SOIL SURVEY OF THE HENDERSON AREA, TEXAS.

By CHARLES W. ELY and A. E. KOCHER.

DESCRIPTION OF THE AREA.

Rusk County is located in the northeastern part of the State of Texas. Henderson, the county seat, is about 200 miles north of Galveston, and is 60 miles west and about 25 south of Shreveport, La. The northern part of the county, embracing some 580 square miles, is included in the Henderson sheet. The county lines are in dispute in places; hence it is not certain that they are exactly as shown on the soil map.

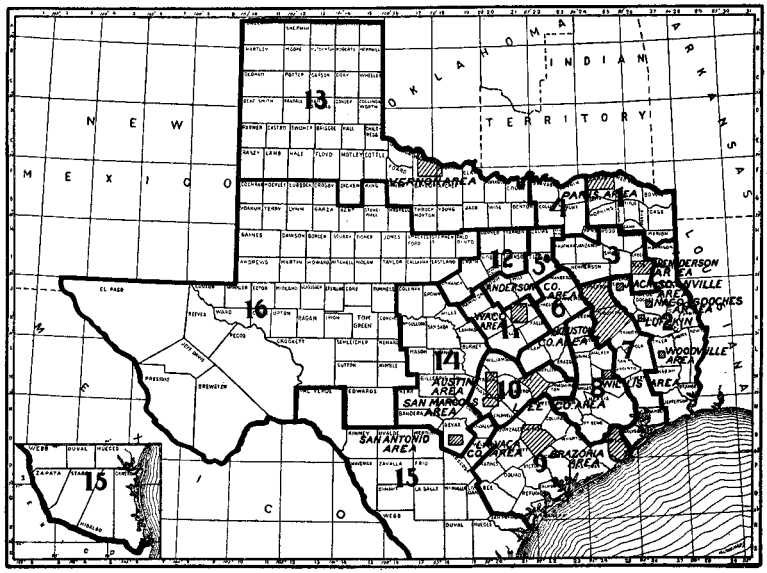

FIG. 15.—Sketch map showing location of the Henderson area, Texas.

In general the topographic features are those of a rolling country, with few high hills or sharp bluffs. There are no large streams except the Sabine River, which flows along the northeast corner for 5 or 6 miles. Aside from this, all the streams take their rise inside the area. Cherokee Bayou drains nearly all the northern part and Martins Creek the eastern part of the area. These streams discharge their waters into the Sabine River. The Henderson and Overton Branch of the International and Great Northern Railroad

and a line continued in the same general direction roughly follows the divide between the waters which flow into the Sabine River and those which flow into the Angelina River and through the Neches into the Gulf. South of the divide Boles Creek, Johnsons Creek, and Big and Little Shawnee creeks form the principal drainage channels. The divide between these drainage systems and all other subdivisions is nearly always well defined, there being but a few small areas so low and flat that the water finds difficulty in reaching one or another of the channels. During the winter a large quantity of water falls which is not disposed of by evaporation, and hence a small creek soon becomes a fair-sized stream within a few miles of its source. Two or 3 miles from their sources the small creeks have well-defined bottoms, through which they wind from side to side. The larger streams have numerous bayous, through which they flow in times of flood. Sometimes the entire bottom, one-half mile wide, may be covered with water for several days. A second terrace occurs along a few of the streams.

If we except the bottoms and some small areas in the uplands where artificial drains might help, drainage is fairly well established over the Henderson area. A large proportion of the land is rolling enough to wash badly unless carefully cultivated, and in some instances the need for contour cultivation and terracing is very marked.

The population of this section is nearly all drawn from native American sources. The early settlers of Rusk County came from North and South Carolina, Tennessee, Alabama, and Kentucky. The county was organized in 1843. Immigration was rapid until 1860, but the civil war turned people's attention to other things, and since then the population has been nearly stationary. The northern and northwestern parts of the area are at present the most thickly settled. In the southern and southeastern parts considerable lumbering is done and the population is scattering. The area could probably support four times its present population. Henderson, the county seat, has a population of only 2,200, and Overton, the next largest town, has about 500. Besides these there are no towns of any size. There is no local market of any importance for small fruits, vegetables, etc. Transportation facilities are inadequate. The main line of the International and Great Northern Railroad crosses the northwest corner of the area, and a branch, 16 miles long, runs from Overton into Henderson. A branch of the Santa Fe touches the northeast corner. These are the only railroads within the area and for several miles south. Much of the best land in the area, especially for peaches and tobacco, is more than 9 miles away from a railroad, which condition, to a great extent, has hindered development. The wagon roads of the area are very poor and at times almost impassable. Little attempt is made to improve them. It is

difficult to make a good road because there is no suitable material for surfacing, yet proper grading and drainage would do much to improve present conditions.

CLIMATE.

The following table shows the normal monthly and annual precipitation and temperature for the stations named. Longview is located a little to the north and Dialville to the southwest of the area. The heaviest rainfall is in January, and the lightest is in August. The winters, while never very cold, are often rendered disagreeable by sudden cold spells, or "northers," but these last for only a few days. The average date for the last killing frost in spring is March 16, and the first in fall is November 13, giving a growing season of approximately two hundred and forty days. People generally expect a good crop of peaches three years out of five and more or less damage from frost in the other two years.

Normal monthly and annual temperature and precipitation.

Month.	Longview.		Dialville.		Month.	Longview.		Dialville.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	°F.	In.	°F.	In.		°F.	In.	°F.	In.
January	47.0	5.33	49.3	3.94	August	83.5	1.96	82.4	1.97
February	48.6	3.54	48.1	2.78	September	77.4	3.26	76.2	4.21
March	57.1	4.50	59.3	4.27	October	67.1	2.95	67.8	3.53
April	66.8	4.26	64.9	3.76	November	56.4	4.44	57.6	3.51
May	74.7	4.49	73.7	3.52	December	49.7	1.57	47.8	3.14
June	81.5	4.98	79.4	4.10	Year	66.2	44.68	65.6	42.46
July	84.3	3.40	80.9	3.73					

Dates of first and last killing frosts.

