

# SOIL SURVEY OF HENDERSON COUNTY, NORTH CAROLINA.

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## DESCRIPTION OF THE AREA.

Henderson County lies in the southwestern part of the State of North Carolina, and is included in the Saluda and Pisgah quadrangle sheets of the United States Geological Survey. The county is bounded on the north by Buncombe County; on the northeast and east by McDowell, Rutherford, and Polk counties; on the south by the South Carolina State line, and on the west by Transylvania

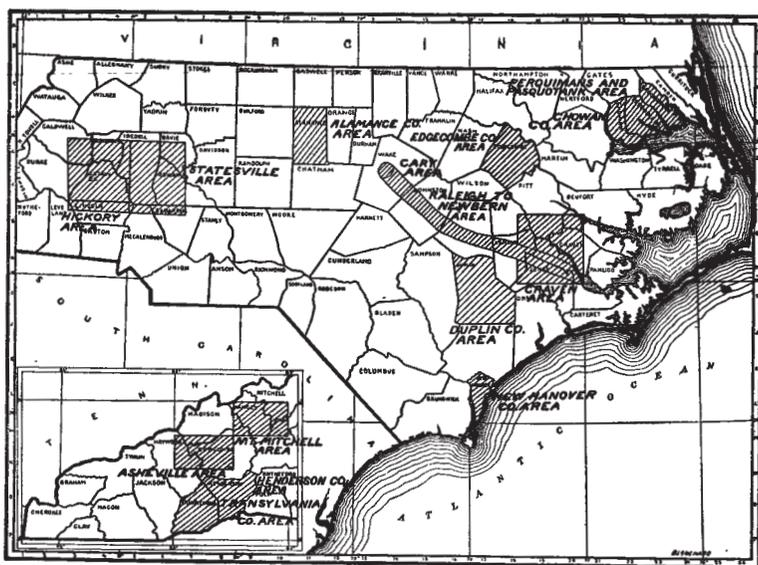


FIG. 6.—Sketch map showing location of the Henderson County area, North Carolina.

County. It comprises an area of 234,240 acres, or about 366 square miles. The outline of the county is very irregular, following in many places the tops of ridges or of mountains; especially is this true of the northern and eastern boundaries.

It is a typical mountain county, consisting of mountain ranges, isolated peaks, a rolling plateau, and level areas of valley land. The western end of the county touches the Pisgah ridge, while the eastern and southern sides lie along the Blue Ridge range and Saluda

Mountains. The elevation of the county varies from 1,400 feet near Bat Cave to 5,000 feet on Little Pisgah Mountain, while at Hendersonville it is about 2,150 feet. The general slope of all the western, central, and northern parts of the county is toward the French Broad basin, of the northeast corner to the east, and of the extreme east and southeast parts toward Green River. The most rugged topography is in the western and northeastern parts and along Green and Hungry rivers. Many of the mountains rise to an elevation of 4,000 feet or more. The more important peaks are Black Mountain, Johnson, Shell, and Stony knobs in the western end; Bear Wallow Mountain in the northeastern part; Sugar Loaf Mountain, the highest point in the Blue Ridge range in Henderson County, in the east, and Pinnacle and Stony mountains in the south. These mountains are in many cases steep, and the small streams have carved out deep, narrow gorges or valleys in their heavy fall to lower levels. There are many badly dissected areas, especially along Green and Hungry rivers, in the northeast corner, and in the western end of the county. Several escarpments occur near the drainage lines in the vicinity of Bat Cave and Pinnacle Mountain, where almost perpendicular bare rock walls are prominent.

One of the most noticeable features of the topography of Henderson County is the broad, rolling intermountain plateau, covering about 60 or 75 square miles, in the vicinity of Hendersonville, Flat Rock, and northeast to Fruitland. This plateau has an elevation of from 2,100 to 2,300 feet and resembles in many respects the Piedmont section of the State. It constitutes the greater part of the rolling upland in the county. In the west-central part of the county lies the French Broad Valley, varying in width from one-quarter mile to  $1\frac{1}{2}$  miles. This, together with the valleys along Mills River and Cane and Mud creeks, constitutes practically all the level bottom land in the area.

The county has excellent natural surface drainage, effected through the many rivers and creeks within its borders. The drainage is divided between the waters flowing toward the Gulf of Mexico and those flowing toward the Atlantic Ocean. The French Broad River, with its tributaries—Mills River and Boyleston, Mud, Clear, Cane, and Hooper creeks, which drain the western and central parts of the county—flows toward the Gulf. The Broad River, with its tributaries—Hickorynut and Readypatch creeks—drains the northeast corner; while the Green, Hungry, and Little Hungry rivers carry the drainage waters of the extreme eastern and southern parts; these streams flow toward the Atlantic Ocean. All the streams except the French Broad River and Cane and Mud creeks are very swift flowing, falling in heavy grades down the mountain sides. In many places

there are beautiful waterfalls where much power could be easily and cheaply developed. All the gristmills in the county and several sawmills are operated by water power. Most of the farm houses could be supplied by gravity with spring water from the mountain sides.

Prior to 1861 Henderson County was considerably larger than it is at the present time. Practically all the population are descendants of the first settlers, who were American-born whites and who moved into the county from other parts of the State. Only a very small percentage of the population is colored.

Around Hendersonville, Flat Rock, northeast of Fruitland, and throughout the French Broad Valley and the valleys of other streams the county is fairly well settled. In the remoter parts and in the mountainous regions it is very sparsely settled, and there are few inhabitants in the extreme western part of the county. The soil, climate, and other natural advantages of Henderson County should attract settlers, and the county could support a population many times the present number, which is about 15,000.

Hendersonville, the county seat, with a population of 2,500, is the largest and most important town. Flat Rock, Horse Shoe, and Fletcher are small places, and there are many sidings and stations along the railroads in the county from which shipments of farm and forest products are made. Hendersonville and many other places in the county, especially in the Flat Rock vicinity, where there are many beautiful summer homes, are noted summer resorts.

