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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF HENRICO COUNTY,
VIRGINIA.

BY

W. J. LATIMER AND M. W. BECK.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1913.]



WASHINGTON:
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1914.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., April 10, 1914.

SIR: During the field season of 1913 a soil survey was made of Henrico County, Va., for the purpose of gathering information in regard to the soils and their use.

I have the honor to transmit herewith the manuscript report and map covering this work, and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1913, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

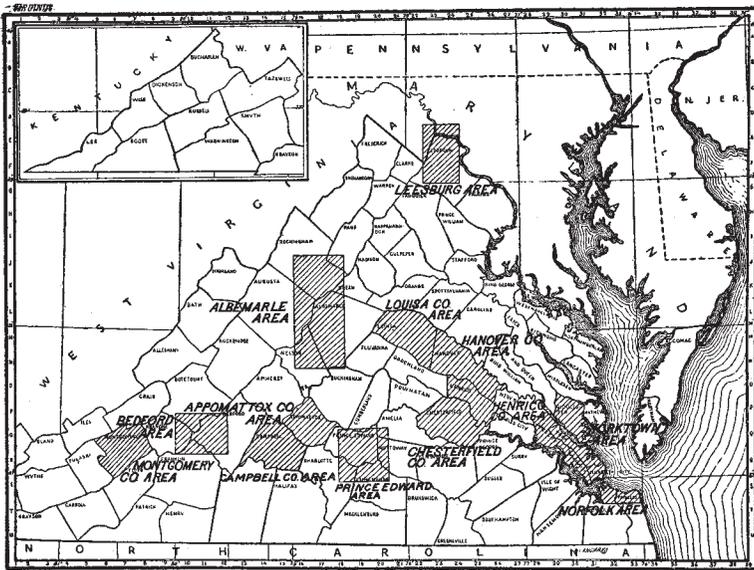
Soil map, Henrico County sheet, Virginia.

SOIL SURVEY OF HENRICO COUNTY, VIRGINIA.

By W. J. LATIMER and M. W. BECK.

DESCRIPTION OF THE AREA.

Henrico County is near the center of the State of Virginia. The county comprises an area of 264 square miles, or 168,960 acres. It is irregular in shape and is bounded on the north and northeast by the Chickahominy River, separating it from Hanover and New Kent Counties, on the southeast by Charles City County, on the southwest



Sketch map showing areas surveyed in Virginia.

and west by the James River, forming the Chesterfield County line, and on the northwest by Goochland County. Henrico County, in its present outline, was one of the original shires into which Virginia was divided in 1634.

Physiographically the county comprises two divisions, the Piedmont Plateau in the western part and the Coastal Plain in the eastern. The boundary between the Piedmont region and the Coastal Plain, or "Tidewater," region divides the county approximately in half. The topography of the former is gently undulating to rolling, while that of the latter is level to gently undulating, interrupted by a few

fairly sharp but shallow valleys. Nearly all of the land of the county is topographically suited to tillage operations.

The Coastal Plain region has an average elevation of about 150 feet above sea level, while in the Piedmont Plateau the elevation ranges from 250 to 350 feet above sea level. In general the river terraces are between 25 and 50 feet above high tide, but some of the high terraces lie at an elevation of 100 feet.

The region is drained through two systems, the drainage divide extending in a general northwest and southeast direction approximately through the center of the county. The section northeast of this line is drained by the Chickahominy River, while the drainage of that on the other side enters the James River.

According to the 1910 census Henrico County, excluding Richmond, which was made independent prior to 1900, has a population of 23,437. This population is largely rural. Of the rural population actually engaged in farming about 20 per cent are negroes and about 10 per cent foreign born, the remainder being native white. A large part of the rural population is composed of descendants of the original settlers, who were mainly English. Many of the farmers are German.

Four railroad lines and two interurban electric lines traverse the county, so that it is well supplied with transportation facilities. The Chesapeake & Ohio Railway operates a line through Richmond going east and west, and also a line running north. The Norfolk & Western enters the county from the south, as does the Southern Railway, which extends eastward across the county from Richmond. A branch line extends to Westpoint on York River. The Seaboard Air Line and the Atlantic Coast Line connect the city with points south and operate trains to the north over the tracks of the Richmond, Fredericksburg & Potomac Railroad. Interurban electric lines extend from Richmond to Ashland, Petersburg, and Seven Pines. Trolley lines connect the city with its many suburbs, such as Westhampton, Ginter Park, Barton Heights, and Chestnut Hill. Boat lines on the James River also afford transportation.

There is an excellent system of public roads radiating from Richmond and extending into all parts of the county. The rural districts are well supplied with public and high schools. The buildings are of modern type and so distributed that they are easily reached in all parts of the county. The telephone is in common use throughout the county, and every section is supplied with the rural delivery of mail.

Richmond, the only city of any consequence in the county, is the county seat and has a population of 127,628. It is an independent city and is located at the head of navigation on the James River.

Richmond and suburban towns furnish an excellent market for truck, dairy, hothouse, and poultry products, and the general farm crops grown in the county.

CLIMATE.

The climate of Henrico County is mild and healthful. The winters, although cold, are not severe; the snowfall is not usually heavy and remains on the ground for a relatively short time. The heat of the summer is not excessive, and periods of hot weather are usually of moderate duration. The average annual temperature is 58.2° F.

The precipitation is fairly well distributed throughout the year, the heaviest rainfall occurring during the spring and summer months, when it is most needed by the growing crops. There is a mean annual precipitation of about 43 inches.

The average date of the first killing frost in the fall is November 3, and of the last in the spring April 2. The earliest date of killing frost recorded in the fall is October 12, and the latest in the spring April 20. There is an average growing season of 8 months, which permits the production of two crops, and in rare cases three crops each year.

The following table, compiled from the records of the United States Weather Bureau, gives the normal monthly, seasonal, and annual temperature and precipitation at Richmond:

Normal monthly, seasonal, and annual temperature and precipitation, at Richmond.

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.....	41.0	70	4	3.11	1.00	0.57	3.3
January.....	38.0	78	9	3.04	0.55	4.77	3.9
February.....	39.9	72	-3	3.33	0.59	3.70	6.4
Winter.....	39.6			9.48	2.14	9.04	13.6
March.....	46.9	94	15	3.93	3.74	3.68	2.6
April.....	57.2	90	25	3.48	1.81	8.89	0.2
May.....	63.7	94	39	3.93	3.04	9.13	0.0
Spring.....	55.9			11.34	8.59	21.70	2.8
June.....	75.1	99	49	3.66	3.75	7.93	0.0
July.....	79.2	99	58	4.42	2.50	14.01	0.0
August.....	77.5	102	55	4.72	2.75	3.99	0.0
Summer.....	77.3			12.80	9.00	25.93	0.0
September.....	70.8	100	43	3.47	4.42	5.60	0.0
October.....	59.8	90	33	3.31	1.00	5.23	0.0
November.....	48.8	82	19	2.59	2.50	4.59	0.4
Fall.....	59.8			9.37	7.92	15.42	0.4
Year.....	58.2	102	-3	42.99	27.65	72.09	16.8

AGRICULTURE.

Practically all the land in Henrico County, with the exception of the "slash land," has at one time in the history of the county been under cultivation. Even in heavily forested areas the old rows can still be traced.

The agricultural methods practiced up to within comparatively recent years have not been conducive to the upbuilding of the soil. The tendency was to remove everything from the land, returning little in the form of vegetable matter or fertilizer. Before the Civil War the land was cultivated in extensive plantations, but since that time many fields have been neglected, drainage ditches have filled, the dikes along the river have broken, and in many parts of the upland fields have been left unprotected to be washed and gullied by erosion.

Lately, however, there has been a general improvement in the condition of agriculture, and as a rule the fields are better prepared and cultivated, crops which gather nitrogen and supply vegetable matter are included in systematic rotations, and greater attention is paid to the fertilizing, liming, and draining of the land.

The general farm crops grown since the settlement of the county until within the last 20 years were tobacco, corn, wheat, oats, sweet potatoes, and hay. The tobacco crop is now comparatively unimportant, occupying only a small acreage in the extreme northern end of the county, and according to the 1910 census tobacco was grown on a total of only 86 acres, with a production of 74,472 pounds. Wheat is no longer produced for flour, and is grown mainly with clover for hay. A total area of 2,059 acres is reported in the 1910 census as devoted to wheat, with a production of 25,120 bushels. Oats and corn hold about the same relative position in the agriculture as formerly. Corn is grown on 12,730 acres, and the production of 279,430 bushels is reported. A total of 2,333 acres is reported in oats, with a production of 48,486 bushels. Much corn is converted into silage and fed to dairy cattle.

Dairying has become an important industry. There are over 100 dairies in the county, and a total of 4,831 dairy cows is reported by the 1910 census. By far the greater part of the dairy products is sold in Richmond.

German clover is used extensively for hay and soil improvement. It is seeded with wheat and with oats. Cowpeas, soy beans, and vetch are grown to a small extent, but always profitably, both for hay and soil improvement. The hay crops include timothy, redtop, oats, Italian rye grass, fescue, and chess. Bluegrass and redtop are used for pasture.