Year.	Longview.		Year.	Longview.	
	Last in spring.	First in fall.		Last in spring.	First in fall.
1898	Mar. 25	Oct. 26	1902	Mar. 31	Dec. 4
1899	Mar. 29	Nov. 3	1903	Mar. 1	Nov. 18
1900	Mar. 16	Nov. 12	1904	Mar. 5	Nov. 13
1901	Mar. 6	Nov. 16	Average	Mar. 16	Nov. 13

AGRICULTURE.

As most of the early settlers came from southern States, and as it was natural for them to grow what they had been accustomed to, cotton and corn early became the chief crops. Before the civil war and prior to the advent of the railroads, Shreveport, La., was the great market for this section of the country. Produce was hauled 60 miles and more across country by ox teams and needed supplies

brought back. The railroads in this section have all been built since the sixties. The main line of the International and Great Northern was built in 1872, and the Henderson and Overton branch about 1877. While these have helped the country to some extent, their greatest benefit has been to other areas than this, and at the present time the railroad facilities are very poor.

So far as could be learned, no great change in agricultural practices has taken place, and the methods of cultivating cotton and corn were much the same forty years ago as they are to-day. The use of fertilizers has become more or less general in the last eight or ten years, from 350 to 400 tons being used annually in the area at the present time. The growing of peaches has attracted some attention within the last five or ten years. There are between 200 and 300 acres of bearing orchards in the area at present and more are being planted every year. It is unfortunate that the best peach lands in the county are so far away from railroads as to prohibit peach growing on a commercial scale.

With such poor railroad facilities and such poor wagon roads, the products of the area must be such as can stand being hauled long distances without damage. Cotton and corn fulfill this requirement, and hence have always been the chief crops. The average yield for cotton in 1900 for the entire county was two-sevenths of a bale per acre, and of corn, 13 bushels. In recent years considerable damage has been done to the cotton crop by the boll weevil and other insects, particularly in a wet season, which makes the cotton late in maturing. About two-fifths of the land is under cultivation, and seven-eighths of this is planted to cotton or corn. The other crops are cowpeas, peanuts, sorghum, peaches, and potatoes. No attempt at systematic rotation is made. Cotton follows cotton or corn for a number of years, with an occasional crop of cowpeas sown in the corn. The light color of most of the soils indicates a lack of organic matter. Plowing is very shallow, sometimes as deep as 4 inches, but more often only 2 inches, 1-horse implements commonly being used.

The fertilizers in general use are complete mixtures. As a rule the farmer does not understand very well what constitutes value in fertilizers, and he usually pays a very high price for what he receives. Laborers in this area are both white and colored, but the latter are largely in the majority. Wages for the season vary from $9 to $15 a month, with board. Cotton pickers receive from 40 to 75 cents per hundred pounds. In the rush season of picking peaches wages are much higher, and it is sometimes possible for a man and team to make $5 or $10 a day. The labor is generally regarded as efficient for the implements and methods used, but it is stated that few of the colored laborers are skilled in the use of improved machinery.

Little attention is paid to the adaptation of soils to crops. The

farmers generally recognize that there are various types of soil, but see in these differences greater or less yields of cotton and corn, rather than their better adaptation to one crop or another. The peach orchards are chiefly upon the Norfolk fine sandy loam, the Norfolk fine sand, and the Orangeburg fine sand. This is due to their proximity to the railroads rather than any special adaptability to this crop. A great many people regard the Orangeburg fine sandy loam as the best peach soil. A few farmers are interested in growing alfalfa. So far it has been tried only on the creek bottoms with some success. Some have an idea that a low, wet spot is particularly desirable for this crop. This is incorrect, as alfalfa will not thrive where the water table is within 2 or 3 feet of the surface for any length of time. It would probably do well upon the Orangeburg fine sandy loam, upon well-drained spots in the Meadow, and upon well-drained fields in the uplands.

Slightly less than one-half of the farms in the Henderson area are operated by the owners. Near Henderson some farms rent for from $2 to $4 an acre cash, but away from the towns a rent of one-fourth of the cotton and one-third of the corn is generally paid when the tenant furnishes the teams, implements, and seed. If the landlord furnishes these, he receives one-half of the crops. The average-sized farm is about 75 acres, but only about one-half of that is cultivated land, or about what can be cultivated with one mule. There are some large tracts of 15,000 acres or more held by individuals. Land values range from $2 to $25 an acre near town. Over the county as a whole the price of land would average less than $8 an acre. Much of the Norfolk fine sand can be bought for $2 an acre, while the Orangeburg fine sandy loam well improved will bring from $10 to $15 an acre. Favorably located peach orchards with a good stand of trees will bring from $50 to $75 an acre.

In general, too much dependence is placed upon cotton and corn. Long-continued cultivation of these crops reduces the organic matter in the soil, and the exposed surface readily gullies and the productivity soon declines. Terracing and contour cultivation will prevent much of the damage from erosion. It should be borne in mind that a field does not necessarily have to be gullied to be damaged by washing, but that the removal of the surface soil with its organic matter may work serious injury. On the more sandy soils, growing some crops, such as oats or winter vetch, sand vetches, etc., during the winter, would reduce injury from washing, and, with the hay and pasture secured, would prove profitable. The more systematic rotation of crops, including some leguminous crop once in three or four years, would result in greater returns for a series of years than continued planting to cotton and corn, and at the same time would put the land in better condition. Deeper plowing would prove beneficial,

but the depth should be increased gradually. The production of more hay and grain and the raising of at least enough meat for the family would keep much money in the county and insure greater prosperity to the farming classes. The growing of alfalfa on lands suited to it and of pecans on the Orangeburg fine sandy loam and in some of the bottoms should prove profitable.

SOILS.

The soils of the Henderson area are the fine sands and fine sandy loams characteristic of eastern Texas. Exclusive of Meadow, they fall naturally into three distinct series—the Orangeburg, the Norfolk, and the Susquehanna—each of which is represented by two types of soil. There are also two other types belonging to different series of soils. By referring to the accompanying map it will be seen that there are no extensive bodies of any one soil, but that each type occurs in a number of small bodies scattered throughout the area.