The Asheville and Spartanburg branch of the Southern Railway crosses the county in a general north-and-south direction. The Toxaway branch of the same system leads out from Hendersonville through the western part of the county. These roads afford good transportation facilities. The rural free delivery of mail is established throughout the greater part of the county. Neat schoolhouses and churches have been built in the better developed sections.

There is a good market at Hendersonville for some cattle, hay, garden vegetables, potatoes, fruits, chickens, and eggs, all of which bring high prices. A considerable quantity of such products can be disposed of at Flat Rock and Saluda during the summer months. Potatoes and cabbage are shipped during July and August to Charleston and Columbia, S. C.; Augusta, Ga.; Birmingham, Ala.; and a few points in Florida. Some apples are shipped to eastern and southern towns. A few cattle find their way to market at Asheville, Richmond, Va., and points in South Carolina.

#### AGRICULTURE.

Agricultural development in Henderson County is most marked in the vicinity of Hendersonville, along the valleys of the French Broad

and Mills rivers, and on some of the larger streams. The county has been settled for a long time and the advancement has been slow but steady. Considerable stimulus was given to agriculture by the building of the Asheville and Spartanburg branch of the Southern Railway in 1878, and a further impetus was added in 1896, when the Toxaway branch of the same road was built through the western part of the county.

In several parts of the county are seen neat, painted frame houses, with fairly good barns and other improvements. The best farms are supplied with modern labor-saving machinery and fairly well stocked with work animals and cattle. In some of the more remote and mountainous sections the farm buildings are small and the general appearance denotes less thrift and advancement.

The first crops to be grown were corn, wheat, rye, grass, potatoes, and cabbage. At one time a considerable quantity of tobacco was produced, but the decline in prices discouraged the farmers, and this crop is no longer grown on a commercial scale. On the other hand, the production of potatoes and cabbage on a commercial scale has been gradually increasing for the last twenty years. Cattle have been raised since the settlement of the area. Apples have been the main fruit crop and many of the old trees are still bearing.

At present corn is the principal crop grown in Henderson County, being produced on every farm and on every variety of soil. The important secondary products are wheat, grass (timothy and redtop), Irish potatoes, cabbage, and rye. Irish potatoes and cabbage are the staple money crops in many parts of the county. Some rye is grown with a fair degree of success. Apple orchards are seen around every well-established homestead, and on a few of the mountain sides some of the farmers are growing apples on a commercial scale. A few peaches, pears, and cherries are grown. Some cattle are raised for market, and hogs are kept on the best farms. Only a few sheep are raised, although the climate and natural grazing advantages favor this industry. There is one ginseng farm in the county, and the culture of this herb is said to be very profitable. A small quantity of cowpeas and clover, sweet potatoes, tomatoes, tobacco, and sorghum, from which sirup is made for home use, are grown. Garden vegetables are grown both for home use and for sale in Hendersonville and other near-by markets. In addition to the farm products there is a fairly large revenue derived from the sale of cord wood and of tan bark, taken mainly from chestnut oak, with a little from hemlock. Many cross-ties are sold, but the cutting of the trees for this purpose means the destruction of timber which in a few years would be much more valuable. A little merchantable timber is being sawed in the county.

A few farmers have recognized the importance of the adaptation of soils to crops. The Toxaway loam has long been considered the best soil in the county for corn and grasses, while the more uniform areas of the Toxaway fine sandy loam are almost equally favorable for the production of these crops. The Porters clay is the best wheat and clover land in the county. Potatoes, truck, and garden vegetables do well on the Porters sandy loam. The Porters loam and Porters sandy loam are admirably suited to the production of a number of varieties of apples, among which are the Winesap, Stayman Winesap, York Imperial, Albemarle Pippin, Ben Davis, and some earlier kinds. The best location for orchards is usually on northern, northeastern, and northwestern slopes, at an elevation of from 2,400 to 3,500 feet. Such an altitude is commonly above the frost or fog line and the air drainage is also likely to be good.

On some of the best farms a rotation of corn, wheat, and rye, and sometimes of corn, wheat, rye, and grass is practiced, but the usual rotation is corn one year and grass the next. Some sow oats and grass together in the spring, producing a crop of oats and securing a stand of grass. In many parts of the county little attention is paid to rotation and the same field is devoted to the same crop year after year.

Several of the best farmers are practicing improved methods, especially in the growing of corn, where level, shallow cultivation has supplanted the ridging or bedding of rows. Many of the farmers are buying the latest improved machinery, and the results obtained amply justify its use where the character of the surface is favorable, as in the rolling areas and level bottom lands. In the more mountainous localities the surface is generally too rough to allow the use of much machinery.

Throughout the county farm labor is scarce. Day laborers receive \$1 per day and those working by the month from \$15 to \$25 and board. In the more remote and mountainous sections many women assist in the field work.

Nearly all the farms in Henderson County are operated by the owners. Those tenanted are generally farmed on a share basis. The size of the farms varies greatly. In the vicinity of Hendersonville and in many other localities there are a number of farms which range in size from 15 to 60 acres. Many of the best farms contain about 75 acres under cultivation and more or less woodland, in all from 200 to 500 acres. One lumber company owns about 9,000 acres in a single tract, while 30,000 acres, or practically all of the western end of the county, is included in the Vanderbilt estate.

Within the last few years both the farming and timber lands have increased greatly in value. The rough mountain lands are now held at \$5 or \$6 an acre, the cultivated mountain land at \$10 to \$25, and

land in the valley and in the rolling plateau around Hendersonville at prices ranging from \$20 to \$75 an acre, depending on location and improvements.

