SOIL SURVEY OF

Gillespie County, Texas

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station

Major fieldwork for this soil survey was done in the period 1960–68. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Gillespie County Soil and Water Conservation District.

Copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Gillespie County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the range site and the pasture and hayland suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability groups and range sites.

Game managers, sportsmen and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Interpretations for Town and Country Planning."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in the county may be especially interested in the section, "General Soil Map," where broad patterns of soils are described. They also may be interested in the information about the county given at the beginning of the publication and in the section "Additional Facts About the County."

Cover: **Deer grazing on Keese-Rock outcrop complex, 1 to 8 percent slopes.**

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SOIL SURVEY OF GILLESPIE COUNTY, TEXAS

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SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

GILLESPIE COUNTY is in southwest-central Texas in the Edwards Plateau and the Texas Central Basin Land Resource Areas (fig. 1). It is bordered on the east

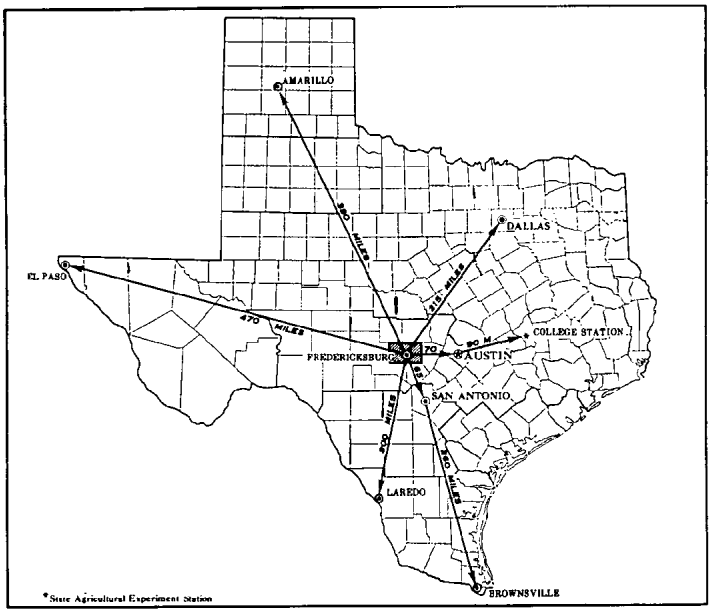

Figure 1.—Location of Gillespie County in Texas.

by Blanco County; on the north by Llano and Mason Counties; on the west by Kimble County; and on the south by Kerr and Kendall Counties.

The total area of the county is 1,055 square miles, or 675,200 acres. The county is rectangular. It is about 46 miles from east to west and 26 miles from north to south.

The average annual precipitation is approximately 27 inches. The greatest amount of rain falls during the months of April, May, June, and September.

Gillespie County has about 573,000 acres of grazing land, 92,000 acres of cropland, and 10,200 acres of nonagricultural land.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Gillespie County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*6*).[1]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Doss and Pedernales, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slopes, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Luckenbach clay loam, 1 to 3 percent slopes, is one of several phases within the Luckenbach series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

[1] Italic numbers in parentheses refer to literature cited p. 77.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three such kinds of mapping units are shown on the soil map of Gillespie County: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Keese-Rock outcrop complex, 1 to 8 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Brackett-Tarrant association, hilly, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Guadalupe and Frio soils, channeled, is an example.

In most areas surveyed, there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Granite outcrop is a land type in Gillespie County.

General Soil Map

The general soil map at the back of this survey shows the soil associations in Gillespie County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The six soil associations in Gillespie County are described in the following pages. The terms for texture used in the title for the association apply to the surface layer.

1. Tarrant-Brackett association

Very shallow to shallow, clayey to loamy, undulating to hilly soils on uplands

This association is on limestone and adobe hills. The limestone layers are more resistant to weathering than the marl and give the landscape a stairstep, or benched, appearance.

This association accounts for about 37 percent of the county. Tarrant soils make up about 70 percent of the association, and Brackett soils 15 percent. The remaining 15 percent is less extensive areas of Doss, Harper, Purves, Speck, and Topia soils and areas of gravel pits, Gullied land, and Rock outcrop.

The Tarrant soils are on the tops of the low hills. These soils have a very dark grayish brown, moderately alkaline, cobbly clay surface layer, about 6 inches thick, that is an estimated 45 percent limestone cobbles and stones. The next lower layer is dark grayish-brown, moderately alkaline cobbly clay, 6 inches thick, that is an estimated 55 percent limestone cobbles and stones. The underlying material is indurated, fractured limestone bedrock.

Brackett soils are on the lower parts of the hills. They have a light brownish-gray, moderately alkaline, loam surface layer 7 inches thick. The next layer is light yellowish-brown, moderately alkaline loam about 7 inches thick. Below this is pale-brown, moderately alkaline loam that extends to a depth of 50 inches. An estimated 50 percent, by volume, of this alkaline layer is soft calcium carbonate and thin layers of fractured limestone.

This association is used for range and wildlife habitat. Gypsum is mined in the Tarrant part of this association.

2. Purves-Speck association

Shallow, clayey, gently sloping and undulating soil on uplands

This association is made up of gently sloping to undulating soils in the western part of the county. It accounts for about 20 percent of the county. Purves soils make up about 48 percent of the association; Speck soils about 31 percent; and less extensive areas of Denton, Doss, Lindy, Tarrant, and Topia soils the remaining 21 percent.

The Purves soils are on convex knolls and hillsides. From 5 to 10 percent of their surface is covered with coarse limestone fragments. They have a very dark grayish brown, moderately alkaline, clay surface layer about 11 inches thick. Below this is brown, moderately alkaline cobbly clay loam, 3 inches thick. An estimated 50 percent, by volume, of this alkaline layer is angular limestone fragments. The underlying material is a bed of fractured limestone.

The Speck soils are between the knolls. They have a dark reddish-brown, neutral, clay surface layer 7 inches

thick. The next layer is reddish-brown, neutral clay that extends to a depth of 17 inches. Below this is indurated limestone.

Most of this association is in native range. A few areas of the Speck soils are cultivated.

3. *Luckenbach-Pedernales-Heatly association*

Deep, sandy to loamy, gently sloping soils on uplands and terraces

This association is made up of gently sloping soils in the eastern part of the county. It accounts for about 14 percent of the county. Luckenbach soils make up about 25 percent of the association; Pedernales soils about 21 percent; Heatly soils about 16 percent; and less extensive areas of Bastrop, Blanket, Demona, Hensley, and Tobosa soils the other 38 percent.

Luckenbach soils are in lower areas between the Pedernales and Heatly soils. They have a very dark grayish brown, mildly alkaline, clay loam surface layer about 8 inches thick. The next layer is dark-brown, mildly alkaline clay loam about 10 inches thick. The next lower layer is reddish-brown, moderately alkaline clay that extends to a depth of 30 inches. Below this is an 8-inch layer of brown, moderately alkaline clay. The underlying material is very pale brown, calcareous clay loam that extends to a depth of 80 inches. Ten percent of this calcareous layer is weakly and strongly cemented calcium carbonate concretions.

The Pedernales soils have a reddish-brown, neutral, fine sandy loam surface layer 11 inches thick. The next lower layer is red, mildly alkaline sandy clay that extends to a depth of 37 inches. Below this is 6 inches of yellowish-red, moderately alkaline sandy clay loam. The underlying material is light reddish-brown, moderately alkaline sandy clay loam that extends to a depth of 63 inches.

The Heatly soils have a yellowish-red, neutral, loamy fine sand surface layer 28 inches thick. The next lower layer is red, neutral sandy clay loam that extends to a depth of 83 inches. The underlying material, extending to a depth of 90 inches, is red, slightly acid sandy clay loam.

About half of this association is cultivated, and the other half is in range.

4. *Frio-Guadalupe association*

Deep, loamy, nearly level to gently sloping and undulating soils of bottom lands

This association is made up of soils that lie along streams and are subject to flooding. This association accounts for about 11 percent of the county. Frio soils make up about 44 percent of the association; Guadalupe soils about 25 percent; and less extensive areas of Altoga, Krum, and Lewisville soils the remaining 31 percent. This association also includes stream channels.

Frio soils are in ancient flood plains near streams and have a dark grayish-brown, moderately alkaline, silty clay loam surface layer about 7 inches thick. The next lower layer is dark grayish-brown, moderately alkaline silty clay loam 17 inches thick. Below this, and extending to a depth of 47 inches, is dark grayish-brown, moderately alkaline silty clay. The underlying material is brown, moderately alkaline silty clay that extends to a depth of 63 inches.

In most areas Guadalupe soils are adjacent to the stream channels. They have a brown, moderately alkaline loam surface layer 7 inches thick. The next lower layer is brown, moderately alkaline fine sandy loam 10 inches thick. Below this is 14 inches of brown, moderately alkaline loam. The next lower layer is brown, moderately alkaline fine sandy loam 6 inches thick. The underlying material is brown, calcareous, moderately alkaline loamy sand.

About half of this association is cultivated, and the other half is in range.

5. *Doss-Denton association*

Shallow to moderately deep, clayey, gently sloping soils on uplands

This association makes up about 9 percent of the county. Doss soils account for about 55 percent of the association; Denton soils about 37 percent; and less extensive areas of Brackett, Krum, and Purves soils the remaining 8 percent.

Doss soils are on the slightly higher parts of the landscape and have a dark grayish-brown, moderately alkaline, silty clay surface layer about 8 inches thick. The next lower layer is brown, moderately alkaline silty clay about 11 inches thick. The underlying material is very pale brown, weakly cemented limestone.

Denton soils are in lower areas than Doss soils and have a dark grayish-brown, calcareous, moderately alkaline, silty clay surface layer 19 inches thick. The next lower layer is light yellowish-brown, calcareous, moderately alkaline silty clay 19 inches thick. The underlying material is strongly cemented limestone.

This association is in range and crops.

6. *Ligon-Keese-Eckert association*

Shallow, loamy, gently sloping and gently undulating to hilly soils on uplands

This association accounts for about 9 percent of the county. Ligon soils make up about 14 percent of the association, Keese soils about 13 percent, and Eckert soils about 9 percent. Rock outcrop make up another 9 percent; and less extensive areas of Bonti, Castell, Click, Cobb, Katemcy, Nebgen, Oben, Renick, and Vashti soils and Granite outcrop the other 55 percent.

Ligon soils have a reddish-brown, neutral, clay loam surface layer about 4 inches thick. The next lower layer is red, neutral clay loam 13 inches thick. The underlying material is soft, dark-colored schist.

Keese soils are yellowish-brown, medium acid gravelly sandy loam 19 inches thick. The underlying material is granite.

Eckert soils have a dark-brown, moderately alkaline silt loam surface layer about 12 inches thick. The underlying material is indurated, fractured limestone.

Most of this association is best suited to range and wildlife habitat, but a few small areas are cultivated. Serpentine is mined from some areas of this association.

Descriptions of the Soils

This section describes the soil series and mapping units in Gillespie County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for dry soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Gullied land for example, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, range site, and pasture and hayland group in which the mapping unit has been placed. Absence of such classification means that the soil is not used for the specific purpose. The page for the description of each range site or pasture and hayland suitability group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Altoga silty clay, 3 to 5 percent slopes	620	0.1	Krum silty clay, 3 to 5 percent slopes	10,880	1.6
Bastrop fine sandy loam, 1 to 3 percent slopes	600	.1	Lewisville clay loam, 0 to 1 percent slopes	4,510	.7
Bastrop loamy fine sand, 1 to 5 percent slopes	6,490	1.0	Lewisville clay loam, 1 to 3 percent slopes	3,230	.5
Blanket clay loam	3,470	.5	Lewisville clay loam, 3 to 5 percent slopes	900	.1
Bonti loamy sand, 3 to 5 percent slopes	990	.1	Ligon clay loam, 1 to 5 percent slopes	770	.1
Brackett soils, undulating	13,390	2.0	Ligon soils, undulating	8,400	1.2
Brackett soils, hilly	14,960	2.2	Lindy cobbly clay loam, 1 to 8 percent slopes	6,140	.9
Brackett-Tarrant association, hilly	22,320	3.3	Luckenbach clay loam, 1 to 3 percent slopes	21,500	3.4
Castell gravelly sandy loam, 1 to 5 percent slopes	3,400	.5	Luckenbach clay loam, 3 to 5 percent slopes	4,120	.6
Click gravelly sandy loam, 1 to 8 percent slopes	1,960	.3	Luckenbach clay loam, 2 to 5 percent slopes, eroded	870	.1
Cobb fine sandy loam, 1 to 5 percent slopes	1,650	.2	Nebgen-Rock outcrop complex, 1 to 8 percent slopes	1,110	.2
Demona fine sand, 1 to 5 percent slopes	3,330	.5	Nebegen-Rock outcrop complex, 8 to 20 percent slopes	3,730	.6
Denton silty clay, 1 to 3 percent slopes	12,940	1.9	Oben fine sandy loam, 1 to 3 percent slopes	410	.1
Denton silty clay, 3 to 5 percent slopes	11,400	1.7	Oben stony fine sandy loam, 2 to 5 percent slopes	3,600	.5
Denton silty clay, 3 to 5 percent slopes, eroded	1,760	.3	Pedernales fine sandy loam, 1 to 3 percent slopes	12,620	1.9
Doss silty clay, 1 to 5 percent slopes	29,400	4.3	Pedernales fine sandy loam, 3 to 5 percent slopes	7,980	1.2
Doss soils, 1 to 5 percent slopes, eroded	6,790	1.0	Purves soils, undulating	77,520	11.4
Eckert stony soils, rolling	5,950	.9	Renick stony clay loam, 5 to 12 percent slopes	760	.1
Frio silty clay loam	25,220	3.7	Speck gravelly clay, 1 to 4 percent slopes	3,110	.5
Granite outcrop	2,860	.4	Speck stony clay, 1 to 8 percent slopes	47,190	7.0
Guadalupe loam	4,240	.6	Tarrant soils, undulating	151,300	22.3
Guadalupe and Frio soils, channeled	24,190	3.6	Tarrant-Rock outcrop association, steep	42,450	6.3
Gullied land	1,370	.2	Tobosa clay	2,380	.4
Harper stony clay and Rock outcrop, 1 to 8 percent slopes	1,790	.3	Topia clay, 1 to 3 percent slopes	2,460	.4
Heatly loamy fine sand	17,930	2.6	Topia clay, 3 to 5 percent slopes	1,080	.2
Hensley loam, 3 to 8 percent slopes	10,870	1.6	Vashti loamy fine sand, 1 to 5 percent slopes	1,020	.2
Hensley soils, 1 to 3 percent slopes	2,940	.4	Vashti fine sandy loam, 1 to 3 percent slopes	380	.1
Katemcy clay loam, 1 to 5 percent slopes	3,030	.4			
Keese-Rock outcrop complex, 1 to 8 percent slopes	7,100	1.0	Total	675,200	100.0
Keese-Rock outcrop complex, 8 to 20 percent slopes	8,790	1.3			
Krum silty clay, 1 to 3 percent slopes	3,030	.4			

Altoga Series

The Altoga series consists of deep soils on uplands. These soils formed in calcareous clayey and loamy sediment several feet thick. They are on old high terraces adjacent to the flood plain, and soil surfaces are smooth and plane to convex.

In a representative profile, the surface layer is yellowish-brown silty clay about 7 inches thick. The next layer, extending to a depth of 47 inches, is very pale brown, calcareous silty clay intermixed with much calcium carbonate. Below a depth of 47 inches is very pale brown, hard, calcareous silty clay loam.

Altoga soils are used mostly for crops. They are well drained, and their permeability is moderate. Runoff is medium.

Representative profile of Altoga silty clay, 3 to 5 percent slopes, 8.5 miles southwest of the courthouse in Fredericksburg by way of Texas Highway 16, then west 0.3 mile in a cultivated field.

Ap—0 to 7 inches, yellowish-brown (10YR 5/4) silty clay, dark yellowish brown (10YR 4/4) moist; moderate, fine, subangular blocky structure; hard, firm, sticky; common fine and few medium roots; few medium tubes; estimated 5 to 10 percent, by volume, angular calcium carbonate fragments as much as 0.5 inch in diameter; calcareous; moderately alkaline; clear, smooth boundary.

B2—7 to 26 inches, very pale brown (10YR 7/4) silty clay, light yellowish brown (10YR 6/4) moist; weak, medium, subangular blocky structure; hard, firm, sticky; estimated 25 percent, by volume, soft and cemented masses of calcium carbonate; many medium threads of calcium carbonate; few medium insect casts and burrows; calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—26 to 47 inches, very pale brown (10YR 7/4) silty clay, yellowish brown (10YR 5/4) moist; weak, medium, subangular blocky structure; hard, firm, sticky; an estimated 35 percent, by volume, soft and cemented masses of calcium carbonate; many threads and films of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—47 to 63 inches, very pale brown (10YR 8/4) silty clay loam, very pale brown (10YR 7/4) moist; massive; hard, firm, slightly sticky; common fine calcium carbonate masses and threads, but less lime than in B3ca horizon; calcareous; moderately alkaline.

The A horizon ranges from yellowish brown to brown in color and from 5 to 9 inches in thickness. The B horizon ranges from very pale brown to light yellowish brown or yellowish brown in color. The B2 horizon is 17 to 23 inches thick, and the B3ca horizon is 15 to 25 inches thick.

The C horizon is very pale brown or pale brown in color. This horizon is 5 to 35 percent, by volume, soft masses and cemented concretions of calcium carbonate.

The clay content, between depths of 10 and 40 inches, ranges from 35 to 50 percent, but the noncarbonatic clay is less than 40 percent. The solum is 37 to 57 inches thick.

Altoga silty clay, 3 to 5 percent slopes (AlC).—This gently sloping soil is on uplands near major streams. Soil areas are long, narrow, and curved and from 5 to 55 acres in size.

Included with this soil in mapping are small areas of Brackett, Frio, and Lewisville soils. These included areas are mostly 0.5 to 3 acres in size.

This Altoga silty clay is suited to crops. Most of the acreage is cultivated, but some is used for range. The main crops are grain sorghum and small grain. The high lime content causes chlorosis, or a yellowing of the leaves of some plants.

Conserving moisture and maintaining tilth are important where this soil is cultivated. Water erosion is a high hazard. Terraces and contour farming help to control water erosion and conserve moisture. Crop residue kept on the surface helps maintain soil tilth and control erosion. Capability unit IIIe-8; Deep Upland range site; pasture and hayland suitability group 7C.

Bastrop Series

The Bastrop series consists of deep, noncalcareous soils that formed in loamy sediments. These gently sloping soils are on uplands and have plane to convex slopes.

In a representative profile, the surface layer is fine sandy loam about 15 inches thick. It is pale brown in the upper part and brown in the lower part. The next layer is neutral, firm sandy clay loam that extends to a depth of 71 inches. The upper part is reddish brown and the lower part is yellowish red. Below this is light-brown, calcareous sandy clay loam extending to a depth of 80 inches (fig. 2).

Figure 2.—**Profile of Bastrop fine sandy loam, 1 to 3 percent slopes.**

Bastrop soils are used for crops and range. They are well drained, and their permeability is moderate. Runoff is medium.