While the early geology of eastern Texas is but little understood, it is recognized that the material from which the soils of the Orangeburg series are derived was laid down as marine beds about the time of the Lower Claiborne stage of the Eocene. This stage is marked by the accumulation of glauconitic material and iron-bearing sandstones, from which are derived the commercial iron ores of eastern Texas. As the material is more resistant to the action of rains than are the other materials in the soils, it is not infrequently left behind on the surface of the ground after the sands have been removed.

The soils of the Susquehanna series are also derived from marine beds of the Lower Claiborne stage, but from the relatively small content of sands which the subsoils contain it is probable that these soils were deposited in much more quiet waters than were those of the Orangeburg series.

The Lufkin soils, represented here by only one type, and probably a part of the soils of the Norfolk series, are representative of the Lignitic stage of the Eocene epoch. The soils of this stage, like those of the Lower Claiborne, are not confined to any one section, but are found in small irregular bodies throughout the area. In extent, however, they occupy only a small proportion of the area mapped. The stage is easily recognized in the Henderson area by its lower elevation, poorer drainage features, and the occasional outcropping of thin strata of impure lignite coal.

The fine sandy loams of the Orangeburg and Norfolk series have largely been derived by the slow weathering of underlying beds of sandy clays, similar in texture to the present subsoils, from which the clay has been gradually removed by rains, leaving behind a

sandy covering from 8 to 16 inches deep. The deeper sandy soils of the Orangeburg and Norfolk series and the soil of the Susquehanna fine sandy loam have probably been left as a separate deposit over the clays at a later period.

As a rule, the Norfolk fine sandy loam occupies a lower elevation than do the soils of the Orangeburg and the Susquehanna series, and is frequently found as level or gently sloping areas bordering stream courses. Where it is thus found the formation of the surface soil is of comparatively recent date, the topography being such that the coarser sands washed from the higher lying hills are mostly retained, while the silts and clays are carried on and deposited along the stream bottoms to form Meadow.

In a general way it may be said the sands overlying the clays in the Henderson area are somewhat deeper than those found in similar Texas areas to the west and south. The soils of the Orangeburg series, instead of being a clay and a fine sandy loam, as is the case in Anderson and Houston counties, are here entirely made up of a fine sandy loam and a fine sand. The color of the surface soil is usually red, though in other Texas areas it is very often gray, and east of the Mississippi River is nearly always so. The Lufkin soils, which occupy large, well-developed areas to the south and west, are poorly developed in the Henderson area and occupy only a small percentage of the total sheet.

The following table gives the names of the soils mapped and the relative extent of each:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Orangeburg fine sand	110,400	29.7	Caddo fine sandy loam	9,152	2.5
Norfolk fine sand	58,432	15.7	Susquehanna clay	1,728	.5
Susquehanna fine sandy loam	53,312	14.3	Lufkin clay	832	.2
Norfolk fine sandy loam	48,064	12.9	Total	372,032	
Meadow	47,424	12.7			
Orangeburg fine sandy loam	42,688	11.5			

ORANGEBURG FINE SANDY LOAM.

The soil of the Orangeburg fine sandy loam, which is known among the farmers as "Red land," or "Red gravelly land," is a red fine sandy loam or a fine sand from 5 to 14 inches deep, beneath which is found a red sandy clay. There is some variation in the texture of the soil. Within the limits of a single field it may be a fine sandy loam or a fine red sand, and may contain from 10 to 50 per cent of rounded iron concretions, which may disappear within a short distance. There are also small areas where a rotten sandstone is found in small frag-

ments near the surface, but this has little effect on the yield of crops. The sand of the subsoil is of the finer grades. The subsoil is friable when in the right stage of moisture, yet it is very plastic when wet. When in this friable stage it may be compressed in the hand to much less than its bulk when taken from the ground, indicating that its structure is such as to leave much space between the soil particles. It thus permits a ready passage of water and air downward.

The soil passes gradually into the subsoil, the average depth to red clay being about 12 inches. The first 4 or 6 inches of the soil is generally darker, owing to its organic matter content. The soil is friable and easily handled, and the subsoil allows such ready underground drainage that the type can be worked very soon after a rain. It is considered from one to three weeks earlier than the " gray lands," or the Norfolk fine sandy loam and Norfolk and Orangeburg fine sands. If well cultivated and the supply of organic matter maintained it does not suffer from drought. A feature of this soil which makes it very desirable is the fact that it shows the effects of fertilizers and manures for a long time after use and is easily kept in good condition.

The largest and most typical areas of the Orangeburg fine sandy loam are found in the southwestern part of the area and in the vicinity of Motley. The topography varies from almost level to rolling and somewhat hilly, the greater part being gently rolling. No large streams flow through areas of this soil and few small ones, yet the texture and structure of the soil and subsoil are such that it is one of the best drained soils in the area. Some few areas are so rolling as to be damaged by washing, but this can be corrected by terracing and contour cultivation.

This soil is derived from the sandy clay beds of the Eocene. It is probable that when originally laid down the texture of the whole mass was similar to that of the present subsoil, but rain water has removed many of the clay particles, leaving the soil a fine sandy loam or fine sand. It is distinguished by its red color, due to the large quantity of iron it contains.

Most of the native timber was hardwood, principally oak and hickory, with very little pine. This has nearly all been removed.

The Orangeburg fine sandy loam is the best peach soil in this area, producing a better colored and earlier peach than the other soils. It is adapted to the Cuban filler tobacco, which has been grown in several places in Texas. With proper preparation of the soil alfalfa could probably be grown, as well as many grass and forage crops. Cowpeas and Bermuda grass are grown to a limited extent. It is considered the best soil for general farming in the area. Its

development for special crops is seriously hindered by lack of railroad facilities. Cotton and corn are the chief crops grown at present. Cotton produces from one-third to three-fourths of a bale and occasionally 1 bale per acre, and corn from 20 to 30 bushels, with an average of 25 bushels. The earliness of this soil is of advantage in avoiding injury from the cotton boll weevil.