Some fairly good roads are found in Henderson County, but there is need of more, and nothing would do more to enhance the value of farming lands than an extension and improvement of the road system. The rough mountainous areas should remain forested, or when denuded of their timber should be used for pasture. Apple orcharding on the mountain sides would be a profitable industry and one which should be developed. More cattle could be easily and cheaply raised on the land now lying idle, and the dairy and poultry industries ought to be extended. Considerable quantities of corn, hay, and meat are annually bought by some of the farmers at high prices. At least enough of these products for home use should be produced on the farm.

In the matter of general improvement of the soils more care should be taken in saving the barnyard manure. Many more acres of land could be kept in a state of high productiveness if the manure were protected from the leaching effect of rains. The loss through washing away of the valuable ingredients of the manure in the aggregate amounts to thousands of dollars each year. Deeper plowing and a better preparation of the soil before planting should be practiced. Improved seed, especially of corn, wheat, and potatoes, ought to be used. Clover and grass seed should be tested before being sown. It is believed that lime, which can be secured at Fletcher and along Boylston Creek, can be used with profit on all the soils in the county.

#### CLIMATE.

The following tables, compiled from records of the Weather Bureau station at Hendersonville, show the mean monthly and annual precipitation and temperature and the occurrence of early and late killing frosts. The winters are comparatively mild, while the summers are cool and pleasant. The precipitation is fairly well distributed throughout the year, although a slightly greater amount falls during the summer months.

The average date of the last killing frost in the spring is April 23, and of the first in the fall October 21. There is thus for the tenderest plants a growing season of about 180 days.

The air is dry, bracing, and invigorating, and this fact, coupled with the topography and excellent water from the numerous springs on the mountains, makes this section of North Carolina an ideal summer resort, as attested by the thousands who go there each season.

*Normal monthly and annual temperature and precipitation.*

Month.	Hendersonville.		Month.	Hendersonville.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	° F.	Inches.		° F.	Inches.
January.....	37.1	4.57	August.....	73.3	7.78
February.....	38.3	7.38	September.....	65.7	4.55
March.....	46.2	7.64	October.....	56.2	4.24
April.....	53.4	5.04	November.....	46.5	2.98
May.....	63.9	4.18	December.....	38.8	5.24
June.....	70.3	6.39			
July.....	72.9	5.91	Year.....	55.2	65.90

*Dates of first and last killing frosts.*

Year.	Hendersonville.		Year.	Hendersonville.	
	Last in spring.	First in fall.		Last in spring.	First in fall.
1900.....	May 11	Nov. 7	1904.....	Apr. 22	Oct. 15
1901.....	Mar. 29	Nov. 3	1905.....	Apr. 19	Oct. 13
1902.....	Apr. 14	Oct. 15	1906.....	May 10	Oct. 11
1903.....	Apr. 24	Oct. 19	Average.....	Apr. 23	Oct. 21

SOILS.

The rocks forming the soils in Henderson County comprise three great classes—igneous, sedimentary, and metamorphic. The sedimentary rocks are found in a narrow band, varying in width from 1 to 2 miles, stretching across the county in a general northeast-southwest direction. This formation, which has been classified<sup>a</sup> as Brevard schist, is of Cambrian age, the rocks consisting of mica schists and dark-gray or black shales. At several places in this formation there are beds of limestone which have been used extensively as a source of agricultural lime. At one place in the formation (near Fletcher) the rock is of such purity that it is burned on a large scale for building lime.

Northwest and west of the belt of Cambrian rocks is a large body of metamorphic rocks classified as Carolina gneiss. This formation consists mainly of light to dark gray mica gneiss and hornblende gneiss. These rocks offer greater resistance to weathering than the rocks of any other formation and hence the highest mountains are found in this portion of the county. South and east of the Cambrian formation are found the rocks of igneous origin. Adjoining the Cambrian rocks is an area of Henderson granite; this is a gneissoid

<sup>a</sup>The classification of the rocks in this county is taken from the Pisgah Folio of the U. S. Geological Survey, by Arthur Keith.

granite composed of orthoclase and plagioclase feldspars, quartz, muscovite, and biotite. Throughout this rock the crystals of orthoclase feldspar are of a porphyritic nature, frequently an inch or more in length. To the south and east of the Henderson granite is a large area of Whiteside granite. This is a finer grained rock than the Henderson granite and is composed of orthoclase and plagioclase feldspars, quartz, muscovite, and biotite. Scattered through this granite area are small outcrops of the Carolina gneiss and the Roan gneiss composed of dark-colored hornblende gneiss and schists.

The soils of Henderson County may be divided into two general classes—the soils derived in situ from the rocks described above, or residual soils, and the soils which owe their origin to stream action, or alluvial soils. The residual soils occupy the uplands, and consist principally of loams, sandy loams, and clays; they are typical of the soils of the mountain region and have been classified in the Porters series. The alluvial soils are found in the valleys and are very fine-textured loams and fine sandy loams, belonging to the Toxaway series.

The soils derived from the rocks of the Cambrian formation are dark-red, fine-textured clays. Where the forest cover has been left undisturbed, and a considerable proportion of organic matter has consequently accumulated, the Porters loam is found. The typical soil of this belt, especially along the foothills, is the Porters clay.

The rocks of the Carolina gneiss formation disintegrate slowly, forming a fine, even-textured loam known as Porters loam. In this area the forest cover is usually heavy, consequently the soils contain a considerable quantity of organic matter. In the coves and along some of the streams, where the vegetation is quite heavy, the accumulation of vegetable matter is large, giving rise to the Porters black loam. In some of the thinly forested areas, where the rocks are not thoroughly decomposed, spots of Porters sandy loam occur.