Vegetables have been grown locally for the Richmond market since the early history of the city, and the supply is about equal to the demand. Within the last 20 or 30 years the trucking industry has received great impetus. The vegetables used in the city of Richmond are largely grown by negroes in small gardens and peddled on the streets of the city or sold at Richmond markets. Watermelons have been a source of considerable income for a long time. Melons are grown in nearly every part of the county and hauled mainly to Richmond. All of the vegetables common to the South Atlantic States are grown with more or less success by the truckers around Richmond. The principal truck crops are Irish potatoes, beans, turnips, cabbage, kale, beets, lettuce, radishes, onions, sweet corn, spinach, tomatoes, carrots, and peas. Early and late crops of these vegetables are produced, considerable effort being made to supply the markets with vegetables as early and as late in the season as possible. As a rule, the truckers practice some form of rotation, such as growing beets in the spring, followed by kale, which is in turn followed by cabbage. The truckers depend largely upon manure hauled from Richmond to keep up the fertility of the land. About 30 to 40 cartloads per acre are applied annually. Commercial fertilizer is used to some extent. A mixture analyzing 8 per cent phosphoric acid, 4 to 5 per cent nitrogen, and 5 per cent potash is considered a high-grade truck fertilizer. It is applied at the rate of 600 to 800 pounds per acre for cabbage, 400 to 500 pounds for potatoes, and is used in lighter applications for other crops.

Considerable attention has been paid to the introduction of thoroughbred stock and to the improvement of the native breeds. A large number of the dairy cows are Holstein or Holstein grades. The Jersey is also popular. Polled Angus cattle were introduced about five years ago at Curles Neck, and there are numerous Herefords in the county. Sheep and hogs are raised in relatively small numbers. With the exception of dairy cows, horses probably receive more attention than any other stock. The Belgian Coach is the most popular strain, as this is considered the most desirable type of horse for use on the farms.

Rapid improvement has taken place in the kind and quality of farm machinery used. Sulky plows, cultivators, disk harrows, planters, fertilizer distributors, and grain drills are in common use.

Two to four horses are used for plowing and cultivation on most farms, and traction plows are used on several of the large farms along the river. Manure spreaders, mowers, and improved hayrakes are becoming popular. However, there is a general lack of labor-saving facilities for handling hay at the barns. Very few dairies are operated without silos. Brewer's grain is in use to some extent for feed.

The farmers within 5 to 6 miles of Richmond depend largely upon manures hauled from that city to keep up the fertility of the soil, with the exception of the dairymen, who use manure from their own barns and turn under occasional cover crops. The plowing under of green crops is not extensively practiced, however, as there is need for all of the hay and roughage that can be produced.

In the outlying districts the principal occupation is general farming, with the raising of a few cattle, sheep, and hogs, and but little manure is brought from Richmond, owing to the greater distance, the farmers depending more upon the growing of legumes and the turning under of cover crops to maintain the fertility of the soil. In most cases commercial fertilizers are used in small amounts. About 150 to 250 pounds per acre of a low-grade mixture analyzing 9 per cent phosphoric acid, 1.5 per cent nitrogen, and 1.7 per cent potash is commonly applied to corn. Dairymen apply about 10 to 12 manure-spreader loads per acre where the land is in a run-down condition, and about 6 loads when land is in good shape. The best farmers apply manure at the latter rate to all land under cultivation each year. Lime is used to a very small extent, even upon the poorly drained soils, which are badly in need of this element. It is used for alfalfa at the rate of about a ton per acre.

No general system of rotation is followed by the dairymen. Each year all land available for cultural crops is put in winter wheat and German clover, which is cut in the spring and cured for hay. The stubble is turned under and the land put in corn, which is cut for silage. After this the land is usually sown to wheat. Sometimes oats are seeded with clover instead of wheat. With corn, level cultivation is usually practiced on the well-drained land, so that there is no trouble in seeding to grain, clover, or grasses after the corn crop is removed.

Where general farming is practiced, a rotation in which soy beans or cowpeas are grown and followed with wheat and clover or grass, or both, is popular. Vetch is sometimes seeded with wheat or oats instead of clover. Corn usually follows a crop planted in the fall and harvested in the spring. On the bottom land, or overflow land, corn is often planted as the sole crop year after year, and the soils are so rich that yields of about 75 bushels per acre are obtained each season. Crops that mature in the spring are uncertain on the river bottoms, because of the high freshets which frequently occur at that time of the year.

The census of 1910 reports a total of 1,508 farms. They are usually small, the average size being 73.4 acres, of which an average of 38 acres is improved. There are several unusually large estates in the

southern part of the county. Of the total number of farms in Henrico County, 81.7 per cent are operated by their owners, which indicates a good condition for this section of the country. The tidewater section of the county is the most sparsely settled, and land values here are lower, except on the river-terrace areas and the rolling, well-drained country near the river.

Farm labor is scarce and most of the work of the farm is done by the owner or renter, as the case may be, and his family. Farm laborers are paid from 75 cents to \$1 a day with board, or \$1.25 to \$1.50 a day without board. Farm hands can usually be secured for \$20 to \$30 a month, where a house is furnished them.

Rents vary widely, and the system of tenancy is made to suit contracting parties. Most of the land is rented on a cash basis, the rate representing a fair interest on the value of the land. Where leased on a share basis the landlord usually receives half of the grain, hay, and corn crops. Where trucking is practiced, as a rule half of the fertilizer is furnished by the owner, who receives half of the proceeds from the sale of the vegetables.

Where wheat, clover, and corn are grown, particularly by dairymen, the growing of some other legume occasionally is an effective means of preventing the soil from becoming "clover sick." Vetch is about the best substitute that can be used with either wheat, oats, or rye. Miscellaneous grasses are advantageous where included with a good rotation. An excellent rotation where general farming is practiced is wheat, clover, and grass (timothy, redtop, and fescue), allowing the grass to run two seasons, when it is turned under and the land put in corn or potatoes. This is not practicable where land values are very high and more than one crop per year must be produced to pay a reasonable interest on the investment. The farm methods followed by the dairymen of the county are good, and well adapted to the condition of the various soils. They are somewhat superior, as a rule, to the practices of the other farmers of the county. The keeping of live stock on the farms is advantageous where general farming is practiced.

Level cultivation, following deep fall plowing, is the best practice on the well-drained soil types. This makes cultural operations easier and conserves more moisture than ridge cultivation. Shallow cultivation of crops is also advisable. Disking before plowing is a good practice upon the heavy soil types having a tendency to clod.

SOILS.

Henrico County embraces a large variety of soils, ranging from the most productive bottom lands of the eastern United States to good, strong, well-drained uplands and flat uplands very much

in need of drainage. There is a sufficient range in these soils to favor the establishing of a varied agriculture.

Some of the soils are naturally well drained and productive, and require only deep plowing and thorough cultivation for profitable yields; others are well drained, but need to be fertilized or manured liberally and supplied with vegetable matter to produce good crops; while still others are in need of artificial drainage, deep plowing, liming, and fertilizing or manuring to give profitable returns with any crops, except those particularly adapted to wet lands.

Of the 27 soil types mapped in Henrico County there are no two which have exactly the same crop adaptation, crop value, or fertilizer, lime, drainage, or tillage requirement, while most of the types differ widely either in their crop adaptation or the methods of handling necessary, or both. The well-drained bench lands and overflowed bottoms of the James River, for example, comprising the Wickham and Congaree soils, respectively, need little or no fertilizer, except in case of the sandy types, in order to produce satisfactory yields of a number of crops. On the other hand, the well-drained sandy soils of the uplands, such as the gray sandy lands in the western part of the county, comprising the Bradley and Durham soils, need fairly heavy applications of good fertilizer mixtures for the best results with any crop. The Elkton soils, or "slash land," are so poorly drained and otherwise in such bad condition that ditching or tiling and the liberal addition of lime and fertilizer are essential to success with all crops except certain moisture-loving plants, such as redtop, alsike, and lespedeza.

There is comparatively little deep sandy land in the county, such as is ordinarily selected for the production of early vegetables, yet there are large areas of sandy loams which are adapted to medium early and late vegetables. The fact that most of the soils of Henrico County have clay or sandy clay subsoils instead of loose, leachy, sandy subsoils, points to the possibility of building up the various types and keeping them in a good productive condition. The individual peculiarities and needs of the various soils are pointed out in subsequent sections of this report.

In mapping the soils, the unit of classification is the soil type, which is determined by the textural composition; that is, by the relative content of the various grades of sand, silt, and clay. These types, or textural divisions, are grouped into series, each series including those soils which have the same color or range of color in the surface material and in the subsoil, the same structural characteristics, a closely related origin and general condition of drainage, and a similar topography. The gray, better drained soils of the eastern part of the county, which have yellow, friable subsoils, for

example, are included in the Norfolk series, while the brownish to reddish-brown soils of the James River bench lands which have reddish, moderately friable subsoils are all grouped in the Wickham series.

Broadly, the upland soils are recognized as belonging to two divisions or soil provinces: (1) The Piedmont Plateau soils in the western part of the county, and (2) the Coastal Plain (tidewater region) soils in the eastern part of the county. Of the alluvial soils there are also two divisions: (1) The overflowed stream bottoms and (2) the bench lands, which are not subject to overflow.

The soils of the Piedmont division have been derived through decay of the underlying rocks, including principally granite and gneiss. Under the influence of weathering, these rocks have been broken down or decayed, finally being reduced to residuary soil material, which has been subsequently modified in varying degrees by erosion. The soils of this section of the county are principally of the Cecil and Durham series, while the Penn and Granville series have a minor development.