Representative profile of Bastrop fine sandy loam, 1 to 3 percent slopes, 10 miles south and east of the courthouse in Fredericksburg, on U.S. Highway 290; then 0.5 mile north on Jung Lane, and 2 miles east on a private road to the site in a cultivated field.

Ap—0 to 7 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak, fine, granular structure; hard, friable; few fine roots; slightly acid; abrupt, smooth boundary.

A1—7 to 15 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; hard, firm; slightly acid; gradual, smooth boundary.

B21t—15 to 37 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak, fine, subangular blocky structure; hard, firm, slightly sticky; few thin clay films; neutral; gradual, smooth boundary.

B22t—37 to 71 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate, fine, subangular blocky structure; hard, firm, sticky; few thin clay films; neutral; gradual, smooth boundary.

C—71 to 80 inches, light-brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; massive; hard, firm, sticky; calcareous; moderately alkaline.

The A horizon ranges from 13 to 18 inches in thickness; from reddish brown to grayish brown, brown, or pale brown in color; and from fine sandy loam to loamy fine sand in texture.

The Bt horizon ranges from 50 to 61 inches in thickness and from red to reddish brown or yellowish red in color. This horizon is sandy clay loam that is from 20 to 30 percent clay.

The C horizon is light reddish-brown, reddish-yellow, or light-brown loam to sandy clay loam. The solum is 63 to 79 inches thick.

Bastrop fine sandy loam, 1 to 3 percent slopes (BfB).—This gently sloping soil has plane to convex slopes and is mostly near major streams. Soil areas are long and narrow and 5 to 45 acres in size.

This soil has the profile described as representative for the Bastrop series.

Included with this soil in mapping are areas of Pedernales soils, most of which are 1 to 4 acres in size.

This Bastrop fine sandy loam is suited to crops. Most of the acreage is cultivated, but some is used for range. The main crops are grain sorghum and small grain.

Water erosion is a moderate hazard on this soil. Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIe–1; Sandy Loam range site; pasture and hayland suitability group 8C.

Bastrop loamy fine sand, 1 to 5 percent slopes (BaC).—This gently sloping soil has plane to convex slopes and is in irregular areas 5 to 55 acres in size.

The surface layer is brown loamy fine sand about 18 inches thick. The next layer is firm sandy clay loam that extends to a depth of 71 inches. It is red to a depth of 52 inches and yellowish red below. Below 71 inches is reddish-yellow loam.

Included with this soil in mapping are areas of Demona, Heatly, and Vashti soils. These inclusions are mostly 0.3 to 6 acres in size.

This soil is suited to crops. Most of the acreage is cultivated but some is in range. The main crops are grain sorghum, small grain, and peaches. Soil blowing and water erosion are high hazards on this soil.

Crops that produce large amounts of residue are needed. They should be planted in closely spaced rows to help control soil blowing and water erosion. Capability unit IIIe–7; Sandy range site; pasture and hayland suitability group 9A.

Blanket Series

The Blanket series consists of deep, noncalcareous soils on ancient upland terraces. These soils have plane to concave slopes. They formed in ancient, calcareous stream alluvium or interbedded marls and calcareous clays.

In a representative profile, the surface layer is dark-brown clay loam about 5 inches thick. The next lower layer is clay about 37 inches thick. It is dark brown in the upper 11 inches and reddish brown in the lower 26 inches. Below this, and extending to a depth of 80 inches, is very pale brown clay loam.

Blanket soils are used mostly for crops. They are well drained and moderately slowly permeable. Runoff is slow.

Representative profile of Blanket clay loam, 3.2 miles east of the courthouse in Fredericksburg by U.S. Highway 290, then 2.3 miles south on the Old San Antonio Road (a county road), and 60 feet east in a cultivated field.

Ap—0 to 5 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak, fine, subangular blocky structure; hard, firm, slightly sticky and plastic; neutral; abrupt, smooth boundary.

B21t—5 to 16 inches, dark-brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; mildly alkaline; gradual, smooth boundary.

B22t—16 to 30 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; strong, fine, blocky structure; hard, firm, sticky and plastic; mildly alkaline; gradual, smooth boundary.

B3—30 to 42 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; 3 to 5 percent soft lumps and hard concretions of calcium carbonate that are less than 1 inch in diameter; calcareous; moderately alkaline; clear, smooth boundary.

C—42 to 80 inches, very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; massive; hard, firm, sticky; 5 to 10 percent soft lumps and hard concretions of calcium carbonate.

The A horizon ranges from dark brown to very dark grayish brown in color and from 5 to 12 inches in thickness. The B horizon ranges from dark reddish brown or reddish brown to dark brown or very dark grayish brown in color. The Bt horizon is 25 to 34 inches thick, and the B3 horizon is 12 to 20 inches thick. Secondary carbonates are at depths of from 28 to 36 inches.

The solum is 42 to 66 inches thick.

The C horizon is very pale brown to light yellowish brown.

Blanket clay loam (Bk).—This nearly level soil is on smooth uplands in irregular areas 5 to 515 acres in size. Slopes are less than 1 percent.

Included with this soil in mapping are areas of Hensley and Pedernales soils that are mostly 0.2 to 3 acres in size.

Most of this Blanket clay loam is well suited to cultivation. The main crops grown are small grain and grain

sorghum. Contour farming and crop residues kept on the surface help to control water erosion, to conserve moisture, and to maintain tilth. Capability unit IIc–1; Deep Upland range site; pasture and hayland suitability group 7C.

Bonti Series

The Bonti series consists of moderately deep, noncalcareous soils on upland ridgetops. Slopes are plane to convex. These gently sloping soils formed in acid, sandy to clayey materials.

In a representative profile, the surface layer is brown loamy sand about 10 inches thick. The next layer, extending to a depth of 36 inches, is red gravelly clay. This layer contains waterworn, rounded igneous pebbles. Below a depth of 36 inches is indurated sandstone.

Bonti soils are used mostly for range. They are well drained, and their permeability is moderately slow. Runoff is rapid.

Representative profile of Bonti loamy sand, 3 to 5 percent slopes, 1.7 miles north of Doss, by Ranch Road 783, then 0.2 mile west in range.

A1—0 to 10 inches, brown (7.5YR 5/2) loamy sand, dark brown (7.5YR 3/2) moist; weak, medium, granular structure; hard, friable, slightly sticky; common fine and medium roots; an estimated 5 to 10 percent, by volume, rounded igneous pebbles; slightly acid; clear, smooth boundary.

B2t—10 to 36 inches, red (2.5YR 5/6) gravelly clay, red (2.5YR 4/6) moist; moderate, fine and medium, blocky structure; hard, firm, sticky and plastic; few fine roots and tubes; estimated 25 to 30 percent, by volume, waterworn, rounded igneous pebbles from 0.25 to 1.5 inches in diameter; medium acid; abrupt, smooth boundary.

R—36 to 38 inches, bed of indurated sandstone.

The A horizon ranges from brown to yellowish brown in color and from 4 to 10 inches in thickness.

The Bt horizon ranges from red to yellowish red in color and from 16 to 28 inches in thickness. This horizon is medium acid to strongly acid in reaction. It is from 10 to 30 percent, by volume, waterworn gravel 0.25 inch to 1.5 inches in diameter.

The solum is 20 to 38 inches thick.

Bonti loamy sand, 3 to 5 percent slopes (BoC).—This gently sloping soil is on smooth, convex ridgetops in the uplands. The areas are 40 to 640 acres in size.

Included with this soil in mapping are areas of Heatly soils that are mostly 0.6 to 1.5 acres in size.

This Bonti loamy sand is mostly in range. A few areas are cultivated. Water erosion is a high hazard.

Where this soil is cultivated, contour farming helps control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIIe–6; Sandy range site; pasture and hayland suitability group 9A.

Brackett Series

The Brackett series consists of shallow, calcareous soils on uplands. These soils are undulating to hilly. They formed in interbedded soft limestone and marly earth (fig. 3).

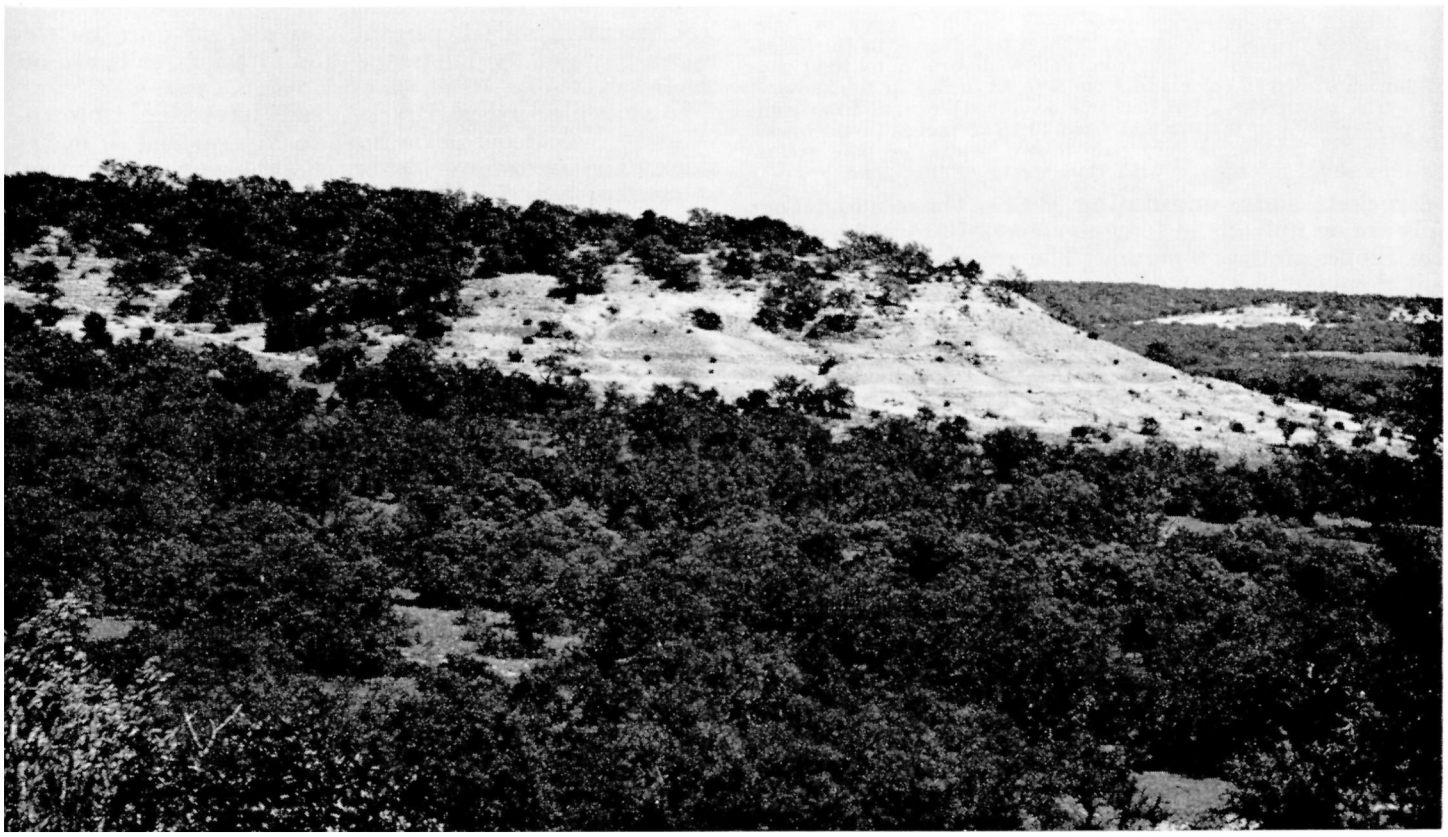

Figure 3.—An area of Brackett loam.

In a representative profile, the surface layer is about 7 inches thick, and is light brownish-gray loam. The next lower layer is about 7 inches of light yellowish-brown loam. The underlying material, extending to a depth of 50 inches, is pale-yellow, calcareous loam that is about 50 percent, by volume, soft masses of calcium carbonate intermixed with thin layers of fractured limestone.

Brackett soils are used mostly for range. They are well drained, and their permeability is moderately slow. Runoff is rapid.

Representative profile of Brackett loam, in an area of Brackett soils, undulating, 7.1 miles northeast of Fredericksburg on Ranch Road 1631, then 20 feet west in range.

A1—0 to 7 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; moderate, fine and medium, subangular blocky and granular structure; hard, firm, slightly sticky; many fine and medium roots; few fine and medium limestone fragments from 1 to 6 inches across the long axis; calcareous; moderately alkaline; clear, smooth boundary.

B2—7 to 14 inches, light yellowish-brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; moderate, fine, subangular blocky and granular structure; hard, firm, slightly sticky; common fine roots; common limestone fragments from 1 to 6 inches across the long axis; calcareous; moderately alkaline; clear, smooth boundary.

C—14 to 50 inches, pale-yellow (2.5Y 7/4) loam, light olive brown (2.5Y 5/4) moist; massive; estimated 50 percent, by volume, soft calcium carbonate intermixed with thin layers of fractured limestone; calcareous; moderately alkaline.

The A horizon ranges from light brownish gray to light yellowish brown in color and from 4 to 8 inches in thickness.

The B horizon ranges from yellowish brown to light yellowish brown in color and from 6 to 12 inches in thickness.

The solum (A and B horizons combined) ranges from loam to clay loam in texture and from 10 to 20 inches in thickness.

The C horizon is very pale brown, white, or pale yellow limy earth intermixed with thin strata of limestone.

Brackett soils, undulating (BrC).—These undulating soils are on uplands in irregular areas 10 to 245 acres in size. Slopes are 1 to 8 percent. The areas of this mapping unit dominantly are much larger and their composition more variable than for most other mapping units in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

These soils have the profile described as representative for the Brackett series, but texture of the surface layer ranges from loam to clay loam. Included with these soils in mapping are less extensive areas of Doss, Tarrant, and Topia soils. These included areas are mostly 2 to 10 acres in size and account for less than 15 percent of the acreage.

These Brackett soils are used mostly for range. Water erosion is a high hazard. Capability unit VIs–1, Adobe range site; not placed in a pasture and hayland suitability group.

Brackett soils, hilly (BrE).—These hilly soils are on uplands in irregular areas 15 to 200 acres in size. Slopes range from 10 to 20 percent. The landscape has a stairstep, or benched, appearance because the limestone layers are more resistant to weathering and erosion than the marl.

The areas of this mapping unit dominantly are much larger and their composition is more variable than for most other mapping units in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

The surface layer is light yellowish-brown, calcareous loam about 6 inches thick. The next lower layer is light yellowish-brown, calcareous loam about 6 inches thick. Below a depth of 12 inches is pale-yellow, calcareous loam.

Included with these soils in mapping are areas of Tarrant soils from 8 to 17 acres in size and a few areas of Brackett soils that have slopes of 8 to 10 percent. All inclusions amount to less than 15 percent of the acreage.

These Brackett soils, hilly, are used for range and are not suited to cultivation. The hazard of erosion is high. A good cover of growing plants helps control erosion. Capability unit VIIs–3; Steep Adobe range site; not placed in a pasture and hayland suitability group.

Brackett-Tarrant association, hilly (BtE).—The hilly soils of this mapping unit are on uplands. Mapped areas are long and narrow and 20 to 860 acres in size. Slopes range from 10 to 20 percent.

The areas of this mapping unit dominantly are much larger and their composition more variable than for most other mapping units in the county. Mapping is controlled well enough, however, for the anticipated use of the soils.

The landscape has a stairstep, or benched, appearance because the limestone outcrops are more resistant to weathering than the marl.

Brackett soils account for about 65 percent of this mapping unit, Tarrant soils about 30 percent, and other less extensive soils 5 percent. Tarrant soils are on the upper parts of the landscape, and Brackett soils are on the lower.

In most places these Brackett soils have a light brownish-gray, calcareous loam surface layer about 7 inches thick. The next lower layer is light yellowish-brown, calcareous loam 7 inches thick. Below this, and extending to a depth of 50 inches, is very pale brown, calcareous loam that is 50 percent, by volume, soft calcium carbonate concretions and thin layers of limestone.

These Tarrant soils have a very dark grayish brown, calcareous cobbly clay surface layer that is about 40 percent limestone fragments. This layer is about 7 inches thick. Below this is dark-brown, calcareous cobbly clay, about 5 inches thick, that is about 50 percent limestone fragments. The underlying material is indurated, fractured limestone.

These soils occur in regular patterns in the landscape and could be separated. Use and management, however, are similar, and separation is not justified.

Included in this mapping unit are areas of Purves soils and rock outcrop 0.5 to 3 acres in size, as well as areas of Brackett and Tarrant soils that have slopes of 8 to 10 percent.

All of this mapping unit is used for range. The hazard of erosion is reduced when a good cover of growing plants is maintained. Brackett soils in capability unit VIIs–3; Tarrant soils in capability unit VIIs–1; Brackett soils in Steep Adobe range site; Tarrant soils in Steep Rocky range site; not placed in a pasture and hayland suitability group.

Castell Series

The Castell series consists of moderately deep, slightly acid soils on uplands. These soils formed in a loamy to clayey mantle that overlies gneiss.

In a representative profile, the surface layer is reddish-brown, slightly acid gravelly sandy loam about 17 inches thick. The next layer, extending to a depth of 32 inches, is yellowish-red, slightly acid gravelly clay that contains feldspar fragments. Below this is a 6-inch layer of light olive-brown, slightly acid very gravelly clay containing saprolite. Below a depth of 38 inches is indurated gneiss.

Castell soils are used for crops and range. These soils are well drained, and their permeability is slow. Runoff is medium.

Representative profile of Castell gravelly sandy loam, 1 to 5 percent slopes, 13.2 miles north of Fredericksburg on Ranch Road 965, then 1 mile west along a county road, and 1.6 miles north in range.

A11—0 to 12 inches, reddish-brown (5YR 5/4) gravelly sandy loam, reddish brown (5YR 4/4) moist; weak, fine, granular structure; very hard, friable; common fine and medium roots; an estimated 10 to 15 percent, by volume, feldspar fragments from 0.25 to 0.5 inch in diameter; slightly acid; gradual, smooth boundary.

A12—12 to 17 inches, reddish-brown (5YR 4/4) gravelly sandy loam, reddish brown (5YR 4/4) moist; weak, fine, granular structure; very hard, friable; few fine roots; an estimated 25 to 35 percent, by volume, feldspar fragments from 0.25 to 0.5 inch in diameter; slightly acid; abrupt, smooth boundary.

B2t—17 to 32 inches, yellowish-red (5YR 4/6) gravelly clay, yellowish red (5YR 4/6) moist; distinct, prominent, yellowish-brown mottles; moderate, medium, subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; clay films on ped surfaces; an estimated 15 to 25 percent, by volume, feldspar fragments from 0.125 to 0.5 inch in diameter; slightly acid; clear, smooth boundary.

C—32 to 38 inches, light olive-brown (2.5Y 5/4) very gravelly clay, light olive brown (2.5Y 5/4) moist; massive; cleavage planes; an estimated 60 percent, by volume, saprolite from 0.25 to 1 inch in diameter; slightly acid; abrupt, wavy boundary.

R—38 to 41 inches, indurated gneiss.