Over the area south and east of the Cambrian belt, which is covered by the granites, the Porters sandy loam is the typical soil. Both the Henderson and Whiteside granites disintegrate readily, forming a rather coarse-textured sandy loam. In the rolling areas in the central part of the county these rocks are well decomposed, forming a mellow sandy loam with a red clay subsoil. In the more mountainous regions, where the decomposition has not been as thorough, the sandy loam is coarser in texture. On many of the mountains and ridges in this area the rocks come very near the surface, frequently outcropping. Decomposition has progressed very slowly in these areas and the resultant soil, which is frequently not over 10 inches deep, is a coarse, gravelly, light-gray or yellow sandy loam. In some localities where these rocks are very thoroughly decomposed or where the Roan gneiss occurs, small areas of the Porters loam are found. In a few localities

along the French Broad River, where the Henderson granite is very thoroughly decomposed, small areas of Porters clay occur.

The alluvial soils are found in the valleys of the rivers and larger creeks. When the materials washed down from the mountains were held in suspension by comparatively rapid moving water very little silt and clay were deposited, and the materials laid down consist largely of fine-grained sand and mica scales. These materials, modified by the addition of vegetable matter, give rise to the Toxaway fine sandy loam.

At times of overflow, when the valleys were covered by large bodies of slow-moving water, a large amount of silt and clay was deposited. These frequent overflows kept the valleys for a long time in a semi-swampy condition, during which period large quantities of vegetable matter accumulated in the soil. This has given rise to a dark-gray or black, heavy, fine-textured loam, classified as Toxaway loam.

Eight distinct types of soil, exclusive of Rock outcrop, have been recognized and mapped in Henderson County. The name and extent of each type are given in the following table:

*Areas of different soils.*

Soil.	Acres.	Percent.	Soil.	Acres.	Percent.
Porters sandy loam.....	115,264	49.2	Rock outcrop.....	2,112	0.9
Porters loam.....	70,656	30.2	Meadow.....	1,024	.4
Porters sand.....	19,328	8.3	Porters black loam.....	320	.1
Toxaway fine sandy loam.....	14,336	6.1			
Porters clay.....	7,296	3.1	Total.....	234,240	.....
Toxaway loam.....	3,904	1.7			

PORTERS SANDY LOAM.

The surface soil of the Porters sandy loam consists of a yellowish-gray to gray, medium to coarse sandy loam, varying in depth from 6 to 15 inches. In a few localities a gray fine sandy loam is encountered, while in some other places, where erosion has been quite active or where the rock is more thoroughly decomposed, a reddish or brown heavy sandy loam is seen. The Porters sandy loam and the Porters loam grade almost imperceptibly into each other throughout the eastern part of the county. In some of the heavily forested areas the soil is more loamy and darker in color, owing to the accumulation of organic matter. Occasionally a few mica scales occur in the soil. Some quartz gravel and rock fragments are scattered over the surface in many places, and sometimes pockets of quartz gravel are seen in the soil to a depth of several inches. The Porters sandy loam is a mellow, loose, and friable soil, is easily tilled, and if properly managed never bakes.

The subsoil varies considerably in texture and color. A thin upper layer is usually a reddish or yellowish brown, heavy, sticky sandy loam, which grades into a red or yellow clay loam or clay. In the vicinity of Hendersonville and eastward to Blue Ridge the subsoil is generally a red clay loam or clay, although yellowish areas are present here and there. It occurs with less uniformity in the more mountainous section and frequently the disintegrated rock comes within 3 feet of the surface, such areas and spots resembling the Porters sand.

The Porters sandy loam has the largest development of any type in the county. It covers practically all of the central and eastern parts, occurring in large continuous areas. It is also largely developed in the northeast and southwest parts, and is particularly important in the vicinity of Hendersonville, Flat Rock, Saluda, Horse Shoe, Blue Ridge, and Edneyville.

This soil type varies greatly in surface features, occupying broad, rolling and hilly to mountainous areas. The more level and rolling areas occur around Hendersonville, Flat Rock, and northeast toward Fruitland, covering practically all of this intermountain plateau. The rougher, more broken bodies are seen in the northeast corner of the county, to the southwest of Hendersonville, and along Green and Hungry rivers. In these localities the mountains attain an elevation of 3,000 to 4,000 feet in many places and the sides are steep, and in limited areas are so rugged that general farming operations can not be profitably carried on. The soil is well drained, both on account of its open texture and rolling to mountainous topography. On some of the mountain slopes where cultivation has ceased gullies have been formed. Considerable washing can be prevented by deeper plowing, thus enabling the soil to absorb more of the rainfall.

The Porters sandy loam is a residual soil derived from the weathering of Henderson and Whiteside granites. These rocks have disintegrated and decomposed to a depth of several feet in many places, thus giving a sandy surface and a red or yellow clay loam to clay subsoil. In a few localities, especially on the steeper slopes, the partly disintegrated rock is found near the surface.

The forest growth on the Porters sandy loam consists mainly of white, post, red, and chestnut oak, with a scattering growth of pines of different species. Some chinquapin and chestnut occur on the ridges, while in the heavily forested areas and coves an abundance of laurel and rhododendron is seen.

This is the most important soil type in the county from an agricultural standpoint and also from its extensive development. It grows every crop common to the county. It is well suited to the production of Irish potatoes, garden vegetables, rye, corn, wheat, and cabbage. On the higher elevations orchard fruits do well, and berries and grapes can be grown almost anywhere. The rough mountain

areas and steep slopes should remain in permanent forest, or if cleared should be devoted to pasture.

Corn yields from 10 to 20 bushels per acre on an average, and as high as 50 bushels have been produced by some of the best farmers. Rye yields from 8 to 20 bushels, wheat from 7 to 15 bushels, and Irish potatoes from 60 to 200 bushels. Oats, clover, and timothy-give fair yields. Cabbage yields from 4 to 6 tons per acre when properly manured. Sweet potatoes, sorghum, tobacco, apples, berries, tomatoes, and garden vegetables are all grown with good results. A small field of ginseng was found, and this crop is said to do well when partly shaded.