The soils of the uplands in the eastern part of the county belong to what is known as the Coastal Plain region, and are sedimentary in origin. The material of these sedimentary soils was deposited in water in prehistoric times. With the recession of the water the material has undergone various changes through processes of weathering, including leaching, oxidation, erosion, and the accumulation of organic matter from plants.

There is a border zone between the Piedmont and Coastal Plain divisions in which the soils of the two provinces grade into each other in such a way that it is difficult to establish definite boundaries. The Bradley gravelly sandy loam, for example, is a type the surface soil of which consists of Coastal Plain material, while the subsoil consists of residual products derived from the decay of rocks of the Piedmont.

The most extensive series of the Coastal Plain section of Henrico County are the Elkton, Orangeburg, and Norfolk. The Ruston is a less important series.

The most important of the first-bottom alluvial soils is the Congaree. This soil occurs in extensive areas along the James River. The least valuable part of the first-bottom alluvium is mapped as Meadow and Swamp. On the stream terraces—bench lands or second bottoms—three soil series are represented—the Wickham, Altavista, and Kalmia. The materials of these terrace soils represent early alluvial deposits laid down when the streams flowed at higher levels.

The following table gives the actual and relative extent of the various soils mapped in Henrico County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Norfolk silt loam.....	26,752	15.8	Elkton sandy loam.....	1,920	1.1
Durham sandy loam.....	25,856	15.3	Orangeburg gravelly sandy loam.....	1,920	1.1
Norfolk fine sandy loam.....	24,256	14.4	Wickham fine sandy loam....	1,792	1.1
Meadow.....	17,600	10.4	Kalmia sandy loam.....	896	.5
Orangeburg fine sandy loam...	9,600	5.7	Ruston silt loam.....	896	.5
Norfolk gravelly sandy loam...	9,344	5.5	Altavista sandy loam.....	768	.5
Altavista silt loam.....	6,272	3.7	Kalmia fine sandy loam.....	768	.5
Ruston fine sandy loam.....	6,080	3.6	Penn clay loam.....	704	.4
Norfolk sandy loam.....	5,952	3.5	Wickham gravelly sandy loam.....	512	.3
Elkton silt loam.....	5,824	3.4	Wickham fine sand.....	448	.3
Wickham silt loam.....	4,864	2.9	Granville silty clay loam.....	384	.2
Elkton fine sandy loam.....	3,840	2.3			
Congaree silt loam.....	3,776	2.2			
Swamp.....	2,816	1.7			
Bradley gravelly sandy loam...	2,624	1.6	Total.....	168,960
Cecil sand loam.....	2,496	1.5			

GRAY SOILS.

SEDIMENTARY MATERIAL—SANDS AND CLAYS.

NORFOLK SERIES.

The surface soils of the Norfolk series are gray, ranging from light gray to grayish yellow. The subsoils are yellow and have a friable structure. These soils occupy nearly level to rolling uplands in the Coastal Plain. They are derived from unconsolidated sedimentary deposits.

NORFOLK GRAVELLY SANDY LOAM.

Where typically developed the Norfolk gravelly sandy loam consists of a grayish sandy loam which passes through pale-yellow heavy sandy loam into yellow friable sandy clay. Like the Orangeburg gravelly sandy loam, this type includes some small, unimportant areas of Ruston gravelly sandy loam. Quartz and quartzite gravel and cobbles are present in sufficient quantities to give the land a prevailing gravelly character.

The type is widely distributed throughout the county and occurs mainly in narrow strips along the minor stream courses. It occupies a position similar to that of the Orangeburg gravelly sandy loam; that is, steep slopes which are mainly unfavorable to cultivation. It has about the same crop adaptation and requires about the same management as the Orangeburg gravelly sandy loam. The latter type is slightly stronger and has a somewhat higher value than the Norfolk gravelly sandy loam.

NORFOLK SANDY LOAM.

The Norfolk sandy loam in Henrico County is usually a gray sandy loam, which quickly grades into pale-yellow heavy sandy loam to sandy clay loam, underlain at about 12 to 20 inches by friable sandy clay. There are some areas in which the soil is more nearly a loamy sand and the subsoil a sandy clay containing considerably more sand than the average of the type.

The material of the greater part of the Norfolk sandy loam area in Henrico County is heavier than that of the typical Norfolk sandy loam as developed over extensive areas throughout the Coastal Plain region of the South. It consists largely of silt and clay and is much more inclined to harden on drying out than the typical soil, and consequently it is more difficult to keep in a good condition of tilth. As compared with the Norfolk fine sandy loam of Henrico County, the material is somewhat coarser and more open and somewhat less inclined to bake. The topography also is slightly less even and the drainage on the average is better. The type as mapped includes areas of material which approaches very closely the character of a loam. Parts of it would be mapped as Norfolk loam if the areas were large enough to be shown on the map.

The topography is prevailingly undulating to very gently rolling. Practically all the land may be cultivated without danger of erosion.

The type has its principal development in the northwestern part of the county, and also occurs in small, detached areas in other parts of the Coastal Plain section, usually near the bluffs of streams, where it is associated with the gravelly sandy loam type. Much of it is located within a short distance of Richmond.

A considerable acreage of the Norfolk sandy loam is devoted to trucking. Such crops as Irish and sweet potatoes, string and lima beans, peas, and melons do well. Late cabbage, kale, and turnips are also successfully grown. The growers depend largely upon manure hauled from Richmond to maintain the productiveness of the soil. Small quantities of high-grade fertilizers also are used. Where dairying is practiced, corn, wheat, and clover are the principal crops. The last crop of clover is usually turned under. Of all the crops grown the type is apparently best adapted to wheat and clover.

The natural forest growth consists largely of shortleaf pine. This is an excellent soil, but its high value is due in part to its situation near the city.

NORFOLK FINE SANDY LOAM.

The typical Norfolk fine sandy loam is a gray to pale-yellow fine sandy loam, underlain at about 6 to 8 or 10 inches by a yellow, friable, heavy fine sandy loam to fine sandy or silty clay loam. The clay content increases with depth, and moderately friable silty clay

to fine sandy clay is usually encountered between 12 and 18 inches. This development of the Norfolk fine sandy loam is considerably heavier than the main portion of the type lying in the States to the south. The surface soil contains considerably more silt and is much shallower than in typical areas, and the subsoil also contains more clay. On this account the land is not so well drained, is more inclined to become compact when dry, and is more difficult to maintain in good tilth.

There are some areas, however, in which the soil is fairly representative of the established type. The surface soil in such places is a grayish, light fine sandy loam or loamy fine sand underlain at 2 or 3 inches by a pale-yellow fine sandy loam which grades between 10 and 15 inches into yellow, friable fine sandy clay. On the other hand, the type includes areas in which the soil is even heavier than the main portion of the type as developed in Henrico County. This heavier material represents a gradational soil between the Norfolk fine sandy loam and the Norfolk silt loam. It approaches closely the texture of a fine loam and grades on one side into the lighter Norfolk fine sandy loam and on the other into the heavier Norfolk silt loam in such a way that definite boundaries are difficult to establish. This heavier phase has a more nearly level surface than the main portion of the type, and is not so well drained.

The characteristic topography of the Norfolk fine sandy loam is gently undulating, the surface being noticeably more uneven than the average of the Norfolk silt loam. Drainage is fairly well established, although some of the included nearly level bodies are in need of ditching or the installation of tile drains. The soil is much easier to keep in a good condition of tilth than the Norfolk silt loam, yet a good supply of organic matter must be maintained in order to prevent the land from baking.

This type is extensively developed throughout the northern, central, and eastern parts of the county.

In handling this soil it has been found best to plow in the fall to an average depth of about 8 inches, to apply liberal quantities of barnyard manure, and to plow under an occasional crop such as cowpeas, clover, or rye. Moderate applications of complete fertilizer mixtures have generally been found to increase yields on the Norfolk fine sandy loam in this region and in those to the south.

The type is well suited to the production of sweet potatoes, Irish potatoes, cabbage, snap beans, lima beans, radishes, cucumbers, cantaloupes, watermelons, garden peas, turnips, and a number of other vegetables. For these crops heavier applications of fertilizer are used than in the case of corn and oats. Cowpeas, crimson clover, vetch, and soy beans are legumes which thrive on the land and which improve the soil whether plowed under or cut for hay.

Corn, wheat, and oats are grown to some extent upon the type and good yields are obtained where the proper methods have been followed. Much of this type is deficient in organic matter, in some few cases to such an extent that it does not produce 10 bushels of corn per acre. This condition can easily be remedied. Timothy, reedtop, and oat grass are fairly well suited to the type and can be grown in conjunction with clover. The type is the best of the upland soils for light and early truck crops, and in the vicinity of Richmond is used quite extensively for their production. The natural forest growth consists almost entirely of pine. Land of this type of soil is valued at \$20 to \$250 an acre.

NORFOLK SILT LOAM.

The Norfolk silt loam is a gray silt loam, which usually passes at a depth of 1 to 2 inches into a yellow or pale-yellow silt loam. This in turn is underlain by a yellow, moderately friable silty clay loam at about 5 to 8 inches. The subsoil, encountered 8 to 16 inches below the surface, consists of a yellow silty clay, slightly friable when fairly moist and somewhat plastic when wet. The lower portion of the subsoil, especially in poorly drained situations, is frequently mottled with shades of gray, yellow, and brown. On drying out the soil has a light-gray color and a compact structure unfavorable to the best development of crops.