The most progressive farmers in the area are found on this type of soil, and there is more 2-horse machinery used on it than on any other type. Level cultivation of crops is practiced to a greater extent than elsewhere and is found advantageous. The type has been cultivated to cotton and corn for a long time, however, and much of it suffers from a lack of organic matter,[a] though not so badly as the more sandy soils. A rotation by which a leguminous or grass crop would be grown regularly every three or four years would keep the soil in much better condition than at present, especially if the hay were fed on the place and the manure returned to the land. Deeper plowing, to a depth of 6 or 8 inches, would also be beneficial. On the rolling areas the rows of cotton and corn should run around the hill, and on the more rolling areas a terrace should be built up for about every 3 feet of fall to prevent the soil from washing. The value of this type ranges from $5 to $15 an acre, depending upon the distance from railroads. Considering only the land itself, and ignoring advantages of location, it is the most valuable type in the area.

The following table gives the results of mechanical anaylses of samples of this soil:

Mechanical analyses of Orangeburg fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
14780	Soil	0.5	2.4	5.5	39.6	26.5	18.6	7.0
14781	Subsoil	.3	1.9	3.6	24.8	17.8	14.4	37.3

[a] This type, as indicated by the results of tests by the wire-basket method, is much in need of the incorporation of organic matter. Samples treated with cowpea vines and lime, and with stable manure, showed greater increases in plant growth than where the mineral fertilizers were used either singly or in combination and with and without lime. The mineral fertilizers gave the best results when the three important elements were combined, and the next best when nitrate of soda was used alone. Lime alone also gave good results. On the other hand, sulphate of potash and acid phosphate, used singly or in combination, apparently had no beneficial effect on the soil. The samples of soil used in these tests had been in cultivation for forty years or more, cotton being grown continuously without rotation in one field, and in another with an occasional change to corn. The fields had received moderate applications of cotton-seed meal during the last few years. While strictly applicable to the particular samples tested, it is believed the results indicate the best treatments for this type in general.

ORANGEBURG FINE SAND.

The soil of the Orangeburg fine sand consists of gray or reddish-gray fine sand, varying greatly in depth, but ranging usually from 15 to 30 inches, with an average of about 2 feet. The typical subsoil is a brownish red sandy clay of moderately open structure, resting on a compact clay of the same color and having a thickness of from 3 to 4 feet. Near the heads of streams and where the drainage is more imperfect this material is of a reddish-yellow color, while on higher elevations it is frequently a bright red. Iron and lime concretions are occasionally found scattered over the surface on the higher levels, but their occurrence is in areas of small extent. The structure of the soil is loose and porous, giving excellent drainage and ease of cultivation at all times.

The Orangeburg fine sand is one of the most widely distributed types in the area. It is usually found occupying the slopes of hills along the courses of the larger streams, and is most typically developed to the north and east of Henderson, in the vicinity of Craig, Stewart, and Harmony Hill. The type has a rolling or gently sloping topography, and in general is the most hilly soil in the area. None of it, however, is so rough as materially to interfere with cultivation. While the surface drainage is excellent, the clay of the subsoil makes the type highly retentive of moisture. If properly cultivated, the damage caused by drought is usually very slight. A large proportion of the Orangeburg fine sand is still covered with native forests of red, black-jack, and post oak and hickory. The soil is considered one of the earliest in the area, and is therefore well adapted to the cultivation of all the early truck crops. Irish potatoes, peaches, strawberries, and the small bush fruits should do well on this soil. Cotton and corn are the chief crops grown, though considerable acreage has recently been devoted to peaches. In the vicinity of Overton the cultivation of strawberries has proven profitable, and it would seem that near the railroads, where the shipping facilities are adequate, the acreage could profitably be extended.

The yield of cotton ranges from one-fourth to three-fourths bale, with an average of about one-half bale per acre. Corn yields from 15 to 30 bushels, with an average of 20 bushels per acre. The yield of Irish potatoes varies greatly with the kind and amount of fertilizer used, the average being about 70 bushels per acre. Sweet potatoes yield from 150 to 300 bushels per acre.

Owing to the heavy rainfall in the spring that part of the type which is devoted to cotton is given ridge cultivation. This provides for needed surface drainage, and thereby hastens the date of planting.

The plowing, however, is shallow, and is frequently poorly done. For corn and potatoes the same method of plowing is followed, except that the ridges are not so high. After planting, corn is rarely cultivated more than three times, the depth frequently being as great as that of the original plowing. Better results would doubtless be had if the cultivations were made more frequent and the depth somewhat less as the season advances. On the steeper hillsides an inexpensive system of terracing would prevent the washing of the loose, sandy soil.

The chief fertilizer used on this type is cotton-seed meal, though commercial fertilizers are used to some extent. Cowpeas are sometimes grown as a fertilizer in the corn fields after the last cultivation, the crop being used for pasture during the late fall months. Much of the area of Orangeburg fine sand is deficient in organic matter, but this may be readily provided by the use of legumes.[a]

For general farming the Orangeburg fine sand is one of the best soils in the area. The value of the type ranges from $5 to $10 an acre.

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

Mechanical analyses of Orangeburg fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
14776, 14778.....	Soil	1.7	2.5	3.5	30.4	36.7	16.1	9.1
14777, 14779.....	Subsoil.....	1.2	1.8	2.7	17.5	21.4	15.0	40.3

NORFOLK FINE SAND.