For some of the farm crops, and especially the truck crops, commercial fertilizer is used. Some farmers buy a complete fertilizer, with the formula 2:8:2, while others use cotton-seed meal, acid phosphate, and kainit, and do their own mixing. A little lime is occasionally used. This type of soil can be greatly improved by growing leguminous crops and turning them under until the soil is filled with humus. More barnyard manure is needed. When a heavy green-manuring crop is turned under, the application of 30 or 40 bushels of lime per acre gives noticeably increased yields. Deeper plowing, more thorough cultivation, and a systematic rotation of crops are necessary for the most profitable management of this soil.

The value of the Porters sandy loam varies according to location and topography. The roughest areas sell at \$5 and upward an acre; the farming land east of Hendersonville brings about \$15 to \$25 an acre, while near Hendersonville and in the Flat Rock vicinity it is held at much higher prices.

The average results of mechanical analyses of samples of the Porters sandy loam are given in the following table:

*Mechanical analyses of Porters sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
17829, 17831.....	Soil.....	2.1	12.2	9.1	27.4	11.9	24.9	12.4
17830, 17832.....	Subsoil.....	1.7	10.1	6.8	21.2	11.0	17.9	29.9

PORTERS LOAM.

The soil of the Porters loam consists of a dark-brown, reddish-brown, or yellowish-brown loam 6 to 14 inches deep. The surface is usually darker than the underlying soil on account of the accumulated vegetable matter. Throughout the mountainous areas, where the forest growth is heavy, there occur areas of very dark brown or black loam. In some of the deeper coves at the heads of streams the loam grades into Porters black loam, but these areas are so small

that they have not been shown on the map. Where the soil is thinly forested, on the foothills and ridges, small areas of a grayish loam occur, and where the granitic rocks come near the surface there is a marked increase in the sand constituents. In a few areas the soil is very stony, but as a rule it is mellow and easily tilled.

The subsoil varies from a reddish-brown or red to a yellowish-brown clay or clay loam. In some localities where it is derived from a mica schist the subsoil is deeper red in color, and both soil and subsoil contain a considerable amount of mica. Areas occur, particularly in the western part of the county, where the subsoil is a brown mellow loam, but on the foothills it is usually a stiff red clay.

The Porters loam is one of the most important types forming a large unbroken area in the mountainous western part of the county. Practically all of the Vanderbilt estate is covered by this type. Other large bodies are found in the northern, southern, and eastern parts, and smaller isolated areas occur throughout the county.

The topography varies from rolling to mountainous, and the elevation ranges from 2,000 to 5,000 feet. The rolling areas are found in the vicinity of Fletcher, Ottanola, and west of Horse Shoe. In the rolling areas and where the type occurs on the foothills of the mountains it can be cultivated easily, but in the mountainous areas it is too steep and rugged for cultivation. On account of its topographic position the surface drainage is excellent. Where the forest cover is removed and the soil improperly cultivated erosion is very active and the fields soon become badly washed and gullied. The heavily forested areas are well watered by many springs.

The Porters loam is a residual soil derived from a variety of rocks, from the fine-grained schists of the Brevard formation to the coarse, gneissoid Henderson granite. The largest and most typical areas are found in the western part of the county, where the Carolina gneiss predominates. This formation consists of mica gneiss and mica schist, and the Porters loam is the characteristic soil derived from these rocks. They are usually deeply weathered, though they sometimes lie near the surface, and the soil is red and reddish brown, the addition of considerable vegetable matter having deepened the color of the surface soil. East of this area is found the belt of Cambrian rocks known as Brevard schist. This formation consists of mica schists and dark-colored fine-grained shales, which in the more heavily forested areas gives rise to the Porters loam. Here the soil is usually more red in color and contains large amounts of micaceous material. The central and eastern parts of the county are covered by the Henderson and White-side granites, which do not give rise to the loam unless they are deeply weathered and heavily forested, so that the loam areas in this part of the county are small. In the eastern and southeastern parts of the county there are a few areas of the Carolina and Roan gneiss which

give rise to the loam. The hornblende rocks of the Roan gneiss form a dark-brown or dark reddish-brown loam.

The forest growth on this type consists largely of hardwood, principally white, chestnut, red, post, scarlet, black, and shingle oaks, hickory, chestnut, and poplar. Of the conifers, white pines are found in some quantity in a few sections, a few shortleaf and scrub or Jersey pines, and in the mountainous areas along streams a few hemlocks. There is generally an undergrowth of *Kalmia* or mountain laurel and *Azalea*, and in the coves and along the streams *rhododendron* is abundant and reaches a large size. Medicinal herbs are gathered to a small extent in the mountainous areas, but this industry is not as important as in the more mountainous counties.

As the greater portion of the Porters loam occurs in the mountainous section of the county, where it is too rugged for profitable cultivation, it should be kept permanently in forest. The gentle slopes and coves are well adapted to apple culture, and this industry can be very profitably developed on a commercial scale. The northern, northwestern, and northeastern exposures have been found to be the best for orchards, and if these are located on the higher slopes the fruit is unlikely to suffer from frost. Where the gentle slopes of this soil are cleared it makes excellent pasture and the grazing of sheep and cattle can be made a very important source of revenue. The rolling areas and the foothills of the mountains are practically the only portions of this type cultivated to any extent. It is well adapted to corn, wheat, rye, potatoes, and cabbage. Corn yields from 12 to 30 bushels and wheat 8 to 20 bushels per acre. Large yields of cabbage and potatoes are obtained. Considerable rye is grown and a small acreage of oats and tobacco. No tobacco, however, is put on the market. Apples are grown to some extent, but very few are shipped out of the county. A few peaches and plums are produced. In the vicinity of the lime kilns lime is used on this soil, with very beneficial results. Practically no commercial fertilizer is used.