The soil in places approaches a fine loam or heavy fine sandy loam in texture. Such areas are mainly confined to the more undulating or slightly higher positions which have better drainage than the typical soil, which occupies almost level to slightly depressed situations. The greater part of this phase consists of a pale-yellow silty loam or fine sandy silt loam which grades at an average depth of about 8 inches into yellow, moderately friable silty clay loam, and this is underlain by a yellow clay containing enough fine sand to be noticeably friable. This phase, like the typical soil, has a light-gray color and is decidedly compact when dry. All of this land clods if plowed when too wet—that is, when wet enough to be miry.

As determined by the results observed on well-managed farms, the most efficient handling of the Norfolk silt loam includes the following steps: (1) Artificial drainage by ditching or tiling, (2) fall plowing to a depth of at least 6 or 8 inches, (3) applications of at least 1 ton of burnt lime or 2 tons of finely ground limestone per acre, and (4) the liberal addition of vegetable matter in the form of barnyard manure or crops of cowpeas, clover, vetch, or rye plowed under in the green state just before maturity. Such treatment tends to prevent the soil from baking and insures the freest possible circulation of soil moisture, which is necessary to the best development of plants. For

intertilled crops the best results are had where the seed bed is prepared in the shape of a ridge, standing above the general level of the land, so as to hold the plants above standing water after heavy rains.

The Norfolk silt loam is widely developed in the eastern part of the county. In extensive areas in this section this type predominates over all other soils, and here settlement is often sparse, much of the land being forested. The principal timber growth is white oak, water oak, black gum, sweet gum, maple, and shortleaf pine. An undergrowth of huckleberry is common. Locally the poorer drained portions of the type are called "slash land." The type is cultivated in places, often in an inefficient way, the plowing being shallow and the surface drainage inadequate. The crops generally grown are wheat, oats, and grass.

Where the type is properly handled, the yields of wheat, clover, and grass are good, and corn gives fair yields, but the type can not be considered a soil suitable for general truck growing, although good yields of Irish potatoes can be obtained. The best use of this type is for growing principally grass and forage crops. Dairying is the most profitable branch of agriculture at present practiced on it.

ORANGEBURG SERIES.

The Orangeburg soils are predominantly gray, ranging to reddish brown. The soils are open structured, and the subsoils consist of friable sandy clay. This series is confined to the uplands of the Coastal Plain, being most extensively developed in a belt extending from southern North Carolina to central Texas. The soils, like the Norfolk types, are derived from unconsolidated deposits of sand and clay. The materials forming the Orangeburg soils are the best drained and most completely weathered materials in the Coastal Plain province.

ORANGEBURG GRAVELLY SANDY LOAM.

The Orangeburg gravelly sandy loam is a reddish-brown to gray light sandy loam, underlain at variable depths by a dull-red friable sandy clay which grades below into a deeper red, heavier clay. Quartz and quartzite gravel and cobbles up to 4 or 5 inches in diameter are abundant on the surface and throughout the soil. In some places the subsoil material is of a much lighter shade of red than the subsoil of the typical portion of the type or is yellowish red to reddish yellow. Such areas comprise the Ruston gravelly sandy loam, but they are not mapped separately because of their small extent.

The type characteristically occupies slopes which are too steep for easy cultivation. It is developed in long, narrow strips south of Richmond and in the extreme southeastern part of the county, and in small areas just west of Richmond. Much of it is still in forest, and over half of the cleared area is in pasture. The more gentle

slopes are cultivated, and fair crops of wheat, oats, corn, and hay are produced. Where the land is cultivated it is best used for inter-tilled crops, as there is difficulty in operating reapers and mowers and other labor-saving machinery, owing to the steep slopes.

The natural forest growth consists of oak, pine, sweet gum, beech, and maple.

ORANGEBURG FINE SANDY LOAM.

The Orangeburg fine sandy loam is typically a light-brown to grayish-brown loamy fine sand to fine sandy loam, underlain at an average depth of about 8 inches by a reddish-yellow heavy fine sandy loam. This material becomes heavier and redder with increasing depth, passing usually at about 10 to 20 inches into red friable fine sandy clay. The type as mapped includes a few small areas in which the subsoil is a light-red to reddish-yellow friable fine sandy clay. These are really areas of Ruston fine sandy loam which are too small or too intricately associated with the Orangeburg fine sandy loam to be shown separately on the map.

The topography of the Orangeburg fine sandy loam is mainly undulating or very gently rolling, and the drainage is generally well established. Nearly all of the type is easily cultivated and is favorable to the maintenance of a good supply of moisture. It is not subject to erosion. This is the most productive of the Coastal Plain soils. It gives good yields of small grain, forage crops, clover, and alfalfa. The type is used extensively for trucking and dairying. Lighter applications of fertilizers are used than on any of the other Coastal Plain types. An intensive system of farming is generally practiced.

The Orangeburg fine sandy loam is extensively developed along the Chickahominy River north of Richmond, at and west of Richmond, and in the southern and southeastern parts of the county.

The natural growth of pine, oak, hickory, maple, sweet gum, and dogwood has been cleared from nearly all the type.

Land of this type is valued at \$100 to \$150 an acre.

RUSTON SERIES.

The Ruston series includes types having gray to grayish-brown soils and reddish-yellow to yellowish-red or dull-red, moderately friable, sandy clay subsoils. Occasionally the lower subsoil is mottled with gray and shades of yellow. In point of subsoil structure this series is intermediate between the Orangeburg and Norfolk on the one hand and the Susquehanna on the other. The Ruston soils are closely associated with the Orangeburg and Susquehanna.

RUSTON FINE SANDY LOAM.

The Ruston fine sandy loam closely resembles the Orangeburg fine sandy loam, the chief difference being the lighter shade of red in the subsoil material and the slightly lower agricultural value of the former.

The type consists of a gray to grayish-brown fine sandy loam, underlain at about 3 to 5 inches by a pale-yellow heavy fine sandy loam which passes downward through reddish-yellow friable fine sandy clay loam into the subsoil proper. The subsoil is usually encountered at about 10 to 18 inches, and consists of reddish-yellow to yellowish-red or dull-red friable fine sandy clay. In places the lower subsoil is rather a silty clay, with only a small amount of sand. Rounded gravel and a few cobbles are of frequent occurrence on the surface and throughout the soil section.

The type occupies slopes near streams and gently rolling areas in the uplands. It is developed in large areas along the Chickahominy River, north of Richmond, and in the southeastern part of the county. It has good drainage and is susceptible of easy cultivation. Best results are obtained where liberal applications of barnyard manure are made and where green crops are plowed under. The use of commercial fertilizers in moderate amounts is beneficial. A mixture analyzing about 8 per cent phosphoric acid and 3 per cent nitrogen is used successfully with corn, oats, and sweet potatoes.

The type is used for general farming, dairying, and to some extent for trucking. It is intermediate in productiveness between the Norfolk and Orangeburg soils of the same texture. It does not give quite as good results with alfalfa as the Orangeburg type, but makes better land for this crop than the Norfolk fine sandy loam. Vetch and cowpeas do well.

The natural growth is largely oak, pine, dogwood, hickory, and maple.

RUSTON SILT LOAM.

Typically the Ruston silt loam consists of a grayish to pale-yellowish silt loam, underlain at about 6 to 8 inches by a reddish-yellow to yellowish-red silty clay, which usually becomes somewhat redder and heavier with depth and generally passes in the lower part of the 3-foot section into a yellowish-red or dull-red moderately friable compact silty clay. Drainage is well established.

The type occupies comparatively inextensive, well-drained areas in the southern corner of the county. The land has about the same value as the Ruston fine sandy loam.

If plowed too wet, the soil subsequently becomes compact and forms clods. In its natural condition the land assumes a compact unfavorable structure unless the organic supply is maintained by applications of barnyard manure or by turning under vegetation, such as cowpeas, vetch, and clover.

Practically all of the type is cleared and under cultivation. Good yields of corn, small grains, and grass are obtained.

ELKTON SERIES.

The Elkton series includes types with light-gray surface soils and mottled whitish, gray, and yellow subsoils. Gravel or coarse sand, usually saturated with water, is encountered at 2½ to 3 feet. These soils are closely associated with the Sassafras. The Elkton soils, however, are much lighter in color and lower in agricultural value than the Sassafras. The series is encountered in that part of the Coastal Plain lying north of the North Carolina-Virginia line, and is derived from sedimentary material that has existed under conditions of partial drainage.

ELKTON SANDY LOAM.

While this type was classified as a sandy loam, it is recognized that much of it is considerably heavier than the average sandy loam. Even in this heaviest portion, however, a noticeable quantity of medium to coarse sand is usually present. Some areas of silt loam or silty clay loam, and also patches of Portsmouth loam too small to be mapped are included with this type.