The Norfolk fine sand is the most sandy soil in the Henderson area. The soil consists of a fine gray sand from 4 to 6 inches deep and is underlain by a yellow sand of about the same texture and from 3 to 30 feet deep. The only difference between the soil and subsoil is the greater organic matter content of the soil. The texture of both varies from a fine to medium sand, and both are loose and incoherent, occasionally so much so that the surface is blown about by the wind. In fact, any area becomes very loose and in

[a] As in case of the Orangeburg fine sandy loam, this type of soil responds best to applications of manure and cowpea vines, the increase from the use of manure being greatly in excess of that derived from any other treatment. The several mineral fertilizers were more or less beneficial, with the exception of acid phosphate. In case of the mineral fertilizers the increase derived from the use of nitrate of soda, sulphate of potash, acid phosphate, and lime in combination was the most marked. The results of this test, while strictly applicable only to the field from which the sample was taken, will probably apply in some degree to much of this soil in the Henderson area.

coherent if cultivated for a long time without the addition of organic matter in some form. Fair crops are secured the first year or two after the land is cleared, but the productiveness rapidly decreases. In some areas in the southeastern part of the survey the sand is red, and such areas are considered more productive than the gray or yellow sand. In a few areas the soil contains more or less iron concretions. In one sense this is an easy soil to cultivate, as it is not hard to plow and can be worked at almost any stage of moisture, but in another sense it is hard to handle because of the difficulty of keeping enough organic matter in the soil. As a result it is leachy, will not hold fertilizers well, and it is badly affected by dry weather.

The Norfolk fine sand is found in all parts of the survey, but the largest and most typical areas are within 8 miles southwest, south, and southeast of Henderson. It is found on the tops of divides and may be rolling or hilly, though small areas are level enough to be spoken of as "sand flats." Few streams flow through the type, but it is excessively drained owing to its texture and to its high position on the divides.

The Norfolk fine sand is a deposit from moving water and has some of the features of a beach deposit. It is almost entirely a fine quartz sand to which some organic matter has been added by the growth and decay of plants. Some areas have been modified by wind action.

The native vegetation is a sparse growth of pine, with an undergrowth of scrub, sand jack, and black jack oaks. Sometimes the pines are entirely lacking. A leguminous plant, sometimes called wild pea, is characteristic of the soil.

This soil is adapted to the growing of truck crops, peanuts, cowpeas, sand vetches, sweet potatoes, and tomatoes, and is a fair soil for peaches and small fruits. It is an early soil, though not any more so than the Orangeburg fine sandy loam, and is not so productive as the latter. The chief crops now grown are corn and cotton. Corn yields from 8 to 14 bushels, and cotton from one-eighth to one-half of a bale per acre. Some peach orchards are planted on this type. It is usually given ridge cultivation, which hardly seems advisable, as the ridges favor drainage and evaporation. It needs to be plowed from 6 to 8 inches deep, terraced where rolling, and should not be left bare during the winter under any circumstances. A crop of winter oats and winter or sand vetch sown broadcast in early fall will furnish some pasture before winter and a great deal of pasture or hay in early spring and may be removed in time for another crop. This will keep the ground covered during winter and will add considerable organic matter to the soil. Some such crop should occupy the ground every winter to prevent washing and leaching. Besides this, a leguminous crop, such as cowpeas or peanuts, should

be grown every third year.[a] In this manner the productiveness of the soil can be in a measure maintained and a fair profit be secured from the land. The Norfolk fine sand sells for from $2 to $5 an acre.

The following table contains the results of a mechanical analysis of a sample of this soil:

Mechanical analysis of Norfolk fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
13961	Soil	0.1	1.8	9.5	69.1	13.8	3.3	2.2

NORFOLK FINE SANDY LOAM.

The soil of the Norfolk fine sandy loam is a fine sand or fine sandy loam from 14 to 30 inches deep. The soil to a depth of 4 to 6 inches is dark gray or gray, below which to 14 or 30 inches it is yellow. The subsoil is a lemon-yellow sandy clay, sometimes slightly mottled with red or red and gray. At greater depths—from 4 to 8 feet—this is frequently underlain by a gray clay. In places there are from 5 to 10 per cent of iron concretions scattered in the soil, and occasionally pieces of iron sandstone, but these are not so numerous as in the Orangeburg fine sandy loam. The soil is easily cultivated, holds moisture and fertilizers well, and can be kept in good condition without difficulty. The sandy clay subsoil permits fair underdrainage, and unless it is very flat and low this is not a very wet soil, though it is not so well drained and can not stand as much rain as the Orangeburg fine sandy loam. Where the soil is a fine sand it usually lies near the Norfolk fine sand and in most other areas there is enough silt and fine material to cause it to pack to some extent and form a crust on the surface after rains. Areas like these frequently wash badly, and care should be taken to prevent damage from this source.

Some Norfolk fine sandy loam is found in all parts of the area, but the largest body is found in the southwestern and in the northern

[a] Manurial requirements of this type were tested in the laboratories by the wire-basket method. The best results were obtained by the application of stable manure, and the next from cowpea vines with lime. The use of a complete mineral fertilizer also gave marked increases, but so much less than secured from the first two treatments that the necessity for increasing the humus content of the type was at once apparent. The samples of soil tested were from fields that had been under cultivation for many years, and results are held to be strictly applicable to these fields only, but as much of the type in the area is apparently in a similar condition, the treatment indicated, it may be assumed, would be beneficial in nearly all instances.

parts of the survey. The topography varies from level to gently rolling. It occurs in comparatively low and flat areas near streams, in many cases resembling second bottoms. It is also found on hillsides where the soil of the Norfolk fine sand becomes shallow. In some areas there are mounds 3 or 4 feet high and 10 or 15 feet across, probably formed by the winds. In the center of the mounds the soil is more sandy, while it is heavy and dark in the depressions. On the whole, the type is well enough drained for ordinary seasons, but crops suffer in continued wet weather. If carefully cultivated it will withstand much drought.

This type is derived from Eocene beds, reworked to a slight extent by moving water and modified by erosion and wind action. The soil contains much less iron than the Orangeburg fine sandy loam. The native forest was pine, sweet gum, and oak, with some post oak on the flatter areas. As a rule the type occurs in such small areas that no characteristic growth has been developed.