The cultivable areas of the Porters loam are valued at \$10 to \$50 an acre, depending on the distance from the railroad. The rugged, mountainous areas, which can not be cultivated, are valued at \$5 or \$6 an acre.

The average results of mechanical analyses of samples of the Porters loam are shown in the following table:

*Mechanical analyses of Porters loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
17823, 17825.....	Soil.....	1.1	8.2	6.5	20.9	5.8	37.4	19.3
17824, 17826.....	Subsoil.....	1.1	8.3	6.2	19.0	8.4	24.3	32.1

## PORTERS CLAY.

The soil of the Porters clay is a red or brownish loam, having an average depth of 5 or 6 inches. In a few places the surface is a yellowish or gray loam or heavy sandy loam for a few inches, while on some of the knolls and eroded areas a rather stiff red clay is encountered at the surface. Occasionally a few shale and schist fragments, rounded quartz gravel, and a little mica are scattered in the soil. Generally the soil is fairly easy to till, as there is present a sufficient quantity of sand and silt to make it friable.

The subsoil of the typical areas is a stiff red clay to a depth of several feet. Spots of yellowish and reddish-yellow clay occur in a few localities. On some of the ridges and sides of the knolls the partially decomposed rock comes within 3 feet of the surface, and in such places there are small fragments of the rock in the subsoil.

The Porters clay is confined exclusively to the west-central part of the county. The largest bodies lie along Boylston Creek and the French Broad River. Many smaller isolated bodies occur around Etowah, Horse Shoe, and Gypsy.

This type occupies the knolls, ridges, and foothills of the mountains in the French Broad basin, having generally a rolling to hilly surface and an elevation of from 2,100 to 2,300 feet. Most of the areas can be cultivated, and all may be used for pasture. The natural surface drainage is good, in fact, often too rapid, and many gullied areas were seen where erosion had been severe. In such places deeper plowing and seeding to grass should be practiced to prevent further waste of the land.

The Porters clay is a residual soil derived from the weathering of the Brevard formation, composed mainly of a dark-gray to black schist, with some banded mica shale. The formation contains oxide of iron and minute scales of mica. Some limestone rock also occurs in this formation and possibly has influenced the soil in some places. On the east side of the French Broad River the areas of Porters clay are derived from granite rocks, where these have thoroughly decomposed.

Practically all of this soil type has been cleared of its native growth of oak, chestnut, and other hardwoods. At present some of it has a scattering second growth of hardwood with an undergrowth of chinquapin and other brush. Some fields, which the farmers consider "worn out," have been abandoned. The soil is especially adapted to wheat and clover, being the best in the county for these crops. It produces good crops of corn, potatoes, and cabbage and is excellent pasture land. Corn averages from 12 to 30 bushels, wheat 8 to 25 bushels, clover from 1 to 1½ tons, Irish potatoes 80 to 150 bushels, and cabbage 5 to 6 tons per acre. Even larger yields have been

secured by proper cultivation and fertilization. Apples and a few other fruits, sorghum, and vegetables are grown for home use.

On some areas of this type a little commercial fertilizer is applied, usually from 200 to 500 pounds per acre. Lime is used by some and beneficial results are always obtained. The Porters clay is a strong soil and one which can be highly and permanently improved. It needs to be plowed deeper and more thoroughly pulverized before planting. The growing of clover and cowpeas and incorporating of coarse manures in the soil would supply needed humus. When these green crops are plowed under it is best to add lime, both to correct the acidity and aid in their decomposition. The red clay knolls can be quickly reclaimed and made fairly productive in this way. Porters clay brings from \$20 to \$40 an acre.

Below are given the results of mechanical analyses of typical samples of the soil and subsoil of the Porters clay:

*Mechanical analyses of Porters clay.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
17839.....	Soil.....	3.0	4.9	2.2	18.2	4.3	41.6	24.9
17840.....	Subsoil.....	2.0	4.6	1.3	5.3	11.0	34.5	41.2

PORTERS SAND.

The soil of the Porters sand, to an average depth of 8 inches, is a yellowish-gray or gray, medium to coarse sand or light sandy loam. In many localities there are from 10 to 15 per cent of fine rock fragments in the soil, and occasionally a few granitic boulders are strewn upon the surface. The soil is quite similar in many respects to the lightest portions of the Porters sandy loam and might be considered as a phase of that type. The two differ, however, in agricultural value, topography, and in character of the underlying material. The subsoil is a yellowish to brownish sandy loam or sticky sand, which commonly grades into the disintegrated granite at 20 to 36 inches. In many places this weathered, soft, and crumbly rock comes within 8 inches of the surface and even outcrops frequently, and there is usually a gradation of the surface soil into the rotten rock. Throughout this soil there are small areas where the subsoil is a yellowish to red sticky sandy loam, and again spots of heavy sandy loam or clay are encountered.

This soil occurs throughout the roughest areas of the Porters sandy loam. The largest bodies of it are in the southern part of the county to the southwest of Flat Rock and to the southwest of Zirconia on Grassy and Pinnacle mountains. Many smaller bodies lie in the central and northeastern parts of the county.

The Porters sand usually occupies the mountain tops and steep slopes. In the Grassy Mountain locality it occurs in the plateaulike region. In the central part of the county it covers the crest of the low mountains and high ridges. The loose, open character of both the soil and subsoil, together with the topographic position, assures ready and excellent drainage. The rainfall runs off or drains through the soil immediately, thus giving a warm, early soil and one which can be handled soon after rains. The soil is subject to drought, especially where the rock comes near the surface. Many areas of this soil are badly eroded.

The Porters sand is derived from the Whiteside and Henderson granites. On the steep slopes the material has been removed nearly as fast as the rock has disintegrated and the finer soil material has accumulated only where the land is heavily forested or in coves and pockets. The partially decomposed rock outcropping in many places retains its original structure, and the quartz, feldspar, and mica particles are readily detected.