The typical Elkton sandy loam is a gray or drab sandy loam or heavy sandy loam, underlain at about 8 to 12 inches by drab to light-gray or mottled drab, gray, and yellow sandy loam, sandy clay, or clay of a rather plastic structure. This type, like the Elkton fine sandy loam, occupies low, flat, poorly drained situations, and much of it supports a plant growth similar to that covering the latter type. It is used for the same kinds of crops as the Elkton fine sandy loam, and requires practically the same treatment, including deep plowing, liming, the addition of organic matter and the application of commercial fertilizers. It is only where such methods are employed that profitable yields are obtained. Very little of the type is cleared and under cultivation.

This type is not extensive. It is developed in the north-central section of the county, where it is associated with the Norfolk sandy loam. It is not valued very highly for agricultural purposes and is used chiefly for grazing. The pastures are generally burned over in the spring.

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

Mechanical analyses of Elkton sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
211349.....	Soil.....	2.9	13.1	12.6	22.6	18.3	23.9	6.6
211350.....	Subsoil.....	2.4	10.4	10.4	19.4	16.6	22.1	18.6

ELKTON FINE SANDY LOAM.

The Elkton fine sandy loam is a light-gray fine sandy loam, or heavy fine sandy loam, underlain at about 6 to 10 inches by mottled gray and yellow, slightly friable to rather plastic fine sandy clay. In places a subsurface layer of mottled gray and yellow fine sandy clay extends to a depth of 15 to 20 inches before the subsoil proper is encountered. The subsoil is frequently mottled with drab and reddish yellow. When dry the soil has a compact structure. Some of the lower depressions comprise small areas of brown to black loam or silty clay loam. Some of these spots would be mapped as Portsmouth loam and others as Portsmouth silty clay loam and as Elkton silty clay loam, if of sufficient size.

The type has its main development just north and west of Richmond, east of that city, and in the northern part of the county. It occupies slightly depressed areas, which are very poorly drained during a large part of the year. Most of these areas dry out in the summer, so that cultivation is possible, but without artificial drainage by ditching or tiling good results are not secured with any crops, except such crops as redbud, or herds-grass, alsike, and lespedeza.

The more important steps necessary to bring this land into a proper condition for farming are drainage, the application of burnt lime or ground limestone, the liberal incorporation of vegetable matter, as barnyard manure, or green crops plowed under, and deep fall plowing.

Much of the Elkton fine sandy loam is covered with mixed forests of maple, black gum, sweet gum, shortleaf pine, white oak, and water oak. The undergrowth consists largely of huckleberry, and the type is sometimes called "huckleberry slash" and "slash land." There is an extensive growth of sassafras.

A large part of the type is cleared, drained, and cultivated. Corn, some wheat, very little or no clover, and grasses, comprising timothy, redbud, orchard grass, fescue, and oat grass, are grown. Vegetables, such as beans, cabbage, onions, and beets, are produced successfully. Potatoes, turnips, and cucumbers do only fairly well.

The results of mechanical analyses of samples of the soil and subsoil of the Elkton fine sandy loam are given in the following table:

Mechanical analyses of Elkton fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
211347.....	Soil.....	1.0	6.5	9.8	28.6	9.4	28.9	16.0
211348.....	Subsoil.....	1.2	6.0	8.8	24.1	7.4	20.7	31.8

ELKTON SILT LOAM.

The surface soil of the Elkton silt loam is a gray silt loam, underlain at about 8 to 15 inches by mottled gray and yellow, stiff, plastic clay or silty clay, mottled in places with drab, yellow, and reddish yellow in the lower part of the 3-foot section. Between the silt loam soil and clay subsoil proper there is usually a thin stratum of mottled gray and yellow silty clay loam. The type includes areas in which the material approaches a fine sandy loam in texture, but such areas are too small for satisfactory separation.

When dry, the surface soil is quite compact and almost white, but when thoroughly wet the land is miry and rather darker in color. The soil is deficient in organic matter, or at least the kind of organic matter which usually imparts the brownish color indicative of a productive condition. This type is locally known as "crawfish land" and as "slash land."

The type occupies flat areas and faintly undulating depressions. It occurs just north of Richmond, and in large areas in the eastern part of the county. The drainage is very poor, on account of inadequate slope and scarcity of drainage outlets, as well as the impervious character of the subsoil. Water usually stands on the surface for long periods after heavy rains. Over a part of this type the drainage is somewhat better. This phase consists of a gray silt loam, underlain at about 8 to 10 inches by yellow, stiff clay, which, below 15 to 20 inches, is mottled with reddish yellow, gray, or drab. The lower part of the subsoil is more plastic than the upper part. Reddish mottlings are common at a depth of about 30 inches.

A large part of this type is forested with black gum, sweet gum, white oak, water oak, and shortleaf pine. The undergrowth consists largely of huckleberry. The soil dries out in the summer so that the type, or much of it, can be cultivated, but the yields secured are only fair, except where the land is drained by ditches or tiles. Even where properly drained low yields are obtained with such crops as corn and clover, unless the soil is plowed deeply and supplied with liberal quantities of vegetable matter and lime.

The soil remains cold late in the spring, and while in this condition is not responsive to fertilizers or manure. It is used to a very small extent for crops, most of the cleared land being in pastures. In one place an excellent system of tile drainage has been installed for about 20 years, and good yields are said to have been obtained from this field. It is now included in one of the suburbs of Richmond and no longer cropped.

In the table following the results of mechanical analyses of samples of the soil and subsoil of the Elkton silt loam are given.

Mechanical analyses of Elkton silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
211331.....	Soil.....	0.3	1.0	1.4	9.3	11.5	60.4	16.2
211332.....	Subsoil.....	.0	.5	.8	5.0	8.1	42.3	43.1

BRADLEY SERIES.

The surface soils of the Bradley series are gray and the subsoils predominantly red, slightly mottled with yellow or gray. The latter consist of clay. The Bradley series is formed of a thin layer of sedimentary Coastal Plain material (Norfolk) over residual Piedmont material (mainly Cecil). It is developed most extensively near the junction of the Coastal Plain and Piedmont, or in that region where there is an overlapping of the former upon the latter.

BRADLEY GRAVELLY SANDY LOAM.

Typically the soil of the Bradley gravelly sandy loam is a grayish fine sandy loam or sandy loam, underlain at a depth of 5 or 6 inches by a pale-yellow, heavy, fine sandy loam. The subsoil, which is ordinarily encountered at depths of 10 to 30 inches, is a red or light-red to mottled red, yellow, and gray brittle clay. The surface soil carries sufficient gravel and cobbles, principally of quartz, to give most of the type a decidedly gravelly character.

The type is quite variable, especially in the depth of the surface soil, which ranges from about 1 inch to nearly 36 inches. The deeper soil is generally found in the smoother areas. The type includes patches of the Durham sandy loam and Cecil sandy loam, and some areas of the Norfolk sandy loam or gravelly sandy loam, which are too small to be shown separately on the map.

This type is developed in irregularly shaped areas along the line of overlap of the Piedmont material by the Coastal Plain material, and in detached, elevated areas in the Piedmont region where the mantle of Coastal Plain material still remains. The type is encountered in the west-central part of the county. The topography varies from undulating to gently rolling. The slopes are sufficiently steep near the larger streams to permit the land to wash badly, particularly where the residual subsoil is near the surface. The drainage is good to excessive. The soil is retentive of moisture where it is kept well supplied with organic matter and where frequent shallow cultivation, following the deep breaking of the land, is practiced.

The Bradley gravelly sandy loam is not rated as a very productive soil, although with liberal fertilization it produces profitable yields of vegetables, sweet potatoes, and forage crops. As a rule, the nearer

the surface the subsoil lies the more valuable is the land. Some of the areas in which the underlying clay occurs at a depth of about 12 to 14 inches have about the same value as the Cecil sandy loam.

A large part of the type supports a forest of hardwoods. The same agricultural practices are used on this type as upon the adjacent Cecil and Durham soils, and it seems adapted to the same crops.

WATER-LAID MATERIAL (OLD ALLUVIUM)—MIXED DERIVATION.

ALTAVISTA SERIES.

The surface soils of the Altavista series are gray, the subsoils yellow, or mottled yellow and gray or yellow, gray, and red. The series is developed as well-defined to rather indistinct stream terraces lying above normal overflow. The soils are encountered in the Piedmont region and in the near-by Coastal Plain along streams issuing from the Piedmont. The material is typically alluvial in origin, but in places near foot slopes some colluvial material has been mixed with the alluvial deposits. In places also the subsoil appears to be, at least in part, residual. The flatter areas are in need of surface drainage.

ALTAVISTA SANDY LOAM.

The Altavista sandy loam is a gray sandy loam, underlain at about 10 to 15 inches either by light-gray to drab sandy clay mottled with yellow, or by yellow sandy clay mottled with drab. In places the texture varies to fine sandy loam and even to silt loam.

The type occurs in the western part of the county. It occurs along the streams which receive wash mainly from the Durham sandy loam and is believed to represent old alluvial terraces formed when the streams were flowing at higher levels than at present.

Most of this soil is forested with beech, birch, sweet gum, black gum, white oak, water oak, maple, and shortleaf pine. The land in its natural condition gives the best results with alsike clover, lespe-deza, and redbud. With better drainage, wheat and oats are successfully grown.

The type is too distant from market for profitable trucking, but fair yields of the general farm crops are obtained.

ALTAVISTA SILT LOAM.