The Norfolk fine sandy loam is adapted to a wide range of crops. It is probably the best Bermuda grass land in the area. Nearly all other grasses would do well. Japan clover, cowpeas, and peanuts also grow nicely. On the higher areas peaches are grown successfully. Irish potatoes, sweet potatoes, and small fruits of various kinds should do well on this soil, and alfalfa may possibly be grown on the better drained areas. At present the chief crops are cotton and corn, yielding from one-fourth to three-fourths of a bale, and from 15 to 20 bushels per acre, respectively. Ridge cultivation is generally practiced. As a whole the soil needs deeper plowing, the addition of organic matter,[a] and the growing of leguminous and hay crops. Less than one-half of this type is under cultivation. The values range from $5 to $12 an acre.

The following table gives the average results of mechanical analyses of samples of this type:

Mechanical analyses of Norfolk fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
13959, 14774.....	Soil	0.7	0.9	1.1	26.6	36.9	25.9	7.3
13960, 14775.....	Subsoil.....	.5	.7	.8	19.9	27.5	23.3	26.6

[a] Two large samples of this type were collected from fields near Henderson and subjected to a test by the wire-basket method to determine its manurial requirements. As in case of the Norfolk fine sand the largest increase in plant growth was obtained through the use of stable manure. Good increases followed the application of all the mineral fertilizers, the effect of nitrate of soda and sulphate of potash being particularly marked, though increased by the addition of acid phosphate and lime. The benefits derived from chopped cowpea vines and lime were very decided, being equal to results obtained where the treatment was fertilizer and lime. It is believed that these tests indicate the proper treatment of this soil in general, though of course the results are strictly applicable only to the fields in which the samples were obtained.

SUSQUEHANNA FINE SANDY LOAM.

The soil of the Susquehanna fine sandy loam is a gray or rarely a reddish fine sand or fine sandy loam, much resembling the soil of the Orangeburg fine sand. A few iron concretions are found, being most numerous in the better drained areas. The reddish soil is of local occurrence, generally covering only a few acres in a field. The average depth to the subsoil is about 9 inches, varying between 6 and 12. The subsoil is a heavy plastic red or mottled red and gray clay, sometimes containing sand. Though it is generally red at slight depths, it nearly always becomes mottled at a depth of 30 inches or less, and occasionally a gray clay is found at a depth of less than 3 feet. This gray clay can nearly always be found at greater depths. The line between soil and subsoil is generally sharp and distinct. When nearing areas of Orangeburg soils the subsoil grades into a sandy clay. As a rule the subsoil is heavier near streams and on hillsides, though this is not always true. It may be a heavy clay on a slight slope and a few feet away it may be a sandy clay, but the heavy clay predominates. Farmers consider this an easy soil to cultivate.

The mottled and gray color of the subsoil indicates imperfect aeration and oxidation. This is not a very productive soil, nor one which will stand an exhaustive system of cropping without manures. Good crops are secured for the first few years after clearing, but the yields soon decline. The soil holds manure fairly well and can readily be brought to a fine state of productiveness.

The largest bodies of this type are found north of Monroe and Crossroads, and south, southwest, and west of Pinehill, but small areas are found in nearly all parts of the survey. The surface is rolling or sloping enough to give good drainage and there are a great many streams to carry off the water. It is not found on plateaulike areas, as is the Orangeburg fine sandy loam and Norfolk fine sand, but on hillsides and on slopes near streams. The soil of this type has not been formed like the soil of the Orangeburg fine sandy loam, but has been deposited over the clay at a different period, or it may be the sandy remains of thin formations which, if left unchanged, would have formed soils of the Norfolk or Orangeburg series. In many cases small areas of this type are formed by wash from the Norfolk fine sand. In several places in the county the clay is used for making the cheaper grades of pottery.

While the surface drainage of this soil is good, the underground drainage is very poor. The subsoil is so stiff and tenacious that neither water nor air can enter, and the processes of aeration and oxidation, so necessary to a good soil are not very far advanced. The impervious character of the subsoil is shown wherever it is exposed in the roads, where in wet weather mudholes are formed which, at

the right stage of moisture, are so sticky as to render travel almost impossible. With the exception of the roads in the Meadow areas the worst roads in the survey are found on this soil. The native vegetation is chiefly pine, with some hardwood.

The better drained, higher areas of this type will probably grow fair peaches and small fruits. The remainder of the type is best adapted to grasses, such as Bermuda, redtop, etc. Peanuts are successfully grown as a general farming crop. Cotton and corn are the chief crops. Cotton yields from one-fourth to one-half of a bale and corn from 15 to 20 bushels per acre.

Ridge cultivation is generally practiced and seems best adapted to this type under present conditions. The soil should be plowed deeper and terraced and given contour cultivation where subject to washing. Its productiveness decreases rapidly, and a leguminous crop should be sown once every three or four years. [a]

The price of this type ranges from $3 to $8 an acre—just a little above the Norfolk fine sand.

The following table gives the average results of mechanical analyses of samples of this type:

Mechanical anaylses of Susquehanna fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
14418, 14782	Soil	0.5	0.6	0.6	18.7	47.4	26.5	5.4
14419, 14783	Subsoil	.2	.2	.2	3.6	18.2	24.1	53.2

MEADOW.

The Meadow in this area comprises the overflow lands along the streams. The soil is variable in texture and may range from a clay to a fine sand. For the most part it is a silty or fine sandy loam from 6 to 18 inches deep, underlain by a yellowish or gray material of about the same texture as the soil. Along the larger streams are found many sloughs where the soil is heavy enough to be called a clay, and in the northern part of this area there are many places where both

[a] A large sample of this type, collected near Henderson, was subjected to a test by the wire-basket method to determine its manurial requirements. As in case of the other soils tested in this area, stable manure and cowpea vines with lime gave the most marked increases in plant growth. In case of the mineral fertilizers, the best results were secured when a complete fertilizer to which lime was added was used. Of the single elements, nitrate of soda alone gave any increase. The marked increase obtained in the use of organic manures indicates the great value of adopting a rotation in which some green manuring crop is included.

soil and subsoil are a fine sand. The narrower areas of Meadow, when bordered by soils of the Orangeburg series, are apt to be a brown silty loam from 6 to 20 inches deep, underlain by a reddish silty or clay loam. These areas are always very productive. Other areas occur where the stream level is very near the surface of the soil and here the soil is "crawfishy," owing to its water-logged condition. These areas will not produce good crops even if artificially drained, until the drains have been in operation a few years and the soil is aerated.