The greater part of this soil is forested with a native growth of post, white, and chestnut oak, a few scrubby pines, and hemlock. Laurel rhododendron, huckleberry, and chinquapin bushes form a dense undergrowth. The soil is too light and does not retain a sufficient amount of moisture for grain. Most of the type should remain forested or be used for pasture or apple orcharding. If manured or fertilized the soil is suited to early vegetables, berries, and potatoes. Peaches do fairly well, and several thrifty young apple orchards were seen. Orchards should not be set out where the bed rock comes within 3 feet of the surface. Only a very small percentage of the type is under cultivation, and unless manured or fertilized the yields are usually low.

Land composed of the Porters sand is held at \$5 and upward an acre.

The results of a mechanical analysis of the soil and subsoil of this type are given in the following table:

*Mechanical analyses of Porters sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
17827.....	Soil.....	2.8	18.7	11.9	27.3	9.7	19.5	10.1
17828.....	Subsoil.....	3.7	20.2	12.4	29.3	9.9	13.5	11.2

PORTERS BLACK LOAM.

The soil of the Porters black loam, to a depth of 6 to 10 inches, is a very dark gray to black heavy loam or silt loam, containing a large amount of organic matter. In the coves the soil is black and mucky; the dark-gray or brown phase is found in the thinner forested areas.

Both soil and subsoil frequently contain considerable quantities of rock fragments. The subsoil varies from a dark grayish-brown to a yellowish-brown loam or clay loam and is frequently underlain by rock at from 20 to 30 inches. Where the heavy mucky phase of the type occurs the subsoil is much darker in color.

Only three small areas of this type are shown in the map. These occur in the extreme western end of the county between altitudes of 3,300 and 5,000 feet. Other small spots occur in the coves and on the tops of some of the high ridges, but these are of too small extent to be represented on the soil map.

In Henderson County this soil is derived from the Carolina gneiss. It may be regarded as a very fine textured phase of the Porters loam, which upon the addition of very large amounts of vegetable matter under moist conditions passes into the Porters black loam. The areas usually need drainage, which can be readily accomplished.

The forest growth on the Porters black loam is the same as that on the Porters loam. There is usually a dense undergrowth and in the moist places a heavy growth of ferns.

None of this soil is cleared or under cultivation in this county, and its present value depends upon the character of standing timber and its convenience to market. In other areas the soil is a valuable one for apples.

#### TOXAWAY LOAM.

The soil of the Toxaway loam, to a depth of 8 to 16 inches, is a dark-gray to black mellow loam or silt loam. The darker areas contain large quantities of organic matter. In some areas a dark-brown loam or silt loam is found; in others a brown, micaceous, very fine sandy loam. The subsoil varies from a dark-brown or yellow silt loam to clay. In some instances the first 6 or 8 inches of the subsoil is dark brown, grading into a brownish-yellow silty clay.

The largest areas of this type occur in the northwestern part of the county in the valleys of the French Broad and Mills rivers. Smaller areas are found along Boyleston Creek in the same section and along Earle Creek in the southeastern part of the county. Strips of less importance are found along many of the smaller streams.

The Toxaway loam occupies the level areas in the valleys of the French Broad and smaller streams. The greater portion of the type is nearly level, though where it occurs near the foothills it has a gentle slope. The areas bordering the rivers and larger creeks are occasionally subject to overflows that damage the crops to a considerable extent. The natural drainage of the level areas is poor, and open ditches are necessary and generally in use throughout the type.

This is an alluvial soil formed by the deposition in comparatively slow-moving water of the finer sediments brought down from the surrounding mountains. The material consists chiefly of clay, silt, and

very fine sand, frequently with large amounts of mica, washed down from the areas of loam and clay. A large part of this soil was formerly in a semiswampy condition, with a heavy growth of water-loving trees, shrubs, and grasses. The accumulation of large quantities of vegetable matter at that time has produced a dark mellow soil.

The typical growth upon this soil was elm and maple. At present practically all of the soil is under cultivation or in pastures.

The Toxaway loam is regarded as one of the most valuable soils in Henderson County, and is especially adapted to corn, grass (timothy and redtop), rye, and cabbage. Very good celery can be grown on many parts of it. Corn yields from 20 to 50 bushels an acre, hay 1 to 2 tons, and rye 10 to 22 bushels. Oats and wheat are grown to some extent, but they are not as profitable as the other crops mentioned.

On account of the level topography the cultural methods in use on this type are the best in the county, and much modern machinery is used. The application of lime to this soil is found to be very beneficial. Better results are obtained when applications of 15 to 20 bushels an acre are made at intervals of two to three years than when larger applications are made less frequently. A small amount of commercial fertilizer is used for corn, from 200 to 600 pounds per acre of a 2:8:2 mixture being used.

This soil brings from \$40 to \$75 an acre.

The results of mechanical analyses of the soil and subsoil of the Toxaway loam are given in the following table:

*Mechanical analyses of Toxaway loam.*

Number.	Description.	Fine gravel	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
17841.....	Soil.....	0.1	0.6	1.0	13.6	7.8	48.2	28.6
17842.....	Subsoil.....	.0	.2	.6	12.4	5.8	37.5	43.0

TOXAWAY FINE SANDY LOAM.

The surface soil of the typical areas of the Toxaway fine sandy loam consists of a brown fine sandy loam to a depth of 8 to 12 inches. Scattered throughout this soil are small areas or narrow bands of fine loamy sand, medium to coarse brown sandy loam, and a few spots of gravelly sand or sandy loam. Patches of dark-brown silty loam occur in many places where the finer sediments have accumulated. Such patches usually contain more organic matter than the true type. No sharp line could be drawn between this type and the Toxaway loam, and small spots of the latter are not of infrequent occurrence. Again, the soil may be a fine sandy loam and the subsoil a heavy material resembling that of the Toxaway loam. The Toxaway fine sandy

loam is a mellow and very easily tilled soil and the surface allows the use of modern machinery.