The Altavista silt loam is a grayish-brown silt loam at the surface, the subsurface soil consisting of a pale-yellow silt loam, which extends to a depth of about 5 to 8 or 10 inches. The subsoil is a yellow crumbly silty clay, usually compact and stiff in the lower depths, where it is frequently mottled with shades of gray and yellow. On the slight slopes where there has been some erosion the yellowish subsoil clay is near enough the surface to give the type the texture of

a silty clay loam. These areas, however, are not of sufficient size to be shown separately on the map.

In places in the poorly drained depressions the soil is lighter in color and the subsoil is more mottled. These areas belong to a poorer drained phase of the type such as is found in the vicinity of Lorraine. This phase consists of a gray, compact silt loam which quickly passes into drab or gray plastic silty clay mottled with yellow. The phase is more inclined to become compact than the better drained typical soil as it is developed on the James River terraces southeast of Richmond.

The type is developed in the western part of the county in the vicinity of Lorraine, and south of Richmond along the high terrace of the James River. The largest area occurs north of Curles Neck.

The surface of the typical soil is gently undulating while that of the poorer drained phase is either flat or slightly depressed. Over a part of the typical soil tiling is beneficial, although most of it is not in need of artificial drainage. Over all of the poorly drained phase tiling or ditching is necessary.

The better drained part of the type gives good yields of wheat, corn, forage crops, and grass, particularly where the land is plowed deeply in the fall. The poorly drained phase constitutes fairly good wheat land and good grass land. Alsike clover, lespedeza, and redtop find this soil well suited to their requirements, but for corn and crops such as Irish potatoes it is essential that the drainage conditions be improved before good average returns can be secured. Organic matter is needed by this soil throughout its entire extent. This can be supplied by the application of stable manure or by turning under such crops as cowpeas and clover. The application of burnt lime or crushed limestone is beneficial. Owing to the compact structure of the dry soil, heavy teams are required in breaking the land.

Large areas of the type are still supporting a forest growth consisting of white oak, water oak, sweet gum, and scrub pine.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Altavista silt loam:

Mechanical analyses of Altavista silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
211319.....	Soil.....	1.0	2.4	1.5	9.6	13.7	61.7	10.0
211320.....	Subsoil.....	.5	1.3	1.0	6.0	8.8	45.6	36.8

KALMIA SERIES.

The surface soils of the Kalmia series are gray to grayish yellow, and the subsoils mottled gray and yellow. The series is developed along streams of the Coastal Plain region on terraces lying largely

above overflow. The Kalmia soils occur most extensively in the Gulf Coastal Plain region of Mississippi and Alabama. They are derived largely from materials washed from Coastal Plain soils, although along the larger streams issuing from the Appalachian Mountains and Piedmont Plateau more or less material from the soils of these regions is present. In the better drained situations the subsoils are yellow, the soils of such areas resembling very closely the corresponding members of the Norfolk series. The surface is usually flat and drainage is deficient.

KALMIA SANDY LOAM.

The soil of the Kalmia sandy loam is a gray or dark-gray sandy loam grading at a depth of a few inches into a yellowish light sandy loam which is fairly loose and open. The subsoil is encountered at 8 to 10 inches, and consists of a yellow, somewhat compact, friable sandy loam, which is mottled with brown or yellowish brown below 24 inches. The subsoil becomes more compact and heavier with depth. At 36 inches it is a sandy clay, somewhat plastic and sticky when wet.

This type is principally developed in small areas along the Chickahominy River, in the eastern part of the county. The topography is level to gently undulating, and the drainage is fairly well established over most of the type, though a few small areas are in need of ditching or tiling.

Over practically all of the type the natural forest, consisting of poplar, maple, oak, sweet gum, beech, and birch, has been cleared off and the land is under cultivation.

This is a good soil for truck crops, such as radishes, lettuce, cabbage, peas, tomatoes, cantaloupes, watermelons, and cucumbers. It also gives good yields of peanuts and sweet potatoes. Such legumes as cowpeas and vetch do well, and fair yields of corn are obtained, but the type is too light for the best success with farm crops. This type is valued at about \$30 to \$40 an acre.

KALMIA FINE SANDY LOAM.

The Kalmia fine sandy loam is a gray to grayish-brown fine sandy loam, underlain at about 3 to 6 inches by pale-yellow, heavy fine sandy loam. The subsurface material becomes heavier with increase in depth, passing through yellow friable fine sandy loam into yellow friable fine sandy clay at an average depth of about 20 inches. The lower part of the subsoil, especially in the poorer drained situations, is slightly mottled with gray and various shades of yellow.

The type occupies stream terraces, and is developed to only a small extent in this county. It is found along the well-defined terraces of Brook Run, north of Richmond. These terraces are above

overflow. There are also several small areas in the northeastern and western parts of the county. The material consists of old alluvium derived largely from Coastal Plain soils.

The surface of the Kalmia fine sandy loam is faintly undulating, and the drainage is sufficiently well established over most of the type for good results with crops without ditching or tiling. The soil is easily cultivated and kept in good condition provided needed organic matter is supplied by plowing under stable manure or green crops of cowpeas, vetch, clover, or rye. Applications of commercial fertilizers are necessary for the best results, unless sufficient barnyard manure is available.

All this type is cleared and in farms. A large part of it is used for pasture, to which it is well adapted, as the natural grasses and also the cultivated grasses, such as timothy, orchard grass, fescue, oat grass, and chess do well. Good yields of hay are obtained, the production of 2 to 2½ tons per acre not being uncommon. The soil is used to some extent for truck growing, and the yields are generally good. The type is so situated that the water supply for plants is good even in dry seasons, and as the surface is easily cultivated little difficulty is experienced in obtaining good crops. Sweet corn, peas, and melons are among the most profitable truck crops grown.

The type is valued very highly, owing to its proximity to the suburbs of Richmond.

RESIDUAL MATERIAL—CRYSTALLINE ROCKS.

DURHAM SERIES.

The soils of the Durham series are gray, with yellow subsoils. The series is encountered in Virginia, North and South Carolina, Alabama, and Georgia. The soils are derived from light-colored, rather coarse-grained granite and gneiss, consisting principally of quartz and feldspar, with some mica. The topography, as a rule, is gently rolling. The drainage is good, and in places excessive, owing to the sandy, porous texture of the subsoil.

DURHAM SANDY LOAM.

The Durham sandy loam is a gray to pale-yellow sandy loam, the clay content of which increases with depth, a yellow, friable sandy clay loam being encountered ordinarily at about 10 inches. This quickly grades into a yellow, moderately friable sandy clay, which generally extends to a depth of 3 feet without much change. On slopes and near the crests of ridges partially decomposed rock material is frequently encountered in the 3-foot section. The immediate surface soil when dry is decidedly gray or nearly white in color, the material appearing to have been severely leached. Fragments

of quartz and larger fragments of granite are conspicuous on the surface of some areas, and are often disseminated throughout the soil mass. The type resembles the Norfolk sandy loam so closely that it is difficult in places to establish definite boundaries. The Durham sandy loam includes areas near the Coastal Plain-Piedmont boundary in which the surface soil is composed largely of sedimentary material. Water-rounded gravel and cobbles are of common occurrence near the boundary between the Piedmont and Coastal Plain provinces, even where the fine sedimentary material has been mainly or entirely removed by erosion.

This type is extensively developed over the entire western end of the county. The surface is undulating to gently rolling, and practically all the type is suited to cultivation. It is thoroughly drained, yet with proper management it conserves enough moisture to supply the growing crops during ordinary dry spells, especially where a sufficient content of organic matter is maintained. Where the organic matter is depleted crops are likely to be injured during droughts.

Best results with this soil are had where crops such as vetch, cowpeas, crimson clover, and soy beans which supply organic matter are included in the rotation with the general farm crops. The plowing under of one of these, or of some other crop such as rye, at intervals of a year or two is beneficial. Moderate to liberal applications of commercial fertilizers or barnyard manure are necessary for large yields of any crop, but the amount necessary is less where the soil is well supplied with organic matter.

The Durham sandy loam is the best vegetable, potato, and bright tobacco soil of the Piedmont region. The crop adaptation of this soil conforms very closely with that of the Norfolk sandy loam, and its crop value is nearly the same. In southern Virginia and North Carolina the Durham sandy loam is the principal bright tobacco soil of the Piedmont section, and there is no doubt but that it could be just as successfully used here for the production of bright, or cigarette, tobacco. Sun-cured tobacco is produced to a small extent upon this type in the northern part of the county. From 1,000 to 1,200 pounds per acre is considered a good yield. Wheat, oats, corn, and white, red, and crimson clover are the principal crops grown. The soil is fairly well adapted to wheat and clover. It is somewhat too droughty for late maturing crops like corn.

Most of the type is cleared and under cultivation. The forest growth is the same as upon the Cecil sandy loam, but is usually less heavy.

The Durham sandy loam is valued at about \$20 to \$30 an acre.

CECIL SERIES.

The Cecil series includes the most important and widely distributed soils of the Piedmont Plateau. The surface soils are gray, brown, or red. The subsoils consist of red clay. Quartz sand and mica flakes are usually present in the subsoil. Rock outcrops are rare, but fragments and boulders of the parent rock are found in places on the surface. The topography is rolling to hilly, with level to undulating areas in situations where stream erosion has not been particularly active. The Cecil soils are of residual origin, and derived principally from granite and gneiss, which have weathered to great depths. The drainage as a rule is excellent.