Very little of the Meadow is under cultivation. What little is cultivated is chiefly in the smaller bottoms near their junction with the bottoms of the larger streams. The larger areas are so low and flat and have such poor natural drainage that no attempt to grow crops has as yet been made. The streams wind from one side of the Meadow to the other, thus covering two or three times the distance necessary were they straight. There are also numerous bayous and cut-offs through which the water flows during floods. In winter some of these areas are covered with water to a depth of from 2 to 6 feet. The chief reason this land is not productive is because of the imperfect drainage. Straightening and clearing the stream channels and building levees along the ditches would bring a good deal of valuable land into cultivation. For the best results this work should be done on a large scale for 15 or 20 miles along a stream.

The Meadow is an alluvial deposit from the streams, excepting some of the narrower bodies, which are formed by wash from surrounding types. The material of nearly all the Meadow has been derived from soils in this area.

The principal trees on the bottoms are gum, some white oak, and ocasionally a pine. There is little underbrush, and unless the trees stand too thick, good pasturage is provided all summer.

Some areas occur along the smaller streams where the stream has cut its channel 5 or 6 feet below the surface and the land slopes perceptibly from the uplands toward the stream. These and other well-drained areas would make fine alfalfa fields. Many other areas not quite so well drained will grow Japan clover, alsike clover, redtop, and other grasses. If this soil were well drained it would make the best corn and cotton land in the area, but even then it would probably be found more profitable to grow alfalfa or some forage crop. It is at present used chiefly for pasture. Sugar cane and sorghum are grown to a limited extent and sometimes produce 400 gallons of sirup per acre.

The price of this type is rather low, ranging from $2 to $8 an acre. Where the timber is good and is easily reached much higher prices are paid.

CADDO FINE SANDY LOAM.

The Caddo fine sandy loam resembles the Norfolk fine sandy loam in a great many respects, the chief difference being in the topography and the color of the subsoil. The soil is a gray or yellowish fine sandy loam or fine sand from 10 to 30 inches deep. The subsoil is a mottled yellow and gray, yellowish red and gray, or a gray clay or sandy clay. Over most of the surface the fine sandy material has been blown up into mounds from 10 to 15 feet in diameter and from 3 to 4 feet high. The fine sandy material is deepest on the top of the mounds, and the soil is heavier and darker in the depressions. Spots in which water stands during part of the year are occasionally seen. These have the nature of the Lufkin clay, but are too small to be shown on a map of the scale used in the soil survey. A few iron concretions are sometimes found in the surface 8 or 10 inches. Sometimes the subsoil is partially cemented together and behaves like a much stiffer clay than the analysis would show. Such places are always very poorly drained, and the subsoil is pale yellow or gray in color.

Aside from the difficulty of getting rid of the water this soil is easily cultivated, holds manure and fertilizers well, and is not rolling enough to suffer much damage from washing. Crops suffer in a wet year. It is said that the tops of the mounds are more productive the first year after clearing, but when the surface soil of these becomes washed down in the depressions the latter become the most productive. As a general rule the deeper the sandy material the better this soil is, because of the better drainage.

The Caddo fine sandy loam is found in low, flat areas and around stream heads and is always poorly drained. As a result the subsoil shows lack of aeration and oxidation. The resulting gray color is a distinctive difference between this type and the Norfolk fine sandy loam. In addition to the poor drainage resulting from its flat topography this soil frequently receives considerable seepage water from surrounding soil types. Open or tile drains would probably increase the productive capacity of this land, which is formed in much the same way as the Norfolk fine sandy loam.

The type is fairly well adapted to Bermuda grass, redtop, Japan clover, possibly also to alsike clover, and to cotton and corn. The latter two are the chief crops and the best drained areas yield, in favorable years, almost as much as the Norfolk fine sandy loam. The crops on this soil can withstand considerable drought. The value of the Caddo fine sandy loam ranges from $2 to $8 an acre.

The table on the following page gives the results of mechanical analyses of samples of this type.

Mechanical analyses of Caddo fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
14770	Soil	0.0	0.4	2.5	27.1	28.8	35.0	5.5
14771	Subsoil	.0	.3	1.6	19.1	19.5	28.6	30.5

SUSQUEHANNA CLAY.

Susquehanna clay is the name applied to a soil type formed where the subsoil of the Susquehanna fine sandy loam is within 4 inches or less of the surface. The soil, where it has not been washed away, is a grayish fine sandy or silty loam. The subsoil is a heavy plastic red or mottled red and gray clay. Though in places it is red near the surface, it is usually mottled deeper down, and sometimes a gray clay is reached before 3 feet and nearly always at lower depths. The soil is very hard to cultivate and very little attempt has been made to farm this type. Farmers generally speak of it as "poor clay hills." The type is of very limited extent and is found only in small areas, the largest of which is in the southeastern part of the survey.

This type is found on hillsides and around the heads of some streams and is nearly always rolling enough to give good surface drainage. It is badly washed and gullied, so much so that the subsoil is exposed over a great part of the type and is frequently baked hard by the sun. The subsoil is so plastic and its particles are so fine and close together that neither water nor air can penetrate, and nearly all the water falling on the type must run off the surface. As it requires very little current to remove the fine particles of which this clay is composed, it washes badly.

The Susquehanna clay is probably derived chiefly from lignitic clays. The clay is useful for making low-priced pottery, such as jugs and crockery. The native trees are scrub oak and occasionally pine, with little undergrowth and very little grass. This type is probably as well adapted to grass crops as anything. Few attempts have been made to cultivate it, so it is impossible to estimate the yields. Locally it is considered almost worthless for farming purposes.