The A horizon ranges from reddish brown to brown and dark grayish brown in color and from 8 to 18 inches in thickness. The B horizon ranges from yellowish red to reddish brown and yellowish red in color and from 12 to 18 inches in thickness.

The C horizon is light olive brown and yellowish brown to reddish yellow. It is 4 to 6 inches thick and 60 to 90 percent saprolite.

The solum is 20 to 40 inches thick.

Castell gravelly sandy loam, 1 to 5 percent slopes (CaC).—This gently sloping soil is on uplands in irregular areas 10 to 95 acres in size.

Included with this soil in mapping are small areas of Click soils and a soil similar to Castell but deeper to bedrock. These inclusions account for less than 10 percent of the acreage.

This Castell gravelly sandy loam is suited to crops and range. The main crops are grain sorghum and small grain. Conserving moisture, preserving tilth, and controlling erosion are important where this soil is cultivated. Water erosion is a high hazard on this soil.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIIe–4; Sandy Loam range site; pasture and hayland suitability group 8A.

Click Series

The Click series consists of moderately deep and deep, neutral soils on uplands. These soils formed in gravelly coarse sandy loam residuum that weathered from granite. Slopes are smooth and convex.

In a representative profile, the surface layer is brown, neutral gravelly sandy loam about 14 inches thick. The next layer extends to a depth of 46 inches. It is very gravelly sandy loam that is an estimated 55 percent, by volume, feldspar gravel. The upper part is brown and slightly acid, and the lower part is light yellowish brown and medium acid. Below a depth of 46 inches is indurated granite.

Click soils are in range. These soils are somewhat excessively drained, and their permeability is rapid. Runoff is very slow.

Representative profile of Click gravelly sandy loam, 1 to 8 percent slopes, 6.2 miles east of Willow City on Ranch Road 1323, then 0.8 mile north on Althaus Road, and 200 feet east in range.

A1—0 to 14 inches, brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; very hard, friable; common fine and medium roots; an estimated 25 percent, by volume, feldspar gravel; neutral; clear, smooth boundary.

B21t—14 to 34 inches, brown (7.5YR 5/4) very gravelly sandy loam, dark brown (7.5YR 4/4) moist; weak, fine, subangular blocky and granular structure; very hard, friable, slightly sticky; few medium roots; few thin clay films in pores; an estimated 55 percent, by volume, feldspar gravel; common mica flakes; slightly acid; clear, smooth boundary.

B22t—34 to 46 inches, light yellowish-brown (10YR 6/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; very hard, friable; slightly sticky; few clay films along cleavage planes; an estimated 55 percent, by volume, feldspar gravel; common mica flakes; medium acid; abrupt, wavy boundary.

R—46 to 50 inches, indurated granite.

The A horizon ranges from brown to yellowish brown in color and from 8 to 16 inches in thickness. This horizon is an estimated 20 to 30 percent, by volume, feldspar gravel.

The Bt horizon ranges from brown, light brown, or light yellowish brown to light reddish brown in color and from 30 to 40 inches in thickness. It is an estimated 35 to 60 percent, by volume, feldspar gravel.

The solum is 38 to 56 inches thick.

Click gravelly sandy loam, 1 to 8 percent slopes (ClD).—This gently undulating to gently rolling soil is in irregular areas 15 to 290 acres in size. A few granite boulders and outcrops are scattered over the landscape.

Included with this soil in mapping are areas of Castell, Katemcy, and Keese soils. These inclusions are mostly 0.5 to 4 acres in size and make up less than 15 percent of the acreage.

This Click gravelly sandy loam is unsuited to cultivation. Most of the acreage is in range, and a few small areas are in improved pasture. Water erosion is a high hazard on this soil. Capability unit VIs–3; Granite Gravel range site; pasture and hayland suitability group 8C.

Cobb Series

The Cobb series consists of moderately deep and deep, slightly acid soils on uplands. These soils formed in residuum from medium-grained sandstone. Slopes are smooth and plane to concave.

In a representative profile, the surface layer is brown fine sandy loam about 10 inches thick. The next layer, extending to a depth of 36 inches, is reddish-brown, friable sandy clay loam. Below a depth of 36 inches is red, weakly cemented sandstone.

Cobb soils are used mostly for range, but a few small areas are cultivated. These soils are well drained, and their permeability is moderate. Runoff is slow to rapid.

Representative profile of Cobb fine sandy loam, 1 to 5 percent slopes, 18.5 miles northeast of Fredericksburg by way of Texas Highway 16, then 1.3 miles east on Coal Creek Road, and 600 feet north in pasture.

A1—0 to 10 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak, fine, granular structure; soft, friable, slightly sticky; slightly acid; smooth, gradual boundary.

B2t—10 to 36 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak, fine, subangular blocky structure; soft, friable, slightly sticky; slightly acid; abrupt, wavy boundary.

C—36 to 40 inches, red, weakly cemented sandstone.

The A horizon ranges from reddish brown to brown in color and from 8 to 12 inches in thickness. The B2t horizon is reddish brown in color and ranges from 18 to 36 inches in thickness. The C horizon is reddish. The solum is 26 to 48 inches thick.

Cobb fine sandy loam, 1 to 5 percent slopes (CoC).—This gently sloping soil is on uplands in oval areas 10 to 420 acres in size. Slopes are 1 to 5 percent.

Included with this soil in mapping are areas of Oben and Nebgen soils that are mostly 2 to 4 acres in size. Also included are a few areas of soils that have sandstone at depths greater than 48 inches. All inclusions make up less than 15 percent of the acreage.

Most of this Cobb fine sandy loam is in range, but some areas are suited to cultivation of small grain.

The water erosion hazard is high on these soils. Terraces and contour farming help to control water erosion and to conserve moisture. Crop residues kept on the surface help maintain tilth and control erosion. Capability unit IIIe–4; Sandy Loam range site; pasture and hayland suitability group 8C.

Demona Series

The Demona series consists of deep, noncalcareous soils on uplands. These soils formed in loamy and sandy materials. Slopes are smooth to concave.

In a representative profile, the surface layer is light-brown, neutral fine sand about 12 inches thick. The next layer, extending to a depth of 26 inches, is very pale brown, slightly acid fine sand. The next lower layer is medium acid sandy clay that extends to a depth of 56 inches. It is light gray in the upper part and light brownish gray in the lower part. The underlying material is pale-yellow, medium acid sandy clay loam that extends to a depth of 63 inches.

Demona soils are used for crops and range. These soils are moderately well drained, and their permeability is moderately slow. Runoff is slow to medium.

Representative profile of Demona fine sand, 1 to 5 percent slopes, 1.6 miles east of Stonewall on U.S. Highway 290, then 0.1 mile north in an abandoned field.

Ap—0 to 12 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grain; loose, nonsticky; common fine and medium roots, tubes, and pores; neutral; clear, smooth boundary.

A2—12 to 26 inches, very pale brown (10YR 7/4) fine sand, yellowish brown (10YR 5/4) moist; single grain; loose, nonsticky; few fine and medium roots; common fine tubes and pores; slightly acid; abrupt, smooth boundary.

B21t—26 to 47 inches, light-gray (10YR 7/2) sandy clay, grayish brown (10YR 5/2) moist; few, fine, distinct mottles of pale yellow; moderate, fine and medium, subangular blocky structure; few fine roots and tubes; few, white, noncalcareous threads; medium acid; gradual, smooth boundary.

B22t—47 to 56 inches, light brownish-gray (10YR 6/2) sandy clay, grayish brown (10YR 5/2) moist; common, medium, distinct mottles of olive yellow; moderate, fine and medium, subangular blocky structure; extremely hard, firm, very sticky; few fine tubes and pores; medium acid; gradual, smooth boundary.

C—56 to 63 inches, pale-yellow (5Y 7/3) sandy clay loam, pale olive (5Y 6/3) moist; few, fine, distinct mottles of light yellowish brown; massive; hard, firm, sticky; medium acid.

The A horizon ranges from light brown, brown, or grayish brown to very pale brown. The Ap horizon ranges from 10 to 14 inches in thickness, and the A2 horizon ranges from 10 to 16 inches.

The Bt horizon ranges from light gray or reddish yellow to light brownish gray in color and from 30 to 37 inches in thickness. The C horizon is pale yellow to pale olive.

The solum is 50 to 67 inches thick.

Demona fine sand, 1 to 5 percent slopes (DeC).—This gently sloping soil is on uplands that have mixed convex and concave surfaces. Soil areas are long and narrow and 10 to 220 acres in size.

Included with this soil in mapping are areas of Heatly and Vashti soils. These inclusions are mostly 2 to 5 acres in size and account for less than 10 percent of the acreage.

This soil is suited to cultivation and range. The main crops are small grain and improved pasture. Controlling soil blowing, conserving moisture, and maintaining tilth are the main considerations where this soil is cultivated. The soil-blowing hazard is high. A temporary water table is perched on the clayey layer below the surface after heavy rains.

Contour farming helps control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control soil blowing. Capability unit IIIe–7; Sandy range site; pasture and hayland suitability group 9A.

Denton Series

The Denton series consists of moderately deep, gently sloping, calcareous soils on uplands. These soils formed in a mantle of calcareous clayey material that overlies weakly cemented to indurated limestone. Slopes are smooth and plane to convex.

In a representative profile, the surface layer is dark grayish-brown, calcareous silty clay about 19 inches thick. The next layer is light yellowish-brown, calcareous silty clay 14 inches thick. Below this is a layer of light yellowish-brown silty clay about 5 inches thick. The soil rests on strongly cemented limestone at a depth of 38 inches.

Denton soils are used mostly for crops. These soils are well drained, and their permeability is slow. Runoff is medium to rapid.

Representative profile of Denton silty clay, 1 to 3 percent slopes, 7.1 miles northeast of Fredericksburg by Ranch Road 1631, then 2.5 miles east of Ranch Road 2721, 0.65 mile north on Staudt Road, and 60 feet north in a cultivated field.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, fine and medium, granular and subangular blocky structure; hard, firm, sticky and plastic; common fine and very fine roots; few small limestone fragments; calcareous; moderately alkaline; clear, smooth boundary.

A1—7 to 19 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; common fine and few medium roots; few cracks filled with material from above; calcareous; moderately alkaline; gradual, smooth boundary.

B2ca—19 to 33 inches, light yellowish-brown (10YR 6/4) silty clay, yellowish brown (10YR 5/4) moist; moderate, medium, blocky structure; hard, firm, sticky and plastic; few angular calcium carbonate fragments 0.25 to 0.75 inch in diameter; common fine and medium films and threads of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

Cca—33 to 38 inches, light yellowish-brown (2.5Y 6/4) silty clay, light olive brown (2.5Y 5/4) moist; massive; hard, firm, sticky; medium threads and soft masses of calcium carbonate; calcareous; moderately alkaline; abrupt, irregular boundary.

R—38 to 43 inches, strongly cemented limestone.

The A horizon ranges from dark brown to dark grayish brown in color and from 9 to 22 inches in thickness. The B horizon ranges from light yellowish brown and yellowish brown to brown in color and from 9 to 15 inches in thickness. The C horizon is light yellowish brown and light brown to light reddish brown. The Cca horizon is 4 to 6 inches thick. The solum is 22 to 40 inches thick. When dry, the soil has cracks from 0.3 to 0.5 inch in width that extend to depths of more than 20 inches from the surface.

Denton silty clay, 1 to 3 percent slopes (DnB).—This gently sloping soil is on uplands in irregular areas 5 to 130 acres in size.

This soil has the profile described as representative for the Denton series.

Included with this soil in mapping are areas of Doss and Krum soils that are mostly 0.5 to 4 acres in size. These areas make up less than 10 percent of the acreage.

Most of this Denton silty clay is cultivated, and a minor part is in range. The main crops are small grain and grain sorghum. Erosion control and maintenance of tilth are important where this soil is cultivated. Water erosion is a moderate hazard.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIe–2; Deep Upland range site; pasture and hayland suitability group 7C.

Denton silty clay, 3 to 5 percent slopes (DnC).—This gently sloping soil is on uplands in irregular areas 10 to 310 acres in size.

The surface layer is dark-brown, calcareous silty clay about 16 inches thick. The next layer is brown, calcareous silty clay about 12 inches thick. The next lower layer is light yellowish-brown, calcareous silty clay about 6 inches thick. Below a depth of 34 inches is strongly cemented limestone.

Included with this soil in mapping are areas of Doss and Krum soils. These areas are mostly 1 to 4.5 acres in size and account for less than 10 percent of the acreage.

Most of this Denton silty clay is cultivated, and some is in range. The main crops are grain sorghum and small grain. Erosion control and maintenance of tilth are important where this soil is tilled. The hazard of water erosion is high on these soils.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIIe–5; Deep Upland range site; pasture and hayland suitability group 7C.

Denton silty clay, 3 to 5 percent slopes, eroded (DnC2).—This gently sloping soil is on uplands in irregular areas 5 to 50 acres in size. This soil has gullies 50 to 150 feet apart, 2 to 5 feet wide, and 1 to 2 feet deep. Much of the surface has been removed between the gullies by erosion.

The surface layer is dark grayish-brown, calcareous silty clay about 16 inches thick. The next layer is brown, calcareous silty clay about 10 inches thick. The next lower layer is light-brown silty clay about 6 inches thick. Below a depth of 32 inches is strongly cemented limestone.

Included with this soil in mapping are small areas of Brackett and Doss soils. These areas are mostly 0.3 to 1.5 acres in size and account for less than 5 percent of the acreage.

This Denton silty clay is mostly in range, and a few small areas are in crops. The main crops are small grain and grain sorghum. Erosion control and maintenance of tilth are the main considerations where this soil is cultivated. Water erosion is a high hazard.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IVe–1; Deep Upland range site; pasture and hayland suitability group 7C.

Doss Series

The Doss series consists of shallow, calcareous soils on uplands. These soils formed in calcareous marls and weakly cemented limestone. Slopes are plane to convex.

In a representative profile, the surface layer is dark grayish-brown, calcareous silty clay about 8 inches thick. The next layer is brown, calcareous silty clay about 11 inches thick. Below this, beginning at a depth of 19 inches, is very pale brown, weakly cemented limestone (fig. 4).

Figure 4.—**Dark-colored silty clay over weakly cemented limestone in Doss silty clay.**

Doss soils are used for crops and range. They are well drained, and their permeability is moderately slow. Runoff is medium.

Representative profile of Doss silty clay, 1 to 5 percent slopes, 5.8 miles southeast of the courthouse in Fredericksburg, by U.S. Highway 290 to the intersection of Ranch Road 1376; then 4.2 miles south to intersection with Luckenbach-Grapetown road; then 2.2 miles south and west, and 0.4 mile north in pasture.

A1—0 to 8 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, fine and medium, subangular blocky structure; very hard, very firm, very sticky and plastic; many fine and medium grass roots; common fine pores; common very fine soft masses of calcium carbonate; about 3 percent weakly cemented calcium carbonate fragments about 0.25 inch across the long axis; calcareous; moderately alkaline; clear, smooth boundary.

B2ca—8 to 19 inches, brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate, fine and medium, subangular blocky structure; very hard, very firm, very sticky and plastic; common fine and few medium roots; common fine pores; common insect burrows; many, fine, soft and weakly cemented masses of calcium carbonate; few, angular, weakly cemented limestone fragments as much as 0.25 inch across the long axis; calcareous; moderately alkaline; clear, smooth boundary.

Cca—19 to 48 inches, very pale brown (10YR 8/4) weakly cemented limestone, very pale brown (10YR 7/4) moist; platy in the upper 3 inches and hardness rating of 2.5, Moh's scale; massive below and hardness rating of about 1, Moh's scale; many veins and masses of calcium carbonate; calcareous, moderately alkaline.

The A horizon ranges from dark brown and brown to dark grayish brown in color, from 7 to 12 inches in thickness, and from clay loam to silty clay in texture.

The B horizon ranges from reddish brown and brown to yellowish brown in color and from 4 to 13 inches in thickness. The calcium carbonate equivalent in the B horizon ranges from about 40 to 50 percent.

The C horizon is soft limy earth interbedded with weakly cemented limestone. The solum is 11 to 20 inches thick.

Doss silty clay, 1 to 5 percent slopes (DoC).—This gently sloping soil is on uplands in areas 15 to 300 acres in size.

This soil has the profile described as representative for the Doss series.

Included with this soil in mapping are areas of Denton and Brackett soils. These areas are mostly 0.2 to 3.5 acres in size and account for less than 10 percent of the acreage.

This soil is in crops and range. Shallowness limits the depth of plowing and the depth of cuts in terracing. Droughtiness limits the choice of crops, and drought-resistant crops should be grown. Small grain does well on this soil. Water erosion is a high hazard on this soil.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIIe-1; Shallow range site; pasture and hayland suitability group 13A.

Doss soils, 1 to 5 percent slopes, eroded (DsC2).—These gently sloping soils are on uplands in areas 5 to 150 acres in size. The surface layer ranges from clay loam to silty clay.

Mapped areas contain gullies from 25 to 200 feet apart, from 2 to 6 feet wide, and from 6 inches to a foot deep.

In a representative area, the surface layer is dark-brown, calcareous silty clay about 7 inches thick. The next layer is reddish-brown, calcareous silty clay about 8 inches thick. Below a depth of 15 inches is weakly cemented limestone.

Included with these soils in mapping are areas of Brackett and Denton soils. These areas are mostly 0.2 to 2 acres in size and account for less than 10 percent of the acreage.

These Doss soils are in crops and range. The major crop is small grain. Erosion control and improvements of tilth are the main considerations where these soils are cultivated. Water erosion is a high hazard.

Terraces and contour farming help control water erosion and conserve moisture. Crop residues kept on the surface help maintain tilth and also help control erosion. Capability unit IVe–4; Shallow range site; pasture and hayland suitability group 13A.

Eckert Series

The Eckert series consists of shallow, stony, noncalcareous soils on uplands. These soils formed in material weathered from hard crystalline limestone. Rock outcrop makes up from 5 to 15 percent of the mapped acreage. Slopes are convex.

In a representative profile, the surface layer is dark-brown silt loam that is about 40 percent angular limestone fragments from 3 to 18 inches along the long axis. This layer is 12 inches thick. Beneath this is gray indurated limestone.

Eckert soils are used only for range; they are not suited to cultivation. They are well drained, and their permeability is moderate. Runoff is medium to rapid.

Representative profile of Eckert silt loam, in an area of Eckert stony soils, rolling, 3.6 miles north of Doss by way of Ranch Road 783, then 0.5 mile east on a pasture road, and 10 feet west in range.

A1—0 to 12 inches, dark-brown (7.5YR 4/3) silt loam, dark brown (7.5YR 3/2) moist; weak, fine, subangular blocky and granular structure; hard, friable; many roots; 8 percent angular limestone gravel and about 40 percent angular limestone fragments from 3 to 18 inches along the long axis; noncalcareous; moderately alkaline; abrupt, wavy boundary.

R—12 to 15 inches, gray indurated limestone; fractured; less than 5 percent fine earth in fractures and crevices.

The A horizon ranges from dark grayish brown to dark brown in color and from loam to silt loam in texture. The R layer is indurated, fractured limestone bedrock.