The subsoil is a yellowish-brown fine sandy loam or fine micaceous sand. In a few areas the subsoil is a brown, dark-gray, or bluish loam, especially along some of the smaller streams. Mica scales in considerable quantity are present in both soil and subsoil in many localities. Most of this soil lies in the central and northwestern parts of the county, where it occurs as strips along the French Broad, Mills, and Green rivers, and also along Mud, Clear, and Cane creeks. A few narrow strips are located in the valleys of the smaller streams throughout the county.

The Toxaway fine sandy loam occupies level, flat, and very slightly undulating areas. Part of it is subject to overflow during freshets, but good crops can usually be secured. For the broader and more level areas artificial drainage is necessary, and this can be effected by open ditches. All of the type except a few very small spots can be drained and brought under cultivation.

This soil is of alluvial origin, being formed by the deposition of the coarser material which has been washed from the loam and clay areas and the finer material from the sandy loam and sand areas. It has been modified in certain places by the colluvial wash from the mountain sides, thus giving a soil quite variable in texture.

The greater part of this type is under cultivation, and the remainder is either covered with a forest of maple, elm, and white birch or is used for pasture. It will produce good corn, hay, wheat, and cabbage, and the sandier phase, melons and vegetables. Corn is the principal crop, the yield ranging from 15 to 50 bushels per acre. Grass (timothy and redtop) yields from 1 to 1½ tons, wheat 8 to 20 bushels, rye 10 to 20 bushels per acre. Cabbage, Irish potatoes, sorghum, oats, melons, and vegetables are grown to a small extent. Some of the farmers use a little commercial fertilizer and lime on this land. A rotation of grass, corn, and wheat is practiced by the best farmers.

Toxaway fine sandy loam sells for \$20 to \$50 an acre.

Below are given the results of the mechanical analyses of samples of the soil and subsoil of this type.

*Mechanical analyses of Toxaway fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
17843.....	Soil.....	0.4	0.6	0.7	44.4	20.2	20.8	12.5
17844.....	Subsoil.....	.2	3.5	7.6	19.0	15.0	35.0	20.4

## MEADOW.

The soil of the areas mapped as Meadow varies greatly both in color and texture. The greater proportion of it consists of brown to dark-brown fine sandy loam with considerable quantities of micaceous material. In areas of poor drainage spots of a dark-brown mucky loam occur. Along the streams are bands of coarse and fine sand, sometimes containing considerable gravel. The subsoil varies from a sand or fine sand to a heavy sticky loam, usually dark brown in color.

The Meadow mapped in Henderson County lies to the southeast and east of Hendersonville along Mud Creek and Devils Fork Creek, and occupies level areas. The greater part of it is in a semiswampy condition and could be drained only at great expense.

The natural vegetation consists of a few maples and elms and water-loving bushes and grasses. While the Meadow is at present unsuited to the production of cultivated crops, it supports a heavy growth of wild grasses, which afford excellent summer pasturage.

## ROCK OUTCROP.

The few small areas of Rock outcrop indicated on the soil map represent ledges on the sides of mountains or areas thickly strewn with large boulders. The most noticeable areas are the bald-faced cliffs on Pinnacle Mountain, Glassy Rock, and near Bat Cave. The Rock outcrop has no agricultural value.

## SUMMARY.

Henderson County lies in the southwestern part of North Carolina. It is a typical mountain county, varying in elevation from 1,400 feet near Bat Cave to 5,000 feet on the western border. The French Broad and Green rivers and their numerous tributaries form the main drainage systems.

The county is sparsely settled, except in a few places near Hendersonville and in the French Broad Valley, the best developed regions, and a much larger population could be supported. Transportation facilities are supplied by the Southern Railway. Hendersonville, the county seat, is the largest town and principal market. Cabbage, potatoes, and some cattle are shipped out of the county.

Corn is the main crop. Hay, wheat, rye, cabbage, potatoes, fruit, and garden vegetables are secondary products. The production of apples and raising of cattle can be made profitable industries. There are large areas of forest land in the county. Lands range widely in value, from \$5 an acre for rough mountain land to \$75 an acre for the best improved farming lands.

The rocks from which the soils of Henderson County have been formed are mainly gneiss, schist, and shale west of the French Broad River, and granites, with some gneiss and schist, on the east side of this stream. There are eight distinct types of soil, five of which, of residual origin, belong to the Porters series. The remaining three are alluvial.

The Porters sandy loam has the most extensive development of any type in the county. It is best adapted to garden vegetables, potatoes, corn, rye, wheat, and fruits. The rougher areas should remain in forest.

The Porters loam, the next in area, occurs typically developed in the western part of the county in the mountainous section. Most of it is forested to hardwood. The rolling areas and foothills produce good crops of corn, rye, oats, potatoes, and cabbage. It is an excellent apple soil and also affords good pasturage.

The Porters clay occupies knolls and ridges and is well drained. It is the best soil in the county for wheat and clover. Rye, potatoes, and cabbage do well.

The Porters sand occurs on the mountain tops and ridges. It is a droughty soil and only suited to light truck crops and fruit. The most of it should be kept in forest.

The Porters black loam occurs in a few spots in the high, shaded coves. None of it is under cultivation. It is forested to oak, poplar, and hemlock.

The Toxaway loam is the most productive soil in the county. It is especially adapted to corn, grass (timothy and redtop), and rye. Cabbage does well.

The Toxaway fine sandy loam is also a good corn, grass, and rye soil. Cabbage, potatoes, wheat, and vegetables make fair returns.

The Meadow comprises poorly drained alluvial soil lying along Mud Creek and Devils Fork east and southeast of Hendersonville. Its only use is for summer pasture.

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