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

Mechanical analyses of Susquehanna clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
14211	Soil	2.7	1.4	0.9	6.1	29.7	40.4	18.3
14212	Subsoil	.3	.2	.1	.9	3.7	29.6	64.9

LUFKIN CLAY.

Lufkin clay is a type of very limited extent, comprising altogether only 832 acres. The soil is a gray silty or fine sandy loam 6 to 12 inches deep, underneath which is a gray or mottled yellow and gray clay. The subsoil is compact and rather impervious and permits water to escape very slowly. The soil has the peculiarity of packing very hard when dry and behaving like a much heavier soil. Roads become almost glassy during summer. This is probably due to the fact that the soil is water-logged a good portion of the year, and this permits the soil particles to arrange themselves in the closest possible manner. A few mounds of very fine sand are found scattered over this type, but these are too small to map separately. Farmers refer to this type as "post oak flats." It is found in small areas of from 20 to 240 acres, the largest of which are in the western part of the survey. The surface of this type is extremely flat. It has practically no surface or underground drainage and also receives considerable wash and surface water from surrounding types. The areas of this soil are always lower than the surrounding land, which suggests that they may be the bottoms of old lakes. The gray color of the soil and subsoil indicates a condition of imperfect aeration.

None of this type is under cultivation, it being too wet in its natural state and being considered hardly worth draining. Water stands on the surface for long periods. Redtop, or herd's-grass (*Agrostis vulgaris*), orchard grass, alsike clover, and Japan clover will probably grow on this soil without drainage and produce good yields of hay and pasturage. Artificial drainage by open ditches 2 or 3 feet deep and 3 or 4 rods apart would be necessary before ordinary crops could be grown, and even then it would be a few years before good yields could be secured.

The following table gives the results of mechanical analyses of samples of this type.

Mechanical analyses of Lufkin clay.

Number	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
14768	Soil	0.1	1.0	1.2	19.8	26.2	39.1	12.5
14769	Subsoil	.1	.4	.7	14.5	24.2	36.5	23.3

SUMMARY.

The Henderson area embraces the northern part of Rusk County, which lies in the northeastern part of Texas, and entirely within the Coastal Plain. The surface is rolling and the regional drainage is well developed.

The area is sparsely settled, and could easily support four times its present agricultural population. The largest town has but 2,200 inhabitants, and the next largest about 500. The population is nearly stationary. Local markets are wanting, and railroad facilities are inadequate.

The staple crops are cotton and corn, which, under present methods of cultivation, give rather low average yields. The boll weevil is partly responsible for the low average in the case of cotton. Near the railroads a considerable development in peach growing has taken place in recent years. Cowpeas, sorghum, sugar cane, and potatoes are also grown to some extent.

The soils lack organic matter, and are farmed without systematic rotation of crops. The aim of the planters is to maintain the crop yields by the use of commercial fertilizers.

The soils all belong to established series—the Orangeburg, Norfolk, Susquehanna, and Lufkin.

In general the Orangeburg fine sandy loam is the best peach soil in this area. The Norfolk fine sandy loam, when not low and flat, the Norfolk fine sand, and the Orangeburg fine sand are also good peach soils. The higher and more hilly parts of this area are better suited for peach growing than the lower areas. The development of the peach growing industry is seriously hindered by lack of railroad facilities. Peaches can not be hauled more than 3 or 4 miles over these country roads without being injured.

The Cuban filler tobacco, which has been grown successfully in other sections of Texas, can be grown on the Orangeburg fine sandy loam and would prove a very profitable crop and one which can be hauled long distances to railroads without danger of injury.

The Susquehanna fine sandy loam probably finds its best use, under present conditions, in general farming. It is not especially adapted to peaches, although they may be grown on the higher areas. The capacity of this soil to produce hay, peanuts, etc., should be more carefully tested.

The growing of alfalfa is one of the possibilities of the Henderson area. The Orangeburg fine sandy loam, Orangeburg fine sand, and the better drained areas of the Norfolk fine sandy loam, and possibly the Caddo fine sandy loam should grow this crop, if the seed bed were carefully prepared and the seed inoculated.[a] There are many small areas along the smaller streams where the channel is 5 or 6 feet below the level of the bottoms and the latter have a perceptible slope toward the streams. These areas would make fine alfalfa fields. Aside from this crop there are many other grasses and leguminous

[a] See Farmers' Bulletin No. 240, U. S. Dept. Agr., Inoculation of Legumes.

crops which might be grown in this area with a profit. Among these are redtop, alsike clover, orchard grass, and Japan clover on the Lufkin clay and other wet soils; sand and winter vetch and peanuts on the more sandy soils; and fall oats and Bermuda grass on the other soils. A considerable quantity of hay is shipped into the area, so the growing of hay for the home market should prove profitable.

The growing season is about 240 days and a succession of forage crops can be grown so as to provide pasture for stock nearly all the year, and, under any circumstances, animals require special feeding only when finishing the fattening process and for a few days during severe cold weather. These conditions would seem to favor the extension of the live-stock industry.

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457–3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers. If you believe you experienced discrimination when obtaining services from USDA, participating in a USDA program, or participating in a program that receives financial assistance from USDA, you may file a complaint with USDA. Information about how to file a discrimination complaint is available from the Office of the Assistant Secretary for Civil Rights. USDA prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex (including gender identity and expression), marital status, familial status, parental status, religion, sexual orientation, political beliefs, genetic information, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.)

To file a complaint of discrimination, complete, sign, and mail a program discrimination complaint form, available at any USDA office location or online at www.ascr.usda.gov, or write to:

USDA
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, S.W.
Washington, DC 20250-9410

Or call toll free at (866) 632-9992 (voice) to obtain additional information, the appropriate office or to request documents. Individuals who are deaf, hard of hearing, or have speech disabilities may contact USDA through the Federal Relay service at (800) 877-8339 or (800) 845-6136 (in Spanish). USDA is an equal opportunity provider, employer, and lender.

Persons with disabilities who require alternative means for communication of program information (e.g., Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).