CECIL SANDY LOAM.

The soil of the Cecil sandy loam is a grayish-brown to reddish-brown sandy loam, containing considerable grit or fine angular quartz gravel. The subsoil, encountered at about 5 to 8 inches, is typically a brick-red or light-red clay which extends to a depth of 26 inches without much change. It generally contains small fragments of quartz and frequently at lower depths large quantities of partially decomposed material from the parent rocks. The type is not uniformly the true Cecil sandy loam. It includes eroded patches, too small to map separately, of Cecil clay or Cecil clay loam, Durham sandy loam, Bradley sandy loam or gravelly sandy loam, and Appling sandy loam. The Appling sandy loam represents a gradational soil between the typical Cecil and Durham sandy loams. It has a surface soil much like the Cecil or Durham, but the subsoil consists of light-red clay mottled or streaked with yellow and gray.

The type is developed in scattered areas in the northwestern part of the county, and occurs usually as well-drained hills and slopes along streams. The largest areas occupy the hills back from the James River.

The material of the Cecil sandy loam is residual mainly from granite and gneiss. Fragments of these rocks are of common occurrence. Near the Piedmont-Coastal Plain boundary rounded gravel and cobbles are present on the surface. These are remnants of a former mantle of Coastal Plain material, the finer particles of which have been washed off.

The soil is deficient in organic matter, as is indicated by the light-gray color of the surface material when thoroughly dry. Both the surface drainage and underdrainage are good. The run-off of rain water is so rapid on the steeper slopes that damage is caused by erosion, especially where shallow cultivation is practiced and the content of organic matter is not maintained. The topography is mainly undulating to gently rolling. Most of the land is well suited to cultivation.

The crops produced are wheat, oats, corn, clover, and hay. The type produces good yields of wheat and hay where manure is applied or green crops are turned under. Clover grows well.

The natural forest growth has been removed from most of the type, and it is under cultivation. The native forest is mixed, consisting of oak, maple, hickory, and shortleaf pine. The second growth usually is pine. The type is valued at about \$50 an acre.

BROWN SOILS.

WATER-LAID MATERIAL (OLD ALLUVIUM)—MIXED DERIVATION.

WICKHAM SERIES.

The surface soils of the Wickham series are reddish brown, with reddish, micaceous heavy sandy loam or loam subsoils, which are coarser, looser, and more incoherent at a depth of about 30 inches. These soils contain a higher percentage of organic matter than those of the Norfolk series. They occupy river terraces in the higher part of the Coastal Plain near the Piedmont boundary. The surface is generally level to gently undulating. The soils are fairly well drained, and the subsoils are retentive of moisture.

WICKHAM FINE SAND.

The Wickham fine sand consists of a brown to reddish-brown loamy fine sand to loose fine sand which extends to a depth of 3 feet or more without much change in color or texture. The soil is usually loose and inclined to drift.

This type occurs along the immediate banks of the James River in the southern part of the county and in a small area northwest of Richmond. In both cases it is much lower than the other Wickham soils, with the exception of the gravelly sandy loam which occurs at about the same general level, and represents a more recent terrace. It stands just above overflow.

In its natural condition the soil has a rather low agricultural value, but with the liberal use of commercial fertilizers and stable manure and the occasional plowing under of such crops as cowpeas and vetch, this soil can be made to produce good yields of truck crops.

The results of mechanical analyses of samples of the soil and subsoil of the Wickham fine sand are given in the following table:

Mechanical analyses of Wickham fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
211327.....	Soil.....	0.8	5.5	12.6	44.3	12.1	17.8	7.0
211328.....	Subsoil.....	.3	3.4	10.5	46.4	13.8	18.0	7.6

WICKHAM GRAVELLY SANDY LOAM.

The Wickham gravelly sandy loam is a grayish-brown loam to heavy sandy loam, underlain at varying depths, ordinarily at 8 to 14 inches, by yellowish-brown to reddish-brown, friable sandy clay, which in places is more sandy and less coherent in the lower part of the 3-foot section. Gravel and cobbles are fairly abundant on the surface and throughout the body of the soil, being sufficiently numerous to interfere somewhat with cultivation. There are included areas where the gravel is much less abundant which would be separated as Wickham sandy loam if of sufficient size.

The type characteristically occupies the slopes and occasional swells or hummocks on the low terraces of the James River. It occurs mainly in the central and southern parts of the county. The soil is composed, at least in many places, of material derived from exposures of the gravel bed underlying the greater part of the terraces of the James River. It is most frequently found along the slopes of the lateral streams cutting across the terrace to the river. In these places the gravel content of the subsoil is unusually large, forming probably 70 per cent of the entire soil mass.

In general the type has a very low agricultural value owing to its droughty condition and the difficulty of increasing the yields by fertilization. Only in the more loamy and less gravelly areas can this be successfully accomplished. Practically no crops can be produced in dry seasons.

In seasons of normal rainfall the type is fairly well suited to corn, grain, and forage crops. Vegetables give fairly good results. On many of the large farms this type is not cultivated and is covered with brush.

WICKHAM FINE SANDY LOAM.

The material of the Wickham fine sandy loam is somewhat variable, ranging from loamy fine sand to heavy fine sandy loam or light loam. The average of the type, however, is a reddish or brownish fine sandy loam, underlain at depths of 8 to 18 inches by dull-red to reddish-brown fine sandy loam to loam. In places the subsoil consists of sandy clay. The lower part is frequently much more sandy, loose, and friable than the upper subsoil. The subsoil is friable when moderately moist, but on drying out it becomes compact.

The type occurs on both the low and high terraces of the James River and on the terraces of the Chickahominy River. It is most extensively developed on the high terraces around the Dutch Gap Canal.

The Wickham fine sandy loam is inferior from an agricultural standpoint to the Wickham silt loam, particularly for grain and grass. It is a good forage crop soil, giving good yields of cowpeas, vetch, and

crimson clover. Corn, oats, and rye do fairly well. Garden vegetables, Irish potatoes, and sweet potatoes can be successfully grown. The soil is in need of vegetable matter.

WICKHAM SILT LOAM.

The Wickham silt loam is a brown silt loam having a slightly reddish cast to reddish-yellow silt loam, underlain at an average depth of about 8 inches by a reddish-yellow silty clay loam which grades at about 14 inches into reddish-yellow to yellowish-red or dull-red, rather stiff silty clay, faintly mottled in places with shades of brown. The type includes some small areas in which the material ranges close to a silty clay loam, and also small patches which have the texture of a loam.

This type occupies nearly level terraces of the James River. On the lower terraces there is usually less change in the character of the material from the surface downward, in some places scarcely any change occurring within the 3-foot section, but the subsoil is generally somewhat heavier than the surface soil although carrying no more clay than a silty clay loam. The type is most extensively developed in Curles Neck

This is a productive soil which with proper handling gives excellent yields of wheat, clover, grass, corn, and forage crops. Alfalfa can be easily grown with profitable yields. A large acreage of the type is in alfalfa, which averages about 4 cuttings per year with a yield of about 3 or 4 tons per acre. The quality of the hay is excellent. About 1 ton per acre of lime is applied before seeding to alfalfa. The type is well suited to bluegrass, tall oat grass, timothy, fescue, orchard grass, foxtail, etc. Leguminous crops, such as clover, cowpeas, and soy beans, do well and are grown to some extent. Corn averages about 30 to 40 bushels, oats about 50 to 60 bushels, and wheat about 20 bushels per acre.

The Wickham silt loam is fairly well drained under natural conditions, but tile drainage, in one instance at least, improved the productive power of the land to a considerable extent. The type occupies former flood plains composed of sediments laid down when the overflow waters reached much higher levels than at present. The material is largely derived from the Piedmont soils.

WATER-LAID MATERIAL (RECENT ALLUVIUM)—MIXED DERIVATION.

CONGAREE SERIES.

The Congaree soils are brown. They range in places to reddish brown, and there is comparatively little change in color, structure, and texture from the surface downward. Occasionally grayish and yellowish mottling is encountered in the subsoil of poorly drained areas. These soils are developed in the overflowed first bottoms of

the streams of the Piedmont region and in similar positions in the Coastal Plain along streams issuing from the Piedmont. The material is derived from the soils of the Piedmont region, with some admixture of Appalachian material, and in the Coastal Plain a slight admixture of Coastal Plain material. The soils are usually poorly drained.

CONGAREE SILT LOAM.

Typically the Congaree silt loam is a reddish-brown to chocolate-colored, mellow silt loam, which changes but little within the 3-foot section. In slight swales the subsoil is frequently somewhat mottled in the lower portion with gray. On drying out, the surface soil in places is inclined to crack. Near stream banks and on the swells of the bottoms the subsoil is frequently darker in color and is a little lighter and more friable than the surface soil. Usually the subsoil of the type is quite compact when dry. The Congaree silt loam is fairly easy to maintain in a good condition of tilth, yet fairly heavy teams and plows and considerable harrowing are necessary to secure best results from tillage operations.

The type is confined to the first bottoms of the James River and is subject to periodical overflow. The material is derived largely from the Piedmont uplands, each overflow depositing an additional layer of sediment. This is one of the most productive soils in the county, being admirably adapted to the production of corn, oats, wheat, clover, and grass. Alfalfa does well in the absence of continued overflows, which may be prevented by diking. With deep plowing no fertilization is necessary for good yields on this land. Wild onions and wild carrot are weeds of common occurrence, but where the soil is frequently cultivated these do not give much trouble.