Angular gravel, cobbles, and stones as much as 30 inches along the long axis make up 35 to 70 percent of the soil by volume. The solum ranges from 4 to 14 inches in thickness.

Eckert stony soils, rolling (EcD).—This soil is on rolling uplands in areas 10 to 280 acres in size. Slopes are from 5 to 16 percent. Soil texture is loam or silt loam. Coarse fragments cover 20 to 50 percent of the surface.

The composition of this mapping unit is more variable than most others in the county. Mapping is controlled well enough, however, for the anticipated use of the soils.

Included in this mapping unit are areas of limestone outcrops and Hensley and Nebgen soils. These included soils are mostly 1 to 7 acres in size. Some areas that have slopes of less than 5 percent and more than 16 percent also are included. Included soils make up less than 15 percent of the acreage.

These Eckert soils are in range. They are stony and shallow. The vegetation is mid and short grasses, many kinds of forbs, and browse plants. The stones on the surface slow runoff and help reduce the hazard of erosion. Capability unit VIIs–2; Stony Loam range site; not placed in a pasture and hayland suitability group.

Frio Series

The Frio series consists of deep, calcareous soils on flood plains along major streams. These soils formed in silty clay alluvium underlain by gravel. Slopes are smooth and plane.

In a representative profile, the surface layer, about 47 inches thick, is dark grayish brown. It is calcareous silty clay loam in the upper part and silty clay containing a few lime threads in the lower part. Below a depth of 47 inches is brown silty clay that contains soft masses of calcium carbonate.

Frio soils are used mostly for crops. Native pecans grow along streambanks.

Frio soils are well drained and their permeability is moderately slow. Runoff is slow.

Representative profile of Frio silty clay loam, 3.2 miles southeast of the courthouse in Fredericksburg by way of U.S. Highway 290, then 2.3 miles south on a county road, and 0.65 mile east in a cultivated field.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 2/2) moist; moderate, fine and medium, subangular blocky structure; hard, firm, sticky; common fine and few medium roots; calcareous; moderately alkaline; abrupt, smooth boundary.

A11—7 to 24 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 2/2) moist; moderate, medium, subangular blocky structure and moderate, fine and medium, granular; hard, firm, sticky; common fine and few medium roots, tubes, and pores; few medium insect casts and burrows; few faint calcium carbonate threads; calcareous; moderately alkaline; diffuse, smooth boundary.

A12—24 to 47 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10R 3/2) moist; moderate, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; few insect and worm casts and burrows; few thin lenses of organic stains; few faint calcium carbonate threads that are visible when dry; calcareous; moderately alkaline; diffuse, smooth boundary.

C—47 to 63 inches, brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; massive; hard, firm, sticky and plastic; few soft masses of calcium carbonate; calcareous; moderately alkaline.

The Ap horizon ranges from 4 to 8 inches in thickness. The A horizon is dark grayish brown to very dark grayish brown. A few thin lenses of organic stains are at depths between 25 and 50 inches. The solum ranges from 36 to 57 inches in thickness.

Frio silty clay loam (Fr).—This nearly level soil is on the flood plains of major streams in long and narrow areas 5 to 45 acres in size. Slopes are less than 1 percent. This soil floods an average of once in 20 years.

This soil has the profile described as representative for the Frio series.

Included with this soil in mapping are areas of Denton and Lewisville soils. These areas are mostly 0.5 to 3 acres in size and account for less than 5 percent of the acreage.

This Frio silty clay loam is mostly in crops, but some areas are in range. The main crops are small grain and grain sorghum. Moisture conservation and maintenance of tilth are important where this soil is cultivated.

Contour farming helps conserve moisture. Crop residues kept on the surface help maintain tilth and control erosion. Capability unit IIc–2; Bottomland range site; pasture and hayland suitability group 1C.

Granite Outcrop

Granite outcrop (Gn) consists of granite bedrock that appears as low domes in the landscape (fig. 5). Mapped areas range from 15 to 560 acres in size.

Included with Granite outcrops in mapping are areas of Keese soils mostly less than 0.2 acre in size.

Granite outcrop has little value as range because the vegetation is sparse. It is suitable for recreation. Live oak trees grow in cracks in the rock. Granite for monuments is quarried from one of the areas of this outcrop. Capability unit VIIIs–1; not in a range site or in a pasture and hayland suitability group.

Guadalupe Series

The Guadalupe series consists of deep, calcareous soils along major streams. These soils formed in calcareous loamy and sandy stream alluvium. Slopes are nearly level to gently sloping and undulating, and convex.

In a representative profile, the surface layer is brown, calcareous, and about 17 inches thick. The upper part is loam, and the lower part is fine sandy loam. The next layer extends to a depth of 37 inches. It is brown loam that contains thin lenses of organic stains in the upper 14 inches and brown, calcareous fine sandy loam in the lower part. Below this is brown loamy sand (fig. 6).

Guadalupe soils are used mostly for range, but some are in crops. These soils are well drained, and their permeability is moderately rapid. Runoff is slow.

Representative profile of Guadalupe loam, 3.2 miles southeast of the Fredericksburg Courthouse by way of U.S. Highway 290, then 2.3 miles south by Old San Antonio Road, and 1.3 miles east in pasture.

Ap—0 to 7 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; single grain; slightly hard, very friable, slightly sticky; common fine and medium roots, tubes, and pores; few very fine calcium carbonate fragments; calcareous; moderately alkaline; clear, smooth boundary.

A1—7 to 17 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, fine and medium, subangular blocky structure; slightly hard, very friable, slightly sticky; common fine and medium roots, tubes, and pores; few insect burrows; calcareous; moderately alkaline; gradual, smooth boundary.

B21—17 to 31 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, medium, subangular blocky structure; hard, friable, sticky; few fine and medium roots, tubes, and pores; few insect burrows; few thin strata of lighter colored soil; thin horizontal lenses of organic stains; calcareous; moderately alkaline; gradual, smooth boundary.

B22—31 to 37 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; soft, very friable; few fine roots; few very fine calcium carbonate fragments; calcareous; moderately alkaline; clear, smooth boundary.

C—37 to 63 inches, brown (7.5YR 5/4) loamy sand, dark brown (7.5YR 4/4) moist; single grain; loose, very friable, nonsticky; few thin strata of fine sandy loam; calcareous; moderately alkaline.

The A horizon ranges from brown to pale brown in color and from 17 to 22 inches in thickness. It is loam or fine

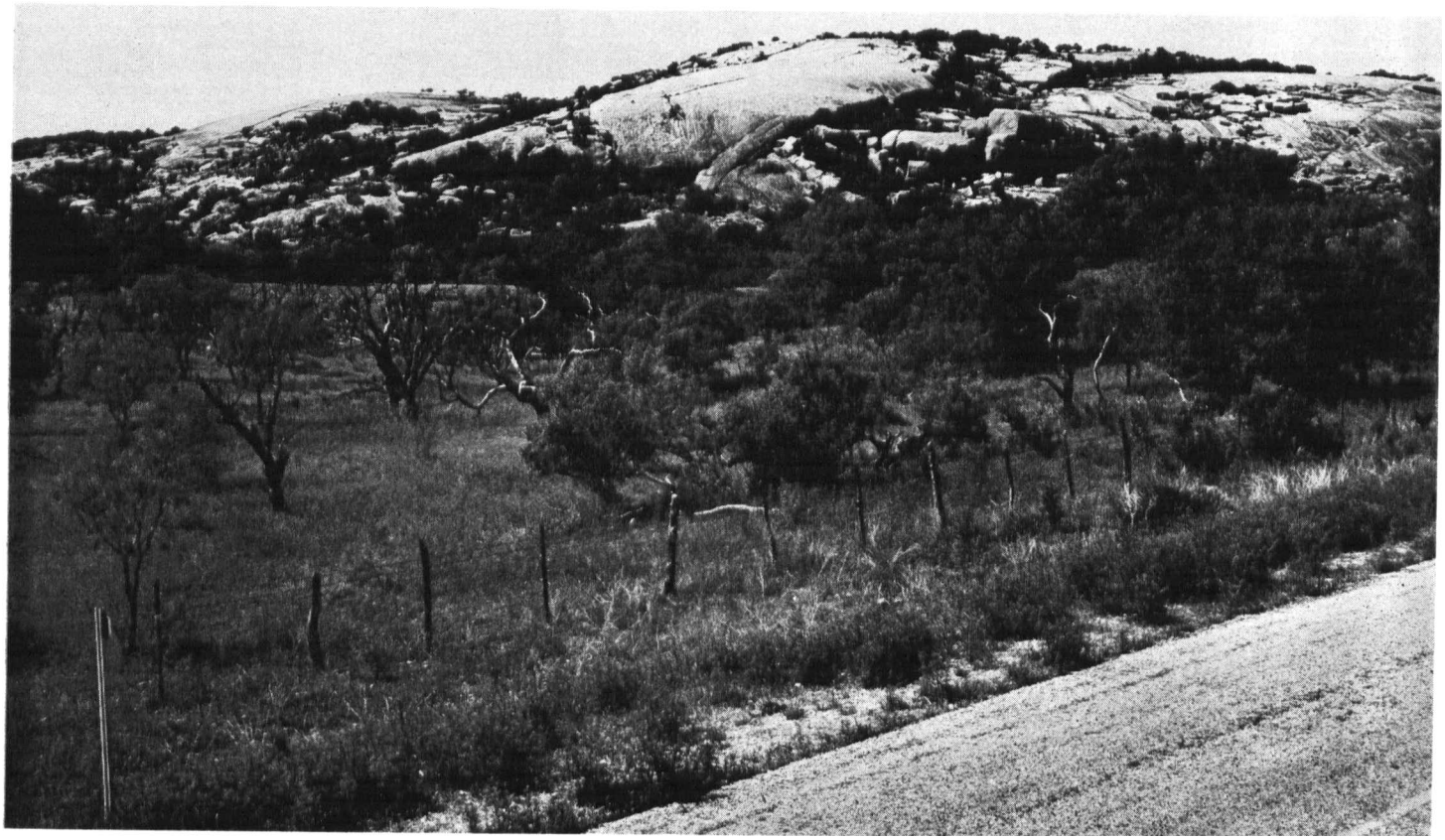

Figure 5.—An area of Granite outcrop.

Figure 6.—**Profile of Guadalupe loam.**

sandy loam in texture. The B horizon ranges from brown to light brown in color and from 20 to 28 inches in thickness. The B horizon is loam or fine sandy loam in texture. The solum is 37 to 50 inches thick.

Guadalupe loam (Gp).—This nearly level to gently sloping soil lies along major streams in long, narrow areas 5 to 45 acres in size. Slopes are 0 to 5 percent.

This soil has the profile described as representative for the Guadalupe series.

Mapped with this soil are areas of Frio soils, mostly 0.5 to 2 acres in size, that account for less than 5 percent of the acreage.

This Guadalupe loam is in range and crops. The main crop is small grain. The areas of this soil adjacent to stream channels are flooded for a few hours once in 4 to 6 years.

Terraces and contour farming help control water erosion and conserve moisture. Crop residues kept on the surface help maintain tilth and control erosion. Capability unit IIe–4; Bottomland range site; pasture and hayland suitability group 2A.

Guadalupe and Frio soils, channeled (Gr).—The nearly level and gently undulating soils in this mapping unit are in long, narrow, low-lying strips adjacent to major perennial and intermittent streams (fig. 7). Slopes are 0 to 5 percent. The areas of this unit are flooded by high velocity water once or twice a year. The floodwaters scour and deposit silt on the soils.

The Guadalupe soil has the steeper slopes and makes up about 60 percent of the mapped areas. It has a surface layer of brown, calcareous fine sandy loam 19 inches thick. The next layer is brown, calcareous fine sandy loam 30 inches thick. Below a depth of about 49 inches is brown loamy sand.

The nearly level Frio soil makes up about 40 percent of the mapped areas. It has a surface layer of dark grayish-brown, calcareous silty clay loam that is 26 inches thick. The next layer is very dark grayish-brown, calcareous silty clay that is 25 inches thick. Below a depth of 51 inches is brown, calcareous silty clay.

The areas of this mapping unit are used for range. Both soils in capability unit Vw–1 and in Bottomland range site; Frio part in pasture and hayland group 1C, Guadalupe part in 2A.

Gullied Land

Gullied land (Gu) is on erosional rolling uplands at the base of Brackett soils. Slopes are from 5 to 12 percent. Areas of this mapping unit are long, narrow, and curved and 5 to 110 acres in size.

Gullies are 15 to 40 feet apart and 4 to 15 deep deep. Some of the gullies are still active, and others have become stable. The gullies have exposed such geological materials as limestone, clays, and sands. This geological material accounts for 40 to 60 percent of the mapped areas.

Included with Gullied land in mapping are areas of Brackett, Hensley, and Pedernales soils. These areas are mostly 0.5 to 7 acres in size.

This mapping unit is all in range. Capability unit VIIs–3; Steep Adobe range site; not placed in a pasture and hayland suitability group.

Harper Series

The Harper series consists of shallow, noncalcareous, stony soils on uplands (fig. 8). These soils formed in a mantle of clay over dolomitic limestone. Slopes are plane to convex.

In a representative profile, the soil is black, noncalcareous clay about 17 inches thick. Below the soil is indurated, fractured limestone bedrock.

Harper soils are used for range. They are well drained, and their permeability is moderately slow. Runoff is slow.

Representative profile of Harper clay, in an area of Harper stony clay and Rock outcrop, 1 to 8 percent slopes, 7.1 miles northeast of Fredericksburg by Ranch Road 1631, then 8.2 miles east by Ranch Road 2721, then

2 miles north on a county road, then 1.5 miles east on a pasture road, and 50 feet east in range.

A11—0 to 7 inches, black (10YR 2/1) clay, black (10YR 2/1) moist; weak, fine, subangular blocky and granular structure; hard, firm, sticky and plastic; common fine and medium grass roots; 45 to 50 percent cobble and stone size fragments on the surface; less than 5 percent limestone fragments in the soil; noncalcareous; moderately alkaline; gradual, smooth boundary.

A12—7 to 17 inches, black (10YR 2/1) clay, black (10YR 2/1) moist; moderate, fine and medium, blocky structure; hard, firm, sticky and plastic; common, fine and medium grass roots; noncalcareous; moderately alkaline; abrupt, wavy boundary.

R—17 to 18 inches, indurated, fractured, dolomitic limestone.

The amount of limestone fragments, rocks, and boulders on the surface ranges from 45 to 70 percent. Limestone fragments in the soil range from 0 to 10 percent.

The A horizon ranges from black to very dark gray to very dark grayish brown in color and from 11 to 20 inches in thickness. The R layer is indurated dolomitic limestone, or dolomite.

Harper stony clay and Rock outcrop, 1 to 8 percent slopes (HaD).—This gently undulating to gently rolling mapping unit is on uplands in areas 35 to 480 acres in size.

This mapping unit is about 70 percent Harper soils, 25 percent Rock outcrop, and 5 percent areas of less extensive soils. The pattern of soils in this unit is not uniform. Some areas are mainly Harper soils, and some are dominated by Rock outcrop.

The Rock outcrop, most of which is limestone, is in areas 0.5 to 3 acres in size.

Mapped in this unit are areas of Doss and Speck soils that are mostly 0.2 to 0.7 acre in size.

All of this mapping unit is in range, and it is also well suited to use as wildlife habitat. Capability unit VIs–2; Low Stony Hill range site; not placed in a pasture and hayland suitability group.

Heatly Series

The Heatly series consists of deep, neutral soils on uplands. These soils formed in moderately sandy to sandy material.

In a representative profile, the surface layer is yellowish-red, neutral, loamy fine sand about 28 inches thick. Below the surface, and extending to a depth of 90 inches, is red sandy clay loam.

Heatly soils are used mostly for crops, although some are in range. They are well drained, and their permeability is moderate. Runoff is very slow.

Representative profile of Heatly loamy fine sand, in pasture, 150 feet north and east of the intersection of West Nimitz and North Orange Streets in Fredericksburg.

A1—0 to 28 inches, yellowish-red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; single grain; loose, very friable, nonsticky; few fine roots; neutral; abrupt, smooth boundary.

B21t—28 to 52 inches, red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; weak, coarse, prismatic

Figure 7.—Channeling on Guadalupe and Frio soils.

Figure 8.—An area of Harper stony clay.

structure and moderate, medium, subangular blocky; hard, firm, sticky; few fine roots; few medium tubes and pores; neutral; clear, smooth boundary.

B22t—52 to 67 inches, red (2.5YR 4/6) sandy clay loam, red (2.5YR 4/6) moist; moderate, medium, subangular blocky structure; hard, firm, sticky; neutral; clear, smooth boundary.

B3—67 to 83 inches, red (2.5YR 4/6) sandy clay loam, red (2.5YR 4/6) moist; moderate, medium, subangular blocky structure; hard, firm, sticky; neutral; clear, smooth boundary.

C—83 to 90 inches, red (10YR 4/6) sandy clay loam, red (10YR 4/6) moist; massive; hard, firm, sticky; slightly acid.

The A horizon ranges from yellowish red or strong brown to yellowish brown in color and from 20 to 30 inches in thickness. The B horizons range from red to yellowish red in color. The Bt horizon is 32 to 48 inches thick, and the B3 horizon is 10 to 20 inches thick. The solum is 62 to 98 inches thick.

Heatly loamy fine sand (He).—This gently sloping soil is on uplands in irregular areas 10 to 170 acres in size. Slopes range from 1 to 5 percent.

Included with this soil in mapping are areas of Demona, Pedernales, and Vashti soils. These areas are mostly 0.5 to 6 acres in size and make up less than 15 percent of the acreage.

About half of the acreage is used for crops, and the other half is still in range. The main crops are small grain and peaches. This soil is well suited to quality peach production. Soil blowing is a high hazard. Moisture conservation and maintenance of tilth also are important considerations where this soil is cultivated.

Contour farming helps control water erosion and conserve moisture. Crop residue kept on the soil surface helps maintain tilth and control erosion. Capability unit IIIe-7; Sandy range site; pasture and hayland suitability group 9A.

Hensley Series

The Hensley series consists of shallow, noncalcareous soils on uplands. These soils formed in noncalcareous clayey material weathered from limestone. Slopes are convex.

In a representative profile, the surface layer is reddish-brown, mildly alkaline loam about 4 inches thick. The next layer is 14 inches thick and consists of red, moderately alkaline clay. Below this, beginning at a depth of 18 inches, is indurated, fractured limestone.

Hensley soils are mostly in range, but small areas are in crops. These soils are well drained, and their permeability is slow. Runoff is slow to moderate.

Representative profile of Hensley loam, 3 to 8 percent slopes, 3.2 miles northeast of Fredericksburg by Ranch Road 1631, then 0.6 mile north on Knopp School Road, and 40 feet east in range.

A1—0 to 4 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; moderate, fine, subangular blocky structure; hard, firm, sticky; common fine and medium roots; 10 percent, by volume, chert fragments; mildly alkaline; clear, smooth boundary.

B2t—4 to 18 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate, medium, subangular blocky to blocky structure; very hard, firm, sticky and plastic; few fine roots; from 5 to 15 percent, by volume, chert fragments; noncalcareous; moderately alkaline; abrupt, wavy boundary.

R—18 to 21 inches, indurated, fractured limestone.

The A horizon ranges from reddish brown to brown in color and from loam to clay loam in texture. It is 4 or 5 inches in thickness. The B horizon ranges from red to dark red in color and from clay to clay loam in texture.

The solum ranges from 13 to 19 inches in thickness. The soil contains from 2 to 15 percent, by volume, chert fragments. The R layer is indurated, fractured limestone.

Some areas of these soils are outside the range of the Hensley series in that the B2t horizon is about 32 to 35 percent clay. This difference, however, does not alter use and management.

Hensley loam, 3 to 8 percent slopes (HnD).—This gently undulating to gently rolling soil is on erosional uplands in oval areas 10 to 85 acres in size. Slopes range from 3 to 8 percent.

This soil has the profile described as representative for the Hensley series.

Included with this soil in mapping are areas of Pedernales and Brackett soils. These areas are mostly 0.2 to 1.5 acres in size and account for less than 8 percent of the acreage.

This soil is in range. It is not suitable for use as cropland. Water erosion is a high hazard. Capability unit VIe–2; Redland range site; pasture and hayland suitability group 13A.

Hensley soils, 1 to 3 percent slopes (HsB).—These gently sloping soils are on erosional uplands in long, narrow areas 5 to 60 acres in size.

The surface layer ranges from loam to clay loam in texture. It is about 4 inches thick and reddish brown. The next lower layer is red, noncalcareous clay or clay loam about 9 inches thick. Below a depth of 13 inches is indurated limestone.

Included in this mapping unit are areas of Luckenbach and Pedernales soils. These areas are mostly 0.5 to 2.5 acres in size and account for less than 10 percent of the acreage.

These soils are suited to both crops and range. The main crops are small grain and grain sorghum. Erosion control, conservation of moisture, and maintenance of tilth are important where this unit is cultivated. Water erosion is a high hazard.

Terraces and contour farming help control water erosion and conserve moisture. Crop residues kept on the surface help maintain tilth and control erosion. Capability unit IIIe–9; Redland range site; pasture and hayland suitability group 13A.

Katemcy Series

The Katemcy series consists of moderately deep soils on uplands. These soils formed in a noncalcareous, loamy and clayey mantle that overlies schist. Slopes are smooth to convex.

In a representative profile, the surface layer is reddish-brown, neutral clay loam about 9 inches thick. The next lower layer, extending to a depth of 35 inches, is neutral clay. It is dark reddish brown in the upper part and reddish brown in the lower part. Below this, beginning at a depth of 35 inches, is reddish and olive-colored schist.

The greater part of Katemcy soils are in range, but a few small areas are cultivated. These soils are well drained, and their permeability is slow. Runoff is medium.

Representative profile of Katemcy clay loam, 1 to 5 percent slopes, 12.4 miles north of Fredericksburg, by Ranch Road 965, then 2.9 miles northwest on a county road, and 100 feet north in range.

A1—0 to 9 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate, fine and medium, subangular blocky structure; hard, friable, sticky; many roots; few fine tubes and pores; few quartz and feldspar pebbles and mica flakes 2 to 5 millimeters in size; neutral; gradual, smooth boundary.

B21t—9 to 25 inches, dark reddish-brown (5YR 3/4) clay, dark reddish brown (5YR 3/4) moist; moderate, medium and coarse, blocky structure; extremely hard, very firm, very sticky and plastic; many roots and tubular pores; few fine mica particles; few thin clay films on ped surfaces; neutral; clear, smooth boundary.

B22t—25 to 35 inches, reddish-brown (5YR 4/4) clay, reddish brown (5YR 4/4) moist; moderate, fine and medium, blocky structure; extremely hard, firm, very sticky and plastic; few fine roots and tubular pores; few clay films; 5 percent, by volume, partially weathered soft schist fragments 2 to 10 millimeters in size; neutral; clear, wavy boundary.

R—35 to 50 inches, reddish and olive-colored schist that is tilted about 30 degrees from horizontal; weakly to strongly cemented; partially weathered along cleavage planes; noncalcareous.

The A horizon ranges from reddish brown to brown in color and from 5 to 9 inches in thickness. The B horizon ranges from dark reddish brown to reddish brown or yellowish red in color and from 15 to 35 inches in thickness. The solum is 20 to 40 inches thick.

The R layer is weakly cemented to indurated schist or schistose gneiss.

Katemcy clay loam, 1 to 5 percent slopes (KaC).—This gently sloping soil is in valleys and on side slopes in irregular areas 10 to 135 acres in size.

Included with this soil in mapping are areas of Ligon and Castell soils. These inclusions are mostly 0.5 to 3 acres in size, and make up less than 8 percent of the acreage.

This soil is mostly used for range. A few small areas are in small grain. Water erosion is a moderate hazard.

Terraces and contour farming help control water erosion and conserve moisture. Crop residues kept on the surface help maintain tilth and control erosion. Capability unit IIIe–4; Schist range site; pasture and hayland suitability group 7C.

Keese Series

The Keese series consists of shallow, medium acid soils on uplands. These soils formed in material weathered from granite. Slopes are plane to convex.

In a representative profile, the surface layer is yellowish-brown, medium acid gravelly sandy loam about 10 inches thick. The next lower layer, extending to a depth of 19 inches, is yellowish-brown, medium acid gravelly sandy loam. Below a depth of 19 inches is indurated granite.

Keese soils are used only for range; they are not suited to use as cropland. These soils are well drained, and their permeability is moderately rapid. Runoff is rapid.

Representative profile of Keese gravelly sandy loam, in an area of Keese-Rock outcrop complex, 1 to 8 percent slopes, 13 miles north by Texas Highway 16 from its intersection with U.S. Highway 290 in Fredericksburg, then 3.1 miles east on Ranch Road 1323, then 3.6 miles north on Coal Creek Road, and 20 feet north in range.

A1—0 to 10 inches, yellowish-brown (10YR 5/4) gravelly sandy loam, dark brown (10YR 3/3) moist; weak, fine, granular structure; hard, friable, slightly sticky; common fine and medium roots; estimated 15 percent, by volume, feldspar and quartz fragments less than 15 millimeters in diameter; medium acid; gradual, wavy boundary.

B2—10 to 19 inches, yellowish-brown (10YR 5/6) gravelly sandy loam, dark yellowish brown (10YR 3/4) moist; weak, fine, subangular blocky structure; very hard, friable, slightly sticky; few fine roots; estimated 20 percent, by volume, feldspar and quartz fragments less than 15 millimeters along major axis; medium acid; gradual, wavy boundary.

R—19 to 21 inches, indurated granite.

The A horizon ranges from yellowish brown to light yellowish brown and brown in color, from 5 to 11 inches in thickness, and from gravelly sandy loam to gravelly loam in texture.

The B horizon ranges from yellowish brown to strong brown and reddish yellow in color and from 5 to 13 inches in thickness.

The solum is 11 to 20 inches thick. Feldspar and quartz fragments 2 to 15 millimeters across the major axis make up 10 to 30 percent, by volume, of the soil.

Keese-Rock outcrop complex, 1 to 8 percent slopes (KrD).—This gently undulating to gently rolling mapping unit is on uplands in irregular areas 20 to 630 acres in size. The unit is made up of about 40 percent Keese soils, 20 percent Rock outcrop, and 40 percent other soils. These are so intricately mixed that it is not feasible to separate them at the scale mapped.

The Keese soils in this mapping unit have the profile described as representative for the Keese series.

The Rock outcrop consists mostly of granite rocks 0.1 to 3 acres in size. Some quartz fragments are scattered throughout the unit.

Included in this mapping unit are areas of Castell and Click soils that are mostly 0.3 to 2 acres in size. Also included is a soil similar to the Keese soil, except it is slightly deeper to rock.

The areas of this mapping unit are used only for range. They are not suitable for cropland. Capability unit VIIs–2; Shallow Gneiss range site; not placed in a pasture and hayland suitability group.

Keese-Rock outcrop complex, 8 to 20 percent slopes (KrF).—This rolling to hilly mapping unit is on uplands in irregular areas 40 to 775 acres in size. This unit is about 50 percent Keese soils, 45 percent Rock outcrop, and 5 percent other soils. These three are so intricately mixed it is not feasible to separate them at the scale mapped.

The surface layer of the Keese soils is brown, medium acid gravelly sandy loam about 7 inches thick. Below the surface layer, and extending to a depth of 15 inches, is yellowish-brown, medium acid gravelly sandy loam. Below a depth of 15 inches is indurated granite.

The Rock outcrop part of the mapping unit is in irregular areas about 50 to 200 feet apart. Most of the outcrops are granite, but some are quartz fragments or quartz dikes. Outcrops are mostly at ground level but, in some places, the rocks extend 5 to 10 feet above ground.

Mapped in this unit are areas of Castell and Click soils that are mostly 0.2 to 1 acre in size.

This mapping unit is used only as range. It is not suitable as cropland. Capability unit VIIs–2; Shallow Gneiss range site; not placed in a pasture and hayland suitability group.

Krum Series

The Krum series consists of deep, gently sloping, calcareous soils in valley fills. These soils formed in thick beds of unconsolidated, calcareous, clayey sediments.

In a representative profile, the surface layer is dark grayish-brown, calcareous silty clay about 24 inches thick. The next layer extends to a depth of 54 inches and is calcareous silty clay. The upper part is grayish brown, and the lower part is brown. Below a depth of 54 inches is grayish-brown clay (fig. 9).

Krum soils are used for crops and range. They are well drained, and their permeability is moderately slow. Runoff is slow to rapid.

Representative profile of Krum silty clay, 1 to 3 percent slopes, 1.7 miles north of Fredericksburg, by Ranch Road 965, then 0.35 mile west in range.

A1—0 to 24 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; common fine and medium roots; cracks 0.25 inch wide and 12 inches long in lower 12 inches; calcareous; moderately alkaline; gradual, smooth boundary.

B2—24 to 41 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate, medium, blocky structure; hard, firm, sticky and plastic; common, medium, soft masses of calcium carbonate; few, fine to medium, angular calcium carbonate fragments; cracks filled with soil from above; calcareous; moderately alkaline; gradual, smooth boundary.

B3—41 to 54 inches, brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate, fine, blocky structure; hard, firm, sticky and plastic; common, soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

Figure 9.—Profile of a Krum silty clay.

C—54 to 63 inches, grayish-brown (10 YR 5/2) clay, dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky and plastic; many, fine, hard and soft masses of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from dark brown to very dark grayish brown and dark grayish brown in color and from 20 to 29 inches in thickness. The B horizon ranges from brown to yellowish brown and grayish brown in color. The B2 horizon is 5 to 18 inches thick, and the B3 horizon is 11 to 13 inches thick. The C horizon is grayish brown to yellowish brown and brown.

The solum is 46 to 60 inches thick.

Krum silty clay, 1 to 3 percent slopes (KuB).—This gently sloping soil is in upland valleys in long, narrow areas 10 to 75 acres in size.

This soil has the profile described as representative for the Krum series.

Included with this soil in mapping are areas of Denton and Brackett soils. These areas are mostly 0.1 to 3 acres in size and make up less than 5 percent of the acreage.

This soil is well suited to crops and range. The main crops grown are small grain and grain sorghum. Erosion control, conservation of moisture, and maintenance of tilth are the main considerations where this soil is cultivated. Water erosion is a moderate hazard.

Terraces and contour farming help control water erosion and conserve moisture. Crop residues kept on the surface help maintain tilth and control erosion. Capability unit IIe–2; Deep Upland range site; pasture and hayland suitability group 7C.

Krum silty clay, 3 to 5 percent slopes (KuC).—This gently sloping soil is in upland valleys in areas 15 to 75 acres in size.

The surface layer is very dark grayish brown, calcareous silty clay about 17 inches thick. The next lower layer is brown, calcareous silty clay about 17 inches thick. The next lower layer is yellowish-brown, calcareous silty clay about 13 inches thick. Below a depth of 50 inches is yellowish-brown, calcareous clay.

Mapped with this soil are areas of Denton and Brackett soils. These areas are mostly 0.5 to 4 acres in size and make up less than 8 percent of the acreage.

Krum silty clay is suitable for crops and range. The main crops are small grain and grain sorghum. Erosion control, conservation of moisture, and maintenance of tilth are the main considerations where this soil is cultivated. Water erosion is a high hazard.

Terraces and contour farming help control water erosion and conserve moisture. Crop residues kept on the surface aid in maintaining tilth and controlling erosion. Capability unit IIIe–5; Deep Upland range site; pasture and hayland suitability group 7C.

Lewisville Series

The Lewisville series consists of deep, calcareous soils on the uplands of old, high terraces adjacent to flood plains. These soils formed in alluvium deposited by streams that drain soils underlain by limestone. Slopes are smooth and plane to convex.

In a representative profile, the surface layer is dark grayish-brown, calcareous clay loam about 19 inches thick. The next lower layer, extending to a depth of 33 inches, is yellowish-brown, calcareous silty clay. Below this is 14 inches of yellowish-brown, calcareous silty clay. Below this is a layer of yellowish-brown silty clay loam (fig. 10).

Lewisville soils are used mostly for crops, but some are in range. These soils are well drained. Runoff is slow to medium and permeability is moderate.

Representative profile of Lewisville clay loam, 0 to 1 percent slopes, 9.4 miles southwest of Fredericksburg on Texas Highway 16, then 0.35 mile west in a cultivated field.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; hard, firm, sticky; common fine and medium roots; common fine tubes and pores; few fine calcium carbonate fragments; calcareous; moderately alkaline; abrupt, smooth boundary.

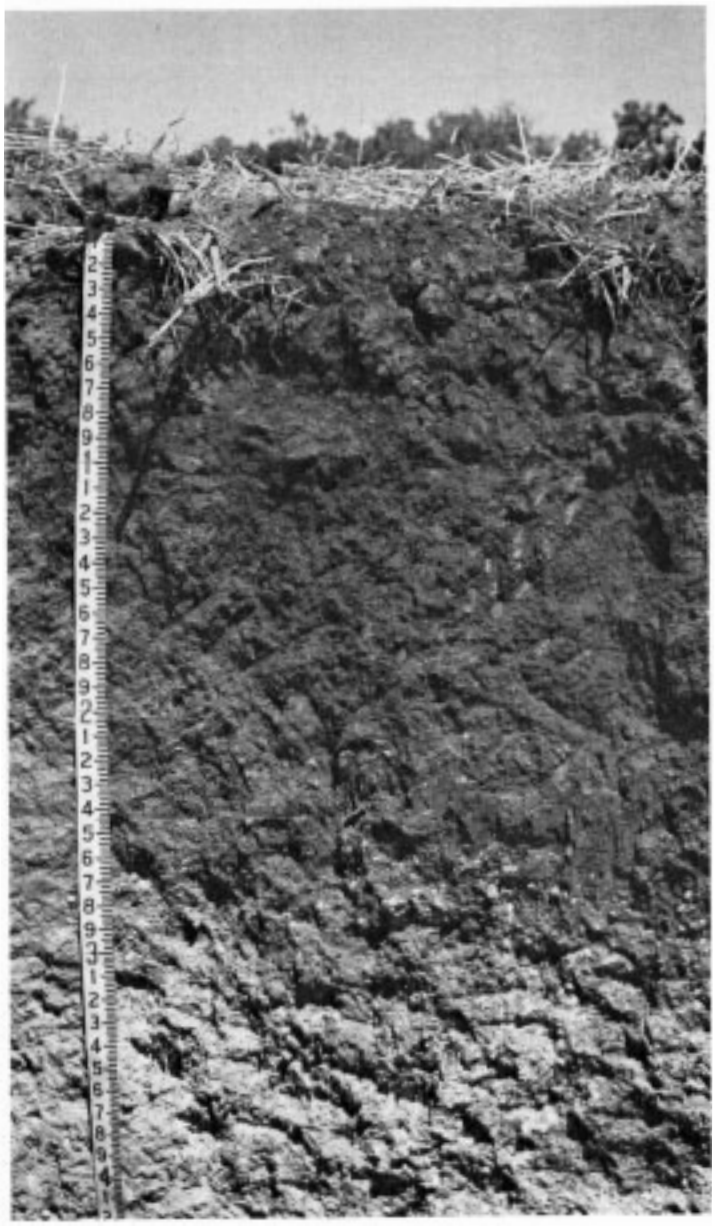

Figure 10.—**Profile of a Lewisville clay loam**

A1—8 to 19 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine and medium, subangular blocky structure; hard, firm, sticky; few fine and medium roots and tubes; common very fine calcium carbonate fragments; calcareous; moderately alkaline; gradual, smooth boundary.

B2—19 to 33 inches, yellowish-brown (10YR 5/4) silty clay, dark yellowish brown (10YR 4/4) moist; moderate fine, subangular blocky structure; hard, firm, sticky; few very fine roots and tubes; few very fine threads and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B21ca—33 to 47 inches, yellowish-brown (10YR 5/4) silty clay, dark yellowish brown (10YR 4/4) moist; weak, fine, subangular blocky structure; hard, firm, sticky; many fine and medium threads of calcium carbonate; few tubes and pores; calcareous; moderately alkaline; gradual, smooth boundary.

B22ca—47 to 63 inches, yellowish-brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; weak, fine, subangular blocky structure; hard, firm, sticky; few fine, weakly and strongly cemented concreations of calcium carbonate; calcareous; moderately alkaline.

The A horizon is dark brown to very dark grayish brown and dark grayish brown in color and is 9 to 19 inches thick. The B2 horizon is brown to grayish brown, light yellowish brown, and yellowish brown in color and is 13 to 20 inches thick. The B21ca and B22ca horizons range from yellowish brown to very pale brown and light brown. The B21ca horizon is 12 to 16 inches thick. The solum is 40 to 70 inches thick.

Lewisville clay loam, 0 to 1 percent slopes (LeA).—This nearly level soil is on uplands near major streams in long, narrow areas 10 to 70 acres in size.

This soil has the profile described as representative for the Lewisville series.

Included with this soil in mapping are areas of Altoga, Denton, and Frio soils. These inclusions are mostly 0.1 to 2.5 acres in size, and account for less than 5 percent of the acreage.

This soil is well suited to use as cropland, and most of it is cultivated. The major crops are small grain and grain sorghum. Where this soil is cultivated, it is important to use crops and practices that conserve moisture and maintain or improve tilth.

Contour farming helps conserve moisture. Crop residue kept on the surface aids in maintaining tilth and conserving moisture. Capability unit IIc–2; Deep Upland range site; pasture and hayland suitability group 7C.

Lewisville clay loam, 1 to 3 percent slopes (LeB).—This gently sloping soil is on uplands along major streams. Soil areas are long, narrow, and curved and 5 to 75 acres in size.

The surface layer is very dark grayish brown, calcareous clay loam about 12 inches thick. The next lower layer is grayish-brown, calcareous silty clay about 30 inches thick. Below a depth of 42 inches is yellowish-brown, calcareous silty clay loam.

Included with this soil in mapping are areas of Altoga, Denton, and Frio soils. These areas are mostly 0.3 to 3 acres in size and make up less than 8 percent of the acreage.

This soil is mostly in crops, but some areas are in range. The main crops grown are grain sorghum and small grain. A moderate hazard of water erosion makes erosion control and moisture conservation important where this soil is cultivated. Crops and practices that improve tilth also are needed.

Terraces and contour farming help control erosion and conserve moisture. Crop residue kept on the surface aids in maintaining tilth and controlling erosion. Capability unit IIe–2; Deep Upland range site; pasture and hayland suitability group 7C.

Lewisville clay loam, 3 to 5 percent slopes (LeC).—This gently sloping soil is on uplands along major streams. Soil areas are long and curved and 5 to 50 acres in size.

The surface layer is dark grayish-brown, calcareous clay loam about 9 inches thick. The next layer, extending to a depth of 26 inches, is light yellowish-brown, calcareous silty clay. Below a depth of 26 inches is very pale brown, calcareous silty clay loam.

Mapped with this Lewisville clay loam are areas of Altoga, Denton, and Doss soils. These areas are mostly 0.5 to 3.5 acres in size and account for less than 8 percent of the acreage.

This soil is suited to both crops and range. The main crops grown are small grain and grain sorghum. A high hazard of water erosion makes erosion control important where this soil is cultivated. Maintenance or improvement of tilth also is needed.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIIe–5; Deep Upland range site; pasture and hayland suitability group 7C.

Ligon Series

The Ligon series consists of shallow, gently sloping and undulating soils on uplands. These soils formed in a thin loamy mantle over schist. Slopes are convex.

In a representative profile, the surface layer is reddish-brown neutral clay loam about 4 inches thick. The next layer, extending to a depth of 17 inches, is red, neutral clay loam. Below this is dark-colored schist.

Ligon soils are mostly in range. They are well drained and permeability is moderately slow. Runoff is medium.

Representative profile of Ligon clay loam, in an area of Ligon soils, undulating, 18 miles northeast of Fredericksburg, on Texas Highway 16, then 6.5 miles east on Coal Creek Road, 2.3 miles north on a private road, and 10 feet west in range.

A1—0 to 4 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak, fine, subangular blocky structure; hard, firm, slightly sticky; common fine roots; few termite channels, neutral; clear, smooth boundary.

B2t—4 to 17 inches, red (2.5YR 4/6) clay loam, dark red (2.5YR 3/6) moist; weak, fine, subangular blocky structure; hard, firm, sticky; few fine and medium roots; neutral; clear, smooth boundary.

R—17 to 19 inches, soft, dark-colored schist.

The A horizon is reddish brown, dark reddish brown, and dark brown in color. This horizon ranges from 4 to 6 inches in thickness and from fine sandy loam to clay loam in texture.

The B2t horizon is red to dark reddish brown and is 8 to 14 inches thick.

The R layer is grayish to olive-colored schist. The solum is 12 to 20 inches thick and is neutral to slightly acid in reaction.

The solum is 12 to 20 inches thick and neutral to slightly acid.

Ligon clay loam, 1 to 5 percent slopes (LgC).—This gently sloping soil is on uplands in areas 5 to 150 acres in size.

The surface layer is dark reddish-brown, slightly acid clay loam about 5 inches thick. The next lower layer is dark reddish-brown, slightly acid clay loam about 13 inches thick. Below a depth of 18 inches is soft, gray-colored schist.

Included with this soil in mapping are areas of Castell and Katemcy soils that are mostly 0.5 to 2.5 acres in size.

This soil is not well suited to cultivation; it is best suited to range. The hazard of water erosion is high, and control of erosion and maintenance of tilth are needed where this soil is cultivated. The main crop grown is small grain. Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IVe–2; Schist range site; pasture and hayland suitability group 14A.

Ligon soils, undulating (LlC).—The soils in this mapping unit are on broad, convex ridges in areas 10 to 160 acres in size. The landscape is undulating, and slopes are 1 to 8 percent. The composition of this mapping unit is more variable than for most others in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

These Ligon soils have a profile similar to that described as representative for the series, but their surface layer ranges from fine sandy loam to clay loam in texture.

Included with these soils in mapping are areas of Castell and Katemcy soils that are mostly 0.5 to 3 acres in size and have a fine sandy loam to clay loam surface layer. These included areas make up less than 15 percent of the acreage.

These Ligon soils are used for range. They are not suitable for crops. The hazard of erosion is high. Capability unit VIe–1; Schist range site; not placed in a pasture and hayland suitability group.

Lindy Series

The Lindy series consists of moderately deep, noncalcareous soils on uplands throughout the county. These soils formed in a loamy or clayey mantle that overlies limestone. Slopes are plane to convex.

In a representative profile, the surface layer is dark grayish-brown, neutral cobbly clay loam about 5 inches thick. The next lower layer, extending to a depth of 26 inches, is reddish-brown, neutral clay. Below a depth of 26 inches is indurated, fractured limestone.

Lindy soils are in range. They are well drained, and permeability is slow. Runoff is slow to medium.

Representative profile of Lindy cobbly clay loam, 1 to 8 percent slopes, 3 miles northwest of Fredericksburg, on U.S. Highway 87, then 3.8 miles northwest on a county road, 0.6 mile west on a second county road, and 0.5 mile north on a private road.

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, subangular blocky structure; hard, firm, sticky; common, fine and medium roots; 20 percent, by volume, limestone cobbles and chert gravel; neutral; clear, smooth boundary.

B2t—5 to 26 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate, medium, blocky structure; hard, firm, sticky and plastic; few fine and medium roots; distinct pressure faces; neutral; abrupt, smooth boundary.

R—26 to 28 inches, indurated, fractured limestone.

The A horizon ranges from dark brown to dark grayish brown in color and from 5 to 9 inches in thickness. It is from 10 to 30 percent, by volume, cobbles and chert fragments.

The B horizon is reddish brown and yellowish red in color and 17 to 25 inches thick. The solum is 22 to 34 inches thick.

Lindy cobbly clay loam, 1 to 8 percent slopes (LnD).—This undulating soil is on erosional uplands in areas 15 to 150 acres in size.

Included with this soil in mapping are areas of Speck, Tarrant, and Topia soils. These areas are mostly 0.3 to 8 acres in size and make up less than 15 percent of the acreage.

This Lindy cobbly clay loam is best suited to range. The hazard of water erosion is moderate. Capability unit VIs–4; Redland range site; pasture and hayland suitability group 7C.

Luckenbach Series

The Luckenbach series consists of deep, noncalcareous, gently sloping soils on uplands and old terraces. These soils formed in calcareous beds of clay loam and clay. Slopes are smooth and plane to convex.

In a representative profile, the surface layer is mildly alkaline clay loam about 18 inches thick. It is very dark grayish brown in the upper 8 inches and dark brown in the lower 10 inches. The next lower layer, extending to a depth of 30 inches, is reddish-brown moderately alkaline clay. The next lower layer is 8 inches of brown, calcareous clay. Below a depth of 38 inches is very pale brown, calcareous clay loam.

Luckenbach soils are used mostly for crops. They are moderately well drained, and permeability is moderately slow. Runoff is medium.

Representative profile of Luckenbach clay loam, 1 to 3 percent slopes, 9.4 miles southwest of the courthouse in Fredericksburg, on Texas Highway 16, then 3.7 miles west on a county road, and 200 feet south in a cultivated field.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate, fine, subangular blocky structure; slightly hard, firm, slightly sticky and plastic; common fine and medium roots; mildly alkaline; abrupt, smooth boundary.

A1—8 to 18 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate, medium, subangular blocky structure; slightly hard, firm, slightly sticky and plastic; few fine roots; mildly alkaline; clear, smooth boundary.

B2t—18 to 30 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate, fine, blocky and subangular blocky structure; hard, firm; few thin clay films; few, fine, weakly cemented calcium carbonate concretions; noncalcareous in soil matrix; moderately alkaline; gradual, smooth boundary.

B3tca—30 to 38 inches, brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate, fine, subangular blocky and blocky structure; hard, firm; 5 percent, by volume, calcium carbonate concretions; calcareous; moderately alkaline; clear, smooth boundary.

C1ca—38 to 45 inches, very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; massive; hard, friable; 10 percent, by volume, calcium carbonate concretions; few limestone fragments; calcareous; moderately alkaline; clear, smooth boundary.

C2ca—45 to 80 inches, very pale brown (10YR 7/3) clay loam; massive; about 10 percent concretions and soft masses of calcium carbonate and 10 percent limestone gravel.

The A horizon is very dark grayish brown, dark grayish brown, and dark brown in color and is 13 to 20 inches thick. It is mildly or moderately alkaline in reaction.

The Bt horizon ranges from reddish brown to brown in color. The B2t horizon is 10 to 18 inches thick, and the B3tca horizon is 8 to 18 inches thick.

The C horizon is very pale brown, pale brown, and light brown in color. The C1ca horizon is 5 to 10 inches thick.

Secondary carbonates in the form of weakly cemented concretions or soft masses are at depths of 18 to 28 inches. The solum is 35 to 50 inches thick.

Luckenbach clay loam, 1 to 3 percent slopes (LuB).—This gently sloping soil is on uplands and terraces in irregular areas 15 to 675 acres in size.

This soil has the profile described as representative for the Luckenbach series.

Included with this soil in mapping are areas of Hensley and Pedernales soils. These areas are mostly 0.5 to 3.5 acres in size and account for less than 8 percent of the acreage.

This Luckenbach clay loam is well suited to cultivation, but some acreage is in range. The main crops grown are small grain and grain sorghum. This soil is subject to a moderate hazard of water erosion. Controlling erosion and maintaining tilth are important where this soil is tilled.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIe–3; Deep Upland range site; pasture and hayland suitability group 7C.

Luckenbach clay loam, 3 to 5 percent slopes (LuC).—This gently sloping soil is on uplands and terraces in oblong to long, narrow areas 5 to 60 acres in size.

The surface layer is dark grayish-brown clay loam about 5 inches thick. The next lower layer is dark-brown clay loam about 12 inches thick. Below this is a layer of reddish-brown clay about 26 inches thick. Below a depth of 43 inches is light-brown, calcareous clay loam.

Included with this soil in mapping are areas of Hensley and Pedernales soils. These areas are mostly 0.7 to 3 acres in size and make up less than 10 percent of the acreage.

This Luckenbach clay loam is mostly in cultivation, but some areas are in range. The main crops are small grain and grain sorghum. This soil is subject to a severe hazard of water erosion. Controlling erosion and maintaining tilth are important where crops are grown.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIIe–3; Deep Upland range site; pasture and hayland suitability group 7C.

Luckenbach clay loam, 2 to 5 percent slopes, eroded (LuC2).—This gently sloping soil is on uplands in areas 5 to 80 acres in size.

The surface layer is dark-brown loam about 14 inches thick. The next lower layer is reddish-brown, calcareous clay about 21 inches thick. Below a depth of 35 inches is light-brown, calcareous clay loam.

Included with this soil in mapping are areas of Hensley soils, mostly 2 to 3 acres in size, that make up less than 5 percent of the acreage.

Most areas of this Luckenbach clay loam have two or three gullies and many small branches per 100 feet. These gullies are 2 to 5 feet wide and 1 to 2 feet deep. Soil also has eroded from between the gullies. These areas are farmed to small grain or are abandoned. This soil is subject to a severe hazard of water erosion, and control-

ling erosion and maintaining tilth are important where it is cultivated.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface aids in maintaining tilth and controlling erosion. Capability unit IVe–1; Deep Upland range site; pasture and hayland suitability group 7C.

Nebgen Series

The Nebgen series consists of very shallow and shallow, slightly acid soils. These soils are gently undulating to hilly and are on uplands. They formed in a thin mantle of loamy materials that overlies strongly cemented sandstone. Slopes are plane to convex.

In a representative profile, about 10 percent of the surface is covered by sandstone fragments that are 10 to 18 inches in diameter. The surface layer is reddish-brown, slightly acid fine sandy loam about 9 inches thick. Below a depth of 9 inches is partially weathered, weakly to strongly cemented, reddish sandstone.

Nebgen soils are best suited to range. They are not suitable for crops. They are well drained, and permeability is moderately rapid. Runoff is rapid.

Representative profile of Nebgen fine sandy loam, in an area of Nebgen-Rock outcrop complex, 1 to 8 percent slopes, 18 miles northeast of Fredericksburg, by Texas Highway 16, then 2.3 miles east by a county road, and 10 feet south in range.

A1—0 to 9 inches, reddish-brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) moist; weak, fine, subangular blocky and granular structure; soft, very friable, slightly sticky; many fine and medium roots; common fine pores; 10 percent of surface covered by sandstone fragments 10 to 18 inches in diameter; slightly acid; clear, irregular boundary.

C—9 to 12 inches, reddish-brown (2.5YR 4/4) partially weathered, weakly cemented, fractured sandstone; an estimated 25 percent reddish-brown (2.5YR 4/4) sandy loam in fractures and in pockets; slightly acid; abrupt, wavy boundary.

R—12 to 16 inches, sandstone; strongly cemented dry; weakly cemented moist.

The A horizon is light reddish brown, reddish brown, or brown and 4 to 9 inches thick. It is fine sandy loam or loam. From 10 to 25 percent of the surface is covered by sandstone fragments.

Where present, the C horizon is partially weathered, weakly cemented, reddish sandstone that is 10 to 25 percent sandy loam or coarse sandy loam. This horizon ranges from 0 to 5 inches in thickness.

The R layer is reddish or brownish sandstone that is strongly cemented when dry but that can be easily broken or crushed when moist. Sandstone bedrock is at a depth of 4 to 14 inches.

Nebgen-Rock outcrop complex, 1 to 8 percent slopes (NrD).—This mapping unit is made up of gently undulating to gently rolling soils and rock outcrops on uplands (fig. 11). Mapped areas are 15 to 275 acres in size. Nebgen soil covers about 75 percent of the unit, Rock outcrop about 15 percent, and less extensive soils about 10 percent. The areas of this unit are so intricately mixed that it is not feasible to separate them at the scale mapped.

This Nebgen soil has the profile described as representative for the series.

Rock outcrop a few square yards to 100 feet in size is scattered throughout the unit. Most of the rock is sandstone, but some areas contain limestone and granite.

Mapped in this unit are areas of Eckert and Oben soils that are mostly 1 to 9 acres in size.

All of this mapping unit is in range. It is subject to a high hazard of water erosion. Capability unit VIIs–2; Sandstone Hill range site; not placed in a pasture and hayland suitability group.

Nebgen-Rock outcrop complex, 8 to 20 percent slopes (NrF).—This mapping unit is made up of rolling to hilly soils and Rock outcrop on uplands. Mapped areas are from 15 to 600 acres in size. Nebgen soil covers about 70 percent of the acreage, Rock outcrop about 25 percent, and less extensive soils about 5 percent. Mapped areas are so intricately mixed that it is not feasible to separate them at the scale used.

The Nebgen soil has a surface layer of reddish-brown, slightly acid fine sandy loam about 8 inches thick. Below this is weakly to strongly cemented sandstone.

Rock outcrop ranges from a few yards to as much as 200 feet in size. Most of the rock is sandstone, but a few areas contain limestone and granite.

Mapped in this unit are areas of Eckert and Oben soils that are mostly 2 to 8 acres in size.

All of this mapping unit is in range. It is subject to a severe hazard of water erosion. Capability unit VIIs–2; Sandstone Hill range site; not placed in a pasture and hayland suitability group.

Oben Series

The Oben series consists of shallow, noncalcareous soils on erosional uplands. These soils formed in material weathered from reddish sandstone.

In a representative profile, the surface layer is reddish-brown, neutral fine sandy loam about 5 inches thick. The next lower layer is yellowish red and neutral. It is fine sandy loam in the upper 9 inches and sandy clay loam in the lower 5 inches. Below a depth of 19 inches is brownish-yellow, strongly cemented sandstone.

Oben soils are best suited to range. Most of the acreage is in range, but a small part is in crops. These soils are well drained and their permeability is moderate. Runoff is slow to medium.

Representative profile of Oben fine sandy loam, 1 to 3 percent slopes, 13 miles northeast of Fredericksburg, by Texas Highway 16, then 1.5 miles east on Ranch Road 1323, 0.15 mile north on a private road, and 100 feet east in pasture.

A1—0 to 5 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak, fine, subangular blocky structure and single grain; slightly hard, very friable; common roots; common fine tubes and pores; 10 percent weakly cemented angular sandstone fragments; neutral; clear, smooth boundary.

B21t—5 to 14 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky structure; slightly hard, very friable, slightly sticky; common, fine and medium roots; common fine tubes and pores; few clay films; estimated 5 percent, by volume, sandstone fragments from 0.5 to 1.5 inches in diameter; neutral; abrupt, wavy boundary.

B22t—14 to 19 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak, very

Figure 11.—An area of Nebgen-Rock outcrop complex, 1 to 8 percent slopes.

fine, subangular blocky and granular structure; hard, friable, sticky; common fine roots; few pores; estimated 65 percent weakly cemented, partially weathered sandstone flags and fragments, 1 to 2 inches thick and 4 to 10 inches long, that can be easily cut with a spade when moist; neutral; abrupt, wavy boundary.

R—19 to 30 inches, brownish-yellow (10YR 6/6) strongly cemented sandstone, less than 3 on Mohs' scale; fractured and somewhat platy in upper part; neutral.

From 0 to 15 percent of the surface is covered by coarse fragments. Coarse fragments in the solum range from a few to about 30 percent, by volume. The fragments are partially weathered sandstone pebbles, cobbles, and flagstones. The solum is 10 to 20 inches thick.

The A horizon ranges from brown to reddish brown in color and from 4 to 7 inches in thickness. The B horizon ranges from yellowish red to reddish brown and brown in color and 5 to 15 inches in thickness. It is fine sandy loam to sandy clay loam in texture.

Some profiles have a 2- to 6-inch C horizon of weathered sandstone or coarsely mottled reddish-brown, red, reddish-yellow, or strong-brown sandy loam or sandy clay loam.

The R layer is yellowish or reddish, weakly to strongly cemented, noncalcareous sandstone that has a hardness of less than 3 on the Mohs' scale.

Oben fine sandy loam, 1 to 3 percent slopes (ObB).—This gently sloping soil is on uplands in areas 10 to 65 acres in size.

This soil has the profile described as representative for the Oben series.

Included with this soil in mapping are areas of Cobb and Nebgen soils. These areas are mostly 0.3 to 1.5 acres in size and make up less than 10 percent of the acreage.

This Oben fine sandy loam is suited to range and crops. The main crops grown are small grain and grain sorghum. This soil is subject to a severe hazard of water erosion. Controlling erosion and maintaining tilth are the major concerns of management where this soil is cultivated.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface aids in maintaining tilth and controlling erosion. Capability unit IVe–3; Sandy Loam range site; pasture and hayland suitability group 14A.

Oben stony fine sandy loam, 2 to 5 percent slopes (OeC).—This gently sloping soil is on uplands in areas 15 to 95 acres in size.

About 15 percent of the surface is covered with stones 10 to 20 inches in diameter. The surface layer is reddish-brown, neutral stony fine sandy loam about 5 inches thick. The next lower layer is reddish-brown, neutral sandy clay loam about 6 inches thick. Below a depth of 11 inches is weakly cemented sandstone.

Included with this soil in mapping are areas of Cobb and Nebgen soils. These areas are mostly 0.2 to 6 acres in size and make up less than 15 percent of the acreage.

This soil is mainly in range, but a small part is in crops. Capability unit VIIs–2; Sandstone Hill range site; pasture and hayland suitability group 14A.

Pedernales Series

The Pedernales series consists of deep, noncalcareous soils on uplands. These soils formed in calcareous, limy earth. Slopes are smooth and plane to convex.

In a representative profile, the surface layer is reddish-brown, neutral fine sandy loam about 11 inches thick. The next lower layer extends to a depth of 43 inches. It is mainly red, mildly alkaline sandy clay, but the lower 5 inches is yellowish-red, moderately alkaline sandy clay loam. Below a depth of 43 inches is light reddish-brown, moderately alkaline sandy clay loam (fig. 12).

Pedernales soils are used mostly for crops; a small acreage is in range. These soils are well drained, and their permeability is moderately slow. Runoff is medium.

Representative profile of Pedernales fine sandy loam, 1 to 3 percent slopes, 2.5 miles southwest of the county courthouse in Fredericksburg by way of Texas Highway 16, and 125 feet southwest of the intersection of Texas Highway 16 and Ranch Road 2093.

Ap—0 to 11 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, subangular blocky and granular structure; hard, friable; few fine roots; neutral; clear, smooth boundary.

B21t—11 to 20 inches, red (2.5YR 5/6) sandy clay, red (2.5YR 4/6) moist; moderate, medium, prismatic structure and moderate, medium, blocky structure; very hard, very firm, sticky and very plastic; few fine tubes and pores; few insect casts and burrows; common clay films; mildly alkaline; gradual, smooth boundary.

B22t—20 to 37 inches, red (2.5YR 5/6) sandy clay, red (2.5YR 4/6) moist; weak, medium, blocky structure; few fine tubes and pores; common clay films; mildly alkaline; gradual, smooth boundary.

B3ca—37 to 43 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak, coarse, blocky structure; hard, firm, sticky; estimated 10 to 15 percent, by volume, soft masses of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

Cca—43 to 63 inches, light reddish-brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; massive; hard, firm, sticky; estimated 25 percent, by volume, soft masses of calcium carbonate; few weakly cemented limestone fragments; calcareous; moderately alkaline.

The A horizon is reddish brown, yellowish red, brown, and pale brown. It is 6 to 15 inches thick.

The Bt and B3ca horizons are red, reddish brown, yellowish red, or reddish yellow. The Bt horizon is 18 to 35 inches thick, and the B3ca horizon is 6 to 20 inches thick.

The Cca horizon is light reddish brown, light brown, reddish brown, reddish yellow, or pinkish gray. The solum is 35 to 60 inches thick.

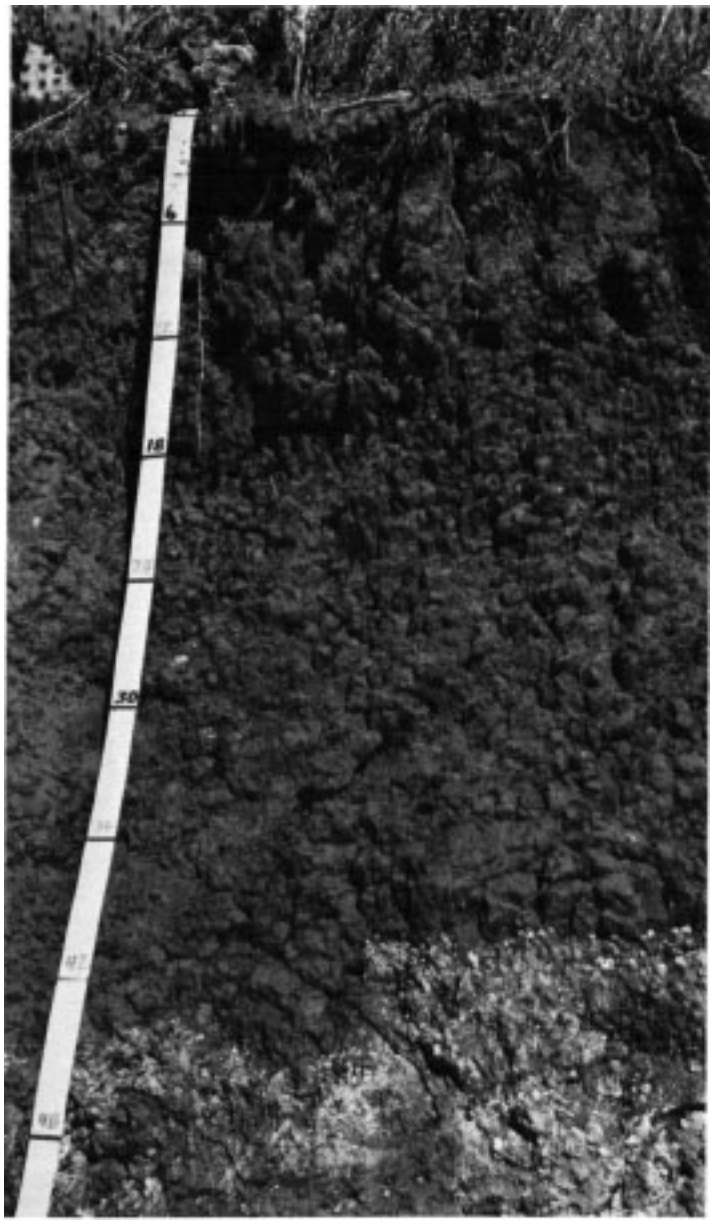

Figure 12.—Profile of a Pedernales fine sandy loam.

Pedernales fine sandy loam, 1 to 3 percent slopes (PeB).—This gently sloping soil is on uplands throughout the county in areas 5 to 145 acres in size.

This soil has the profile described as representative for the Pedernales series.

Included with this soil in mapping are areas of Bastrop, Heatly, and Luckenbach soils. These areas are mostly 0.2 to 3 acres in size and account for less than 5 percent of the acreage.

This Pedernales fine sandy loam is in crops and range. The main crops are grain sorghum, small grain, and peaches. A moderate hazard of water erosion makes controlling erosion and maintaining tilth the main considerations where this soil is cultivated.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the

surface helps maintain tilth and control erosion. Capability unit IIe–3; Tight Sandy Loam range site; pasture and hayland suitability group 8A.

Pedernales fine sandy loam, 3 to 5 percent slopes (PeC).—This gently sloping soil is on uplands throughout the county in areas 5 to 85 acres in size.

The surface layer is reddish-brown, neutral fine sandy loam about 6 inches thick. The next layer is reddish-yellow, neutral sandy clay about 4 inches thick. Below this is red, mildly alkaline sandy clay about 20 inches thick. The next lower layer is red, moderately alkaline sandy clay about 8 inches thick. Below a depth of 38 inches is a pinkish-gray, moderately alkaline sandy clay loam.

Included with this soil in mapping are areas of Heatly, Hensley, and Luckenbach soils. These included soils are mostly 0.2 to 2.5 acres in size and account for less than 10 percent of the acreage.

This Pedernales fine sandy loam is in crops and range. The main crops are small grain, grain sorghum, and peaches. This soil is subject to a severe hazard of water erosion. Controlling erosion and maintaining tilth are important where this soil is cultivated.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIIe–4; Tight Sandy Loam range site; pasture and hayland suitability group 8A.

Purves Series

The Purves series consists of shallow, calcareous soils on uplands throughout the county. These soils formed in material weathered from interbedded, hard limestone and calcareous marls. Slopes are plane to convex.

In a representative profile, the surface layer is very dark grayish brown, calcareous clay in the upper 11 inches and brown, calcareous cobbly clay loam in the lower 3 inches. Below a depth of 14 inches is hard, fractured limestone.

Purves soils are mostly in range. These soils are well drained, and permeability is moderately slow. Runoff is slow to medium.

Representative profile of Purves clay, in an area of Purves soils, undulating, 2.1 miles east of Harper on U.S. Highway 290, then 4.2 miles north and east on a county road, and 20 feet north in range.

A1—0 to 11 inches, very dark grayish-brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate, fine and medium, blocky structure; hard, firm, sticky and plastic; many fine and medium roots; 5 to 10 percent, by volume, coarse limestone fragments on the surface; calcareous; moderately alkaline; clear, smooth boundary.

A1ca—11 to 14 inches, brown (10YR 4/3) cobbly clay loam, dark brown (10YR 3/3) moist; moderate, fine, subangular blocky structure; hard, firm, sticky; estimated 50 percent, by volume, angular limestone fragments from 1 to 2 inches thick and from 2 to 7 inches in diameter that are coated with calcium carbonate; calcareous; moderately alkaline; abrupt, wavy boundary.

R—14 to 19 inches, bed of fractured limestone that has a hardness rating of 3 or more on Mohs' scale.

The A1 horizon is dark grayish brown, very dark grayish brown, or dark brown in color and is 8 to 12 inches thick. It is clay or clay loam in texture.

The A1ca horizon is brown or dark brown in color and 2 to 8 inches thick. It ranges from clay loam to cobbly clay loam or clay in texture.

The solum is 10 to 20 inches thick. The soil is an estimated 10 to 20 percent, by volume, coarse limestone fragments measuring 1 to 10 inches across the long axis.

Purves soils, undulating (PuC).—These undulating soils are on uplands throughout the county. Mapped areas are from 20 to 305 acres in size. Slopes range from 1 to 8 percent. The surface layer ranges from clay loam to clay in texture. The composition of this unit is more variable than for most others in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

Included with these soils in mapping are areas of Denton, Speck, and Tarrant soils. These included soils are mostly 0.5 to 6 acres in size and account for less than 15 percent of the acreage.

These soils are in range. Capability unit VIs–2; Shallow range site; pasture and hayland group 13A.

Renick Series

The Renick series consists of very shallow and shallow, noncalcareous soils on uplands (fig. 13). These soils formed in material weathered from thick beds of tilted, indurated serpentine.

In a representative profile, the surface layer, in sequence from the top, is 8 inches of dark grayish-brown, neutral clay loam that is about 10 percent, by volume, serpentine fragments ranging from 0.25 to 0.5 inch in diameter; 7 inches of dark-brown, neutral clay loam that is 10 to 15 percent, by volume, serpentine fragments from 0.25 to 0.5 inch in diameter; and 4 inches of dark-brown, neutral clay that is 20 percent, by volume, serpentine fragments from 0.25 to 1 inch in diameter. Below a depth of 19 inches is a light olive-gray bed of indurated, fractured serpentine.

Renick soils are used for range. They are well drained, and their permeability is moderately slow. Runoff is medium.

Representative profile of Renick stony clay loam, 5 to 12 percent slopes, 6.5 miles northeast of Willow City, by a county road, then 1.1 miles east on a private road (across Coal Creek), and 0.15 mile north in range.

A11—0 to 8 inches, dark grayish-brown (10YR 4/2) stony clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; hard, friable, sticky; many fine roots; about 10 percent, by volume, serpentine fragments that range from 0.25 to 0.5 inch in diameter; neutral; clear, smooth boundary.

A12—8 to 15 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate, fine and medium, subangular blocky structure; hard, friable, sticky; common fine and medium roots; 10 to 15 percent serpentine fragments that are 0.25 to 0.5 inch in size; neutral; clear, wavy boundary.

A13—15 to 19 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate, fine and medium, subangular blocky structure; hard, friable, sticky; few fine roots; 20 percent, by volume, soft and cemented angular serpentine fragments that are 0.25 to 1 inch in size; neutral; clear, wavy boundary.

R—19 to 22 inches, light olive-gray (5Y 6/2) bed of indurated fractured serpentine that has a few roots in fractures.

The soil surface is broken by outcropping of serpentine rock. Coarse fragments of pebble-size serpentine make up from 10 to 35 percent, by volume, of the soil. The A horizon is dark brown, dark grayish brown, or very dark grayish brown in color.

The R layer is light-gray or light olive-gray indurated serpentine that is tilted from 30 degrees to 60 degrees from horizontal. This layer ranges from slightly acid to mildly alkaline in reaction. The solum is 2 to 20 inches thick.

Renick stony clay loam, 5 to 12 percent slopes (ReE).—This gently rolling to rolling soil is on erosional uplands in long, oval areas.

Included with this soil in mapping are areas of Katemcy and Ligon soils. These included soils are mostly 0.5 to 1.5 acres in size and account for less than 15 percent of the acreage.

This Renick stony clay loam is in range. Capability unit VIIs–2; Serpentine Hills range site; not placed in a pasture and hayland suitability group.

Speck Series

The Speck series consists of shallow, noncalcareous soils on uplands. These soils formed in noncalcareous

Figure 13.—An area of Renick stony clay loam, 5 to 12 percent slopes.

clays that overlie indurated limestone. Slopes are plane to convex.

In a representative profile, the surface layer is dark reddish-brown, neutral clay about 7 inches thick. The next layer, extending to a depth of 17 inches, is reddish-brown, neutral clay. Below a depth of 17 inches is indurated limestone.

Speck soils are mostly in range, but a minor acreage is in crops. These soils are well drained, and their permeability is slow. Runoff is medium.

Representative profile of Speck stony clay, 1 to 8 percent slopes, 19.7 miles west on U.S. Highway 290 from its intersection with U.S. Highway 87 in Fredericksburg, then 20 feet south in range.

A1—0 to 7 inches, dark reddish-brown (5YR 3/2) stony clay, dark reddish brown (5YR 2/2) moist; moderate, fine and medium, granular structure; hard, firm, sticky and plastic; many fine roots; 10 to 15 percent of surface covered by cobbles and stones; neutral; clear, smooth boundary.

B2t—7 to 17 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong, medium, blocky structure; very hard, very firm, sticky and plastic; few fine roots and pores; few angular chert fragments; neutral; abrupt, wavy boundary.

R—17 to 20 inches, indurated limestone bedrock.

Cobbles and stones from 6 to 12 inches in diameter cover 10 to 15 percent of the surface. The A horizon is dark grayish brown, dark reddish brown, or brown in color and is 7 to 9 inches thick. The B2t horizon is reddish brown, dark reddish brown, or brown and is 7 to 10 inches thick. This horizon is slightly acid to mildly alkaline in reaction.

The solum is 14 to 19 inches thick and is 5 to 20 percent, by volume, angular chert fragments from 0.25 to 6 inches in diameter.

Speck gravelly clay, 1 to 4 percent slopes (SpC).—This gently sloping soil is on uplands throughout the county in areas 5 to 125 acres in size.

The surface layer is dark reddish-brown, neutral clay about 7 inches thick. It is about 10 percent, by volume, small chert fragments, mostly of gravel size. The next lower layer, to a depth of 14 inches, is dark reddish-brown, neutral clay. Below a depth of 14 inches is indurated, fractured limestone.

Included with this soil in mapping are areas of Denton, Doss, and Topia soils. These included soils are mostly 0.3 to 1 acre in size and account for less than 10 percent of the acreage.

This Speck gravelly clay is used mostly for crops, but a small acreage is in range. The main crops are small grain and grain sorghum. This soil is subject to a severe hazard of water erosion. Controlling erosion and maintaining tilth are important where this soil is cultivated.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain soil tilth and control erosion. Capability unit IIIe–9; Redland range site; pasture and hayland suitability group 13A.

Speck stony clay, 1 to 8 percent slopes (SsD).—This undulating soil is on erosional uplands in areas 25 to 710 acres in size.

This soil has the profile described as representative for the Speck series.

Included with this soil in mapping are areas of Purves, Tarrant, and Topia soils. These included soils are mostly 0.5 to 3 acres in size and account for less than 15 percent of the acreage.

This Speck stony clay is used for range. Capability unit VIe–2; Redland range site; pasture and hayland suitability group 13A.

Tarrant Series

The Tarrant series consists of shallow and very shallow, calcareous soils on ridgetops and breaks in the erosional uplands. These soils formed in place in material weathered mainly from limestone. Slopes are plane to convex.

In a representative profile, the surface layer is very dark grayish-brown to dark grayish-brown, calcareous stony and cobbly clay about 12 inches thick. Below a depth of 12 inches is indurated, fractured limestone (fig. 14).

Tarrant soils are best suited to and are used for range. These soils are well drained, and permeability is moderately slow. Runoff is rapid.

Representative profile of Tarrant cobbly clay, in an area of Tarrant soils, undulating, 5.3 miles northwest on U.S. Highway 87 from its intersection with U.S. High-

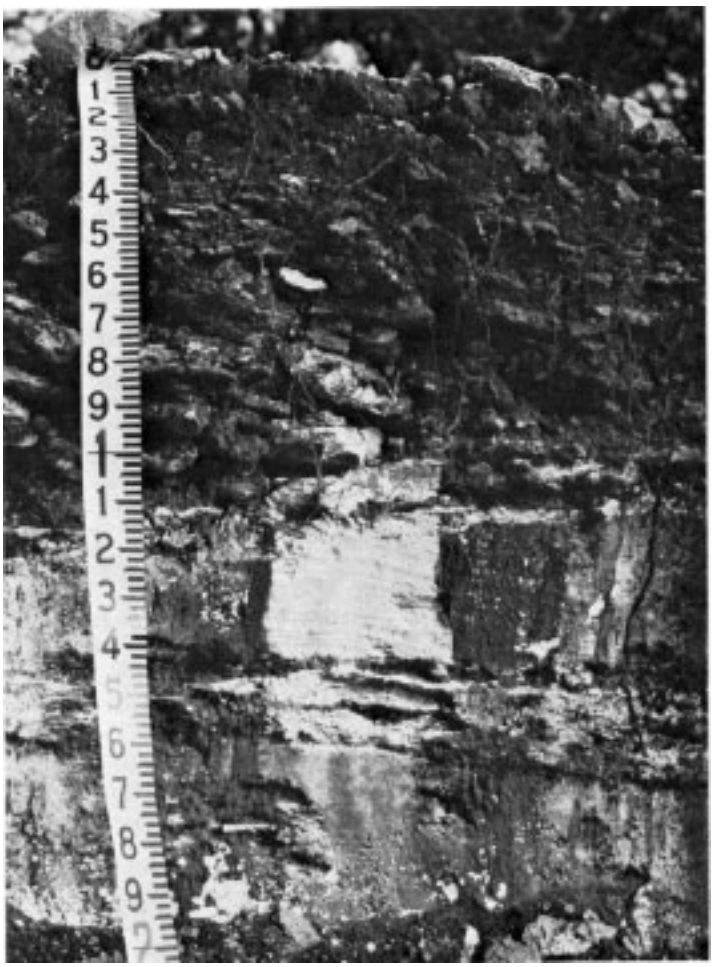

Figure 14.—Indurated, fractured limestone bedrock in Tarrant soils.

way 290 in Fredericksburg, then 3.7 miles north of U.S. Highway 87 on a county road, and 25 feet west of the county road in range.

A1—0 to 6 inches, very dark grayish-brown (10YR 3/2) cobbly clay, very dark brown (10YR 2/2) moist; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; an estimated 45 percent, by volume, limestone cobbles and stones 6 to 12 inches in diameter; calcareous; moderately alkaline; clear, smooth boundary.

A1ca—6 to 12 inches, dark grayish-brown (10YR 4/2) cobbly clay, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure; hard, firm, sticky and plastic; few fine and medium roots; an estimated 55 percent, by volume, limestone cobbles and stones 6 to 12 inches in diameter that have calcium carbonate coatings; calcareous; moderately alkaline; abrupt, wavy boundary.

R—12 to 15 inches, indurated, fractured limestone.

The A horizon is dark grayish brown, dark brown, or very dark grayish brown. The A1 and A1ca horizons are each 4 to 8 inches thick. The R layer is indurated, fractured limestone.

The solum ranges from 8 to 16 inches in thickness. It is an estimated 35 to 65 percent, by volume, limestone cobbles and stones.

Tarrant soils, undulating (TaC).—These undulating soils are on the tops of limestone hills. Mapped areas are on uplands and are from 15 to 950 acres in size. Slopes are 1 to 8 percent and plane to convex. Stones and cobbles cover the surface. The size of these mapped areas generally is larger and the composition more variable than for most others in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

These soils have the profile described as representative for the Tarrant series, but the surface layer ranges from cobbly clay or gravelly clay that contains some stones.

Mapped with these Tarrant soils are areas of Brackett, Purves, Speck, and Topia soils. These included soils are mostly 0.5 to 8 acres in size and account for less than 15 percent of the total acreage.

These Tarrant soils are best suited to range. They provide many kinds of forage for livestock and food and cover for wildlife. Capability unit VIIs–1; Low Stony Hill range site; not placed in a pasture and hayland suitability group.

Tarrant-Rock outcrop association, steep (TkE).—This mapping unit is about 72 percent Tarrant soils, 25 percent Rock outcrop, and 3 percent other less extensive soils. The areas are rolling to hilly and are on the breaks and sides of limestone hills. They are 15 to 740 acres in size. Slopes are 8 to 20 percent. Areas of this mapping unit are larger and more variable than those for most other soils in the county. Mapping has been controlled well enough, however, that the variation does not affect the anticipated uses.

The surface layer of the Tarrant soil is dark grayish-brown, calcareous cobbly clay that is about 6 inches thick. It is an estimated 45 percent, by volume, limestone cobbles and stones 6 to 15 inches in diameter. The next lower layer, about 5 inches thick, is dark-brown, calcareous cobbly clay that is an estimated 60 percent, by volume, limestone cobbles and stones 6 to 15 inches in diameter. Below a depth of 11 inches is indurated, fractured limestone.

The Rock outcrops are 1 to 4 acres in size and are in an irregular pattern in the landscape. Most of the rock is limestone, but sandstone and granite outcrop in a few areas.

Included in this mapping unit are areas of Brackett and Speck soils. These included soils are mostly 3 to 11 acres in size.

The soils of this mapping unit occur in regular patterns that allow separate delineation, but use and management are similar, and separation is therefore not justified. This unit is in range. Capability unit VIIs–1; Steep Rocky range site; not placed in a pasture and hayland suitability group.

Tobosa Series

The Tobosa series consists of deep, calcareous soils on uplands. These soils formed in calcareous clays.

In a representative profile, the surface layer is very dark grayish-brown to dark grayish-brown, calcareous clay about 48 inches thick. The underlying material also is dark grayish-brown, calcareous clay.

Tobosa soils are mostly in crops, but a small acreage is in range. These soils are moderately well drained, and their permeability is very slow. Runoff is medium.

Representative profile of Tobosa clay, 8.1 miles southeast of the courthouse in Fredericksburg, on U.S. Highway 290, and 40 feet north in a cultivated field.

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; many fine and medium roots; calcareous; moderately alkaline; abrupt, smooth boundary.

A11—6 to 14 inches, very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; few fine roots; calcareous; moderately alkaline; clear, smooth boundary.

A12—14 to 30 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, medium, blocky structure; hard, firm, sticky and plastic; some cracks that have filled with soil from horizon above; few fine concretions of iron and manganese; calcareous; moderately alkaline; clear, smooth boundary.

AC—30 to 48 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 4/2) moist; strong, medium, blocky structure; hard, firm, sticky and plastic; 2 to 4 percent concretions of iron and manganese; few hard masses of calcium carbonate; few fine cracks filled with darker colored soil from above; calcareous; moderately alkaline; clear, smooth boundary.

C—48 to 60 inches, dark grayish-brown (10YR 4/2) clay, dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky and plastic; few cemented concretions of calcium carbonate; calcareous; moderately alkaline.

The Ap, A11, and A12 horizons are very dark grayish brown, dark grayish brown, or grayish brown and range from 11 to 32 inches in thickness. The AC horizon is grayish brown, brown, or pale brown and 13 to 25 inches thick. The C horizon is dark grayish brown or grayish brown.

The solum is 42 to 57 inches thick. Cracks 0.25 to 1 inch wide are in this soil when it is dry.

Tobosa clay (To).—This level to nearly level soil is on uplands in areas 5 to 140 acres in size. Slopes are less than 1 percent.

Included with this soil in mapping are areas of Den-

ton soils. These included soils are mostly 0.3 to 1.5 acres in size and account for less than 3 percent of the acreage.

This Tobosa clay is mostly cultivated. The main crops are small grain and grain sorghum. Maintenance of improvement of tilth is important where crops are grown.

Contour farming helps control water erosion and conserve moisture. Crop residues kept on the surface help to maintain tilth and control erosion. Capability unit IIIs–1; Deep Upland range site; pasture and hayland suitability group 7A.

Topia Series

The Topia series consists of moderately deep, noncalcareous soils on uplands. These soils formed in place in clayey material weathered from limestone. Slopes are plane to convex.

In a representative profile, the surface layer is dark grayish-brown, noncalcareous clay about 9 inches thick. The next layer is reddish-brown, noncalcareous clay that extends to a depth of 24 inches. The next lower layer is 8 inches of brown, calcareous clay. Below this is indurated, fractured limestone (fig. 15).

Topia soils are suited to crops and range, and most of these soils are in range. They are well drained, and their permeability is very slow. Runoff is slow to medium.

Representative profile of Topia clay, 11.3 miles southwest of the courthouse in Fredericksburg, by Texas Highway 16, then 30 feet west in range.

A1—0 to 9 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; very hard, very firm, sticky and plastic; common, fine and medium roots; few chert fragments; noncalcareous; moderately alkaline; clear, smooth boundary.

B21t—9 to 24 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate, medium, blocky structure; very hard, very firm, sticky and plastic; few fine roots; common, very fine limestone fragments; cracks filled with darker colored soil from horizon above; noncalcareous; moderately alkaline; clear, wavy boundary.

B22t—24 to 32 inches, brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate, medium, blocky structure; very hard, very firm, sticky and plastic; pressure faces on peds; 5 to 7 percent, by volume, limestone fragments from 1 to 2 millimeters in size; calcareous; moderately alkaline; abrupt, wavy boundary.

R—32 to 35 inches, indurated, fractured limestone.

The A horizon is dark grayish brown, dark brown, or reddish brown and is 7 to 10 inches thick.

The B horizon is brown, reddish brown, or dark brown and is 16 to 27 inches thick. The R layer is interbedded chalk and marl or indurated limestone. The solum is 23 to 38 inches thick.

Topia clay, 1 to 3 percent slopes (TpB).—This gently sloping soil is on uplands in areas 5 to 100 acres in size.

This soil has the profile described as representative for the Topia series.

Included with this soil in mapping are areas of Denton, Hensley, and Speck soils. These included soils are mostly 0.3 to 2.5 acres in size and account for less than 8 percent of the acreage.

This Topia clay is in crops and range. The main crops are small grain and grain sorghum. This soil is subject to a moderate hazard of water erosion. Controlling erosion and maintaining tilth are important where this soil is cultivated.

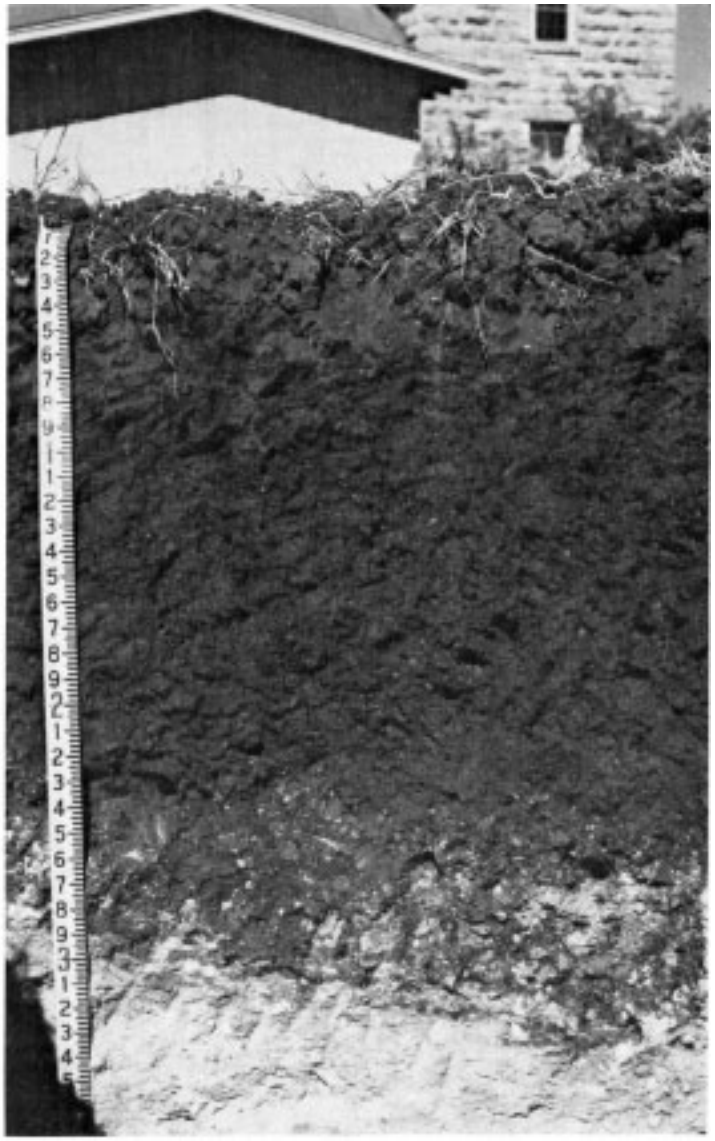

Figure 15.—Profile of a Topia clay

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIIe–2; Redland range site; pasture and hayland suitability group 7A.

Topia clay, 3 to 5 percent slopes (TpC).—This gently sloping soil is on uplands throughout the county in areas 5 to 75 acres in size.

The surface layer is dark-brown, noncalcareous clay about 7 inches thick. The next lower layer is reddish-brown, noncalcareous clay about 16 inches thick. Below a depth of 23 inches is hard limestone.

Included with this soil in mapping are areas of Doss, Hensley, and Speck soils. These included soils are mostly 0.2 to 3 acres in size and account for less than 8 percent of the acreage.

531-432—75——3

This soil is used for range and crops. The main crops are small grain and grain sorghum. A high hazard of water erosion makes controlling erosion important where this soil is cultivated. Preserving tilth also is important.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IVe-1; Redland range site; pasture and hayland suitability group 7A.

Vashti Series

The Vashti series consists of moderately deep to deep, noncalcareous soils on uplands. These soils formed in sandy and loamy materials that overlie sandstone. Slopes are plane to concave.

In a representative profile, the surface layer is slightly acid loamy fine sand. It is yellowish brown in the upper 6 inches and light brownish gray in the lower 8 inches. The next lower layer, extending to a depth of 38 inches, is slightly acid sandy clay loam. It is light yellowish brown in the upper part and light gray in the lower part. Below a depth of 38 inches is strongly cemented sandstone.

Vashti soils are suited to use as cropland and range. They are moderately well drained, and their permeability is moderate. Runoff is slow to medium.

Representative profile of Vashti loamy fine sand, 1 to 5 percent slopes, 15.5 miles northeast of the junction of Texas Highway 16 and U.S. Highway 290 in Fredericksburg, by Texas Highway 16, then 1.6 miles east of a private road, and 30 feet north of the south fence line.

Ap—0 to 6 inches, yellowish-brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; single grain; loose, very friable; common fine and few medium roots; slightly acid; abrupt, smooth boundary.

A2—6 to 14 inches, light brownish-gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; single grain; loose, very friable; common fine roots; few insect burrows; slightly acid; clear, smooth boundary.

B21t—14 to 30 inches, light yellowish-brown (2.5Y 6/4) sandy clay loam, light olive brown (2.5Y 5/4) moist; few, fine, distinct mottles of light brownish gray and common, fine, distinct mottles of red; moderate fine and medium, blocky structure; hard, firm, sticky and plastic; few fine roots; slightly acid; clear, smooth boundary.

B22t—30 to 38 inches, light-gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; common, fine, distinct mottles of red and olive yellow; moderate, medium, blocky structure; hard firm, sticky and plastic; common, fine tubes and pores; slightly acid; abrupt, smooth boundary.

R—38 to 40 inches, strongly cemented, yellowish-brown sandstone.

The Ap horizon is yellowish brown, dark yellowish brown, or light brown and is 4 to 6 inches thick. It is loamy fine sand or fine sandy loam. The A2 horizon is light brownish gray or light gray and is 8 to 10 inches thick.

The B horizon is light yellowish brown, yellowish brown, light olive brown, or light gray and is 16 to 26 inches thick. This horizon has mottles of red, yellowish red, light grayish brown, and light brownish gray.

The R layer is weakly to strongly cemented sandstone. It is neutral to slightly acid. The solum is 29 to 45 inches thick.

Vashti fine sandy loam, 1 to 3 percent slopes (VhB).—This gently sloping soil is in slightly concave, depressed areas that are 5 to 135 acres in size.

The surface layer is dark yellowish-brown, slightly acid fine sandy loam about 5 inches thick. Below the surface layer, and extending to a depth of 10 inches, is light-gray fine sandy loam. The next lower layer, extending to a depth of 26 inches, is yellowish-brown, slightly acid sandy clay loam that has common distinct mottles of yellowish red and light brownish gray. Below this, and extending to a depth of 40 inches, is light olive-brown, slightly acid sandy clay loam that has a few distinct mottles of light grayish brown. Below a depth of 40 inches is light olive-brown, weakly cemented sandstone.

Included with this soil in mapping are areas of Demona and Pedernales soils. Also included are areas of soils in depressions that are wetter than this Vashti fine sandy loam. The included areas are mostly 0.2 to 2.5 acres in size and account for less than 10 percent of the acreage.

This Vashti fine sandy loam is used for both crops and range. The main crop grown is small grain. A moderate hazard of water erosion makes control of erosion important where this soil is cultivated. Maintaining tilth is another important consideration.

Terraces and contour farming help control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control erosion. Capability unit IIe-1; Sandy Loam range site; pasture and hayland suitability group 8C.

Vashti loamy fine sand, 1 to 5 percent slopes (VaC).—This gently sloping soil is on uplands in areas 5 to 50 acres in size.

This soil has the profile described as representative for the Vashti series.

Included with this soil in mapping are areas of Demona and Heatly soils. These included soils are mostly 0.1 to 1.5 acres in size and account for less than 5 percent of the acreage.

This Vashti loamy fine sand is used for crops and range. The major crops grown are small grain and grain sorghum. This soil is subject to severe hazards of water erosion and soil blowing. Controlling erosion and soil blowing and maintaining tilth are the main considerations where this soil is cultivated.

Contour farming helps control water erosion and conserve moisture. Crop residue kept on the surface helps maintain tilth and control soil blowing and water erosion. Capability unit IIIe-7; Sandy range site; pasture and hayland suitability group 9A.

Use and Management of the Soils

This section discusses use and management of the soils in Gillespie County for crops, range, wildlife habitat, and engineering. The capability classification, range site, and pasture and hayland suitability group for each soil are listed in the "Guide to Mapping Units" at the back of this survey. Detailed information about the use and management of each soil for crops or range is discussed in the section "Descriptions of the Soils."

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In Gillespie County, soils are classified only according to dryland capability units. Irrigation is not widely used in this county.

In the capability system, all kinds of soils are grouped at three levels: the capability class, subclass, and unit. The eight capability classes in the broadest, most inclusive grouping are designated by Roman numerals I through VIII. In class I, the soils have few limitations. The soils in other classes have progressively greater limitations.

The capability subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example IIc–2 or VIIs–3. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraphs; and the Arabic numeral specifically identifies the capability unit within each subclass.

The eight classes in the capability system and the subclasses and units in Gillespie County are described in the following list. The unit designation for each soil in the county can be found in the "Guide to Mapping Units" at the back of the survey. The suitability of each soil for crops and suggestions for its management are given under the heading "Descriptions of the Soils."

Class I. Soils have few limitations that restrict their use. (There are no Class I soils in Gillespie County.)

Class II. Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

- Subclass IIc. Soils that have slight limitations because of climate.
  - Unit IIc–1. Nearly level loamy soils that are moderately slowly permeable.
  - Unit IIc–2. Nearly level loamy soils that are moderately slowly to moderately permeable.
- Subclass IIe. Soils that have slight limitations because of erosion.
  - Unit IIe–1. Gently sloping soils that are moderately permeable.
  - Unit IIe–2. Gently sloping loamy to clayey soils that are moderately to slowly permeable.
  - Unit IIe–3. Gently sloping loamy soils that are moderately slowly permeable.
  - Unit IIe–4. Nearly level to gently sloping loamy soils that are moderately rapidly permeable.

Class III. Soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

- Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.
  - Unit IIIe–1. Gently sloping clayey soils that are moderately slowly permeable.
  - Unit IIIe–2. Gently sloping clayey soils that are very slowly permeable.
  - Unit IIIe–3. Gently sloping, deep, loamy soils that are moderately slowly permeable.
  - Unit IIIe–4. Gently sloping loamy and gravelly loamy soils that are moderately to slowly permeable.
  - Unit IIIe–5. Gently sloping loamy to clayey soils that are moderately to slowly permeable.
  - Unit IIIe–6. Gently sloping, moderately deep loamy soils that are moderately slowly permeable.
  - Unit IIIe–7. Gently sloping sandy soils that are moderately to moderately slowly permeable.
  - Unit IIIe–8. Gently sloping clayey soils that are moderately permeable.
  - Unit IIIe–9. Gently sloping clayey and stony clayey soils that are slowly permeable.
- Subclass IIIs. Soils that are subject to severe limitations because they are shallow, droughty, or stony.
  - Unit IIIs–1. Nearly level clayey soils that are very slowly permeable.

Class IV. Soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

- Subclass IVe. Soils that have very severe limitations caused by erosion.

Unit IVe–1. Gently sloping loamy to clayey soils that are moderately slowly to slowly permeable.
Unit IVe–2. Gently sloping loamy soils that are moderately slowly permeable.
Unit IVe–3. Gently sloping loamy soils that are moderately permeable.
Unit IVe–4. Gently sloping clayey soils that are moderately slowly permeable.

Class V. Soils that are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, or wildlife habitat.
Subclass Vw. Soils that are severely limited by water on or in the soil.
Unit Vw–1. Nearly level to gently undulating loamy soils that are moderately slowly to moderately rapidly permeable.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, range, or wildlife habitat.
Subclass VIe. Soils that are severely limited, chiefly by risk of erosion unless protective cover is maintained.
Unit VIe–1. Undulating, noncalcareous loamy soils