sea Island cotton—a high-priced product that can be grown in this country only in limited areas—and sugar cane for the production of sirup. It would also seem that the production of early truck and peaches for northern markets could be made profitable. Needed improvements include the production of more forage crops and the planting of crops for winter grazing to tide the stock over the winter season. At present considerable mortality occurs in the range cattle, owing to insufficient feed during the winter season. A more systematic rotation of crops is also needed, and this should be planned to include some of the leguminous crops. More organic matter should be added to the soils. The clearing of the fields of stumps and the introduction of improved labor-saving farm machinery would enable the planters to tend a larger acreage, give the crops better care, and generally increase the yields and profits.

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