Along the lower James River this type in many places occupies a very low position. Diking and pumping are necessary in the production of successful crops upon these lowlands. Across the river in Chesterfield County at Jones Neck such improvement has been made with excellent results.

RESIDUAL MATERIAL—SHALE AND SANDSTONE.

PENN SERIES.

The Penn soils are brown to red, the red being the peculiar shade known as Indian red. They are derived through processes of weathering from red sandstone and shales of Triassic age. Detached areas of these rock formations occur in shallow basins in the Piedmont Plateau from the vicinity of New York City to South Carolina.

The Penn clay loam as developed in Henrico County is not altogether representative of the established type as mapped in other areas. It is considerably lighter in color at the surface, and the sub-

PENN CLAY LOAM.

soil is in most places more of a brick red than is characteristic of the typical clay material of the Penn series, the color of which is Indian red. The main part of the type consists of grayish-brown to reddish-brown, friable clay loam to silty clay loam, which passes at about 6 to 12 inches into red, moderately friable clay. Frequently, however, the subsoil, particularly the lower part, has an Indian-red color. In some small areas red or Indian-red clay or clay loam is exposed at the surface, and is underlain by Indian-red heavy clay, more nearly like the typical clay of the Penn series. Those areas which have a grayish-brown surface soil consist mainly of silty clay loam, underlain by red clay which is more or less mottled in the lower part of the 3-foot section with yellowish and gray. Usually small chips of reddish and yellowish shale in a state of partial decomposition are present. This incompletely decomposed shale, together with a quantity of mica scales, imparts a greasy feel to the clay subsoil of some areas.

The Penn clay loam is developed along Tuckahoe Creek, which forms a part of the western boundary of the county.

The material is residual from Triassic shales. The parent formation includes a workable vein of coal. Refuse coal material, or mine dumps, consisting principally of shale, carbonaceous shale, and small fragments of coal, commonly occur in heaps sometimes covering an acre or more.

The type is well suited to the production of small grain. Cultivation is rather difficult, owing to the clayey texture of the soil and its tendency to become compact on drying out after heavy rains. The general farm crops of the area are grown. Stock raising could be very successfully carried on upon this type, as the soil is strong and only in need of organic matter to bring it into a proper mechanical condition for the production of satisfactory yields.

Very little of the type is cleared and under cultivation. It supports a forest growth of hardwoods characteristic of the section of the county in which it is developed.

YELLOW SOILS.

RESIDUAL MATERIAL—SHALE AND SANDSTONE.

GRANVILLE SERIES.

The surface soils of the Granville series are yellow, ranging to grayish. The subsoils consist of yellow, friable sandy clay. In the lower part of the subsoil Indian-red clay (Penn material) and a grayish plastic clay are frequently encountered. These soils are similar to the Durham in physical characteristics, but the subsoils are slightly more plastic and somewhat heavier. The deep subsoil or substratum also differs from that of the typical Durham in the variegated color, which frequently includes Indian red, greenish gray,

purple, drab, and white. The material of this series is derived from Triassic sandstone.

GRANVILLE SILTY CLAY LOAM.

The Granville silty clay loam is a yellowish or pale-yellow silty clay loam which quickly grades into yellow silty clay of a rather brittle structure. At a depth of about 20 inches the material is ordinarily mottled yellow, gray, and reddish, while at about 24 to 30 inches the clay is heavier and more plastic and is usually mottled yellowish, reddish, and drab. In some places the yellowish clay subsoil extends to a depth of about 36 inches. The subsoil frequently has a uniform reddish color, or is reddish yellow to yellowish red throughout the 3-foot section. This phase represents a gradational soil between the typical Granville silty clay loam and the Penn clay loam. Chips of yellowish-brown, yellow, grayish, and reddish shale are fairly abundant on the surface and are present in smaller quantities throughout the soil section. Partially decomposed shale material together with mica flakes impart a greasy feel to the clay of the subsoil.

In some respects this soil resembles the Lehigh soils of Pennsylvania, but it differs from those types in having more red and yellow and less blue and gray material in the subsoil.

The type is not extensively developed, and occurs in the north-western part of the county. In one area in the extreme western part of the county, near Gayton, it is associated with the Penn clay loam. Another area to the northeast, near the Chickahominy River, lies almost wholly within the Durham sandy loam.

The material is residual from Triassic shales. The parent rock appears to have had its original color changed by metamorphism from intrusions of igneous rock.

This is a good soil for grass. It needs lime and commercial fertilizers or barnyard manure for success with the general farm crops. It is used for general farm crops and for orcharding. As with the Penn clay loam, it is necessary to plow this soil when in just the proper moisture condition, as its cultivation when too wet is disastrous.

Practically all of the original forest growth of hardwoods has been removed, and the type is largely under cultivation.

MISCELLANEOUS MATERIAL.

MEADOW.

The Meadow classification comprises overflowed first bottoms of alluvium which are so variable in texture and character of material that it is not advisable to attempt any division into definite types. There is frequently a wide range in the texture of the soil within small areas. The soils included in this classification are mainly sand, coarse sand, sandy loam, silt loam, and silty clay loam. The greatest

variation is encountered in the narrow bottoms of the smaller streams where the material has been influenced not only by sediments deposited from overflow water but also by colluvial material swept down from adjacent slopes in times of heavy rainfall.

In the Piedmont portion of the county, Meadow includes alluvium which if classified into types would fall mainly in the Congaree and Wehadkee series. The Congaree soils typically consist of the brownish to reddish first-bottom alluvium derived mainly from the Piedmont uplands, while the Wehadkee soils represent grayish to whitish alluvium derived from the same source. In the Coastal Plain section where the material is derived principally from Coastal Plain upland soils, principally the Norfolk, the soils included in the Meadow classification, if separated into types, would be correlated principally as Bibb and Ocklocknee, the former representing gray to whitish alluvium derived from Coastal Plain material, and the latter brownish soils derived from the same source. Along the Chickahominy River much of the first-bottom soil consists of silt loam to heavy fine sandy loam with a mottled drab and yellow clay subsoil. This land is flat and poorly drained between overflows.

The Meadow is developed in narrow strips on both sides of all of the minor streams of the county.

Formerly large areas of Meadow in the Chickahominy bottoms were cultivated, but at present these are mainly in pasture. Some of the land has been allowed to grow up in timber, in which the old farm rows can still be seen. A few patches are devoted to tilled crops. This is spoken of as "cold-natured" or "tight" land. The furrows left where the land was once cultivated can often be traced by a line of bulrushes in the depressions between the old beds. This grass is common to the low, poorly drained, cleared areas of Meadow.

Considerable ditching or tiling is necessary to bring this land into proper condition for cultivation.¹

SWAMP.

The Swamp classification comprises first-bottom alluvial land of variable character, which is subject to deep inundation and which remains wet between overflows.

The soil is usually composed of various grades of soil material mixed with black organic matter in varying stages of decomposition. From a depth of a few inches to about a foot the soil proper generally has a drab or bluish color, with dark spots. The subsoil usually varies from a fine sandy loam to silty clay of a mottled color similar to that of the soil. The Swamp is mainly confined to the lowest part of the

¹ A drainage survey of the Chickahominy River swamps and bottom land was made by the Drainage Investigation Division of the Office of Experiment Stations, U. S. Dept. of Agriculture, and detailed information concerning that area can be obtained from the report on that survey.

Chickahominy River bottoms in the eastern part of the county. The land seldom dries out and is entirely occupied by timber. The forest growth consists principally of poplar, sweet gum, beech, and birch, with a few tupelo, gum, and cypress trees in the lower areas.

SUMMARY.

Henrico County is situated in east-central Virginia. It has an area of 264 square miles, or 168,960 acres, and a population, according to the 1910 census, of 151,065, including the city of Richmond.

The county comprises a section of the Piedmont Plateau and of the Coastal Plain. The topography varies from gently rolling or hilly to gently undulating or level, the elevation ranging from tide level to 380 feet above sea level.

The county has excellent transportation facilities. In all sections the roads are in good condition. The county is well supplied with schools, and with rural mail delivery and telephone service.

Richmond, the largest city in the State, is located within this county. This city has a population of 127,628, and constitutes a good market for all farm products.

The climate is mild, the growing season averaging about 8 months.

Nearly all of the land in the county can be farmed and is or has been under cultivation. The agriculture practiced includes dairying, trucking, and general farming. Very little live stock is kept, exclusive of dairy cows. The methods of agriculture are comparatively modern.

The soils recognized in Henrico County represent four general divisions—the Piedmont, Coastal Plain, terrace or old alluvial soils, and overflow land.

Twenty-seven soil types, grouped in 13 series and 2 miscellaneous types are mapped in Henrico County, varying from a silty clay loam to a gravelly sandy loam, and from Swamp and poorly drained upland to well-drained terraces and rolling, aerated upland. There is very little deep sandy land in the county, compared with other similarly situated areas. The majority of the soils are very productive, some of them representing the strongest soil types of the Southeastern States. The lighter soils respond very readily to good treatment and are excellent for early truck crops. The "slash lands" represent the poorest soil in the county. These need thorough drainage before they can be most profitably cropped.



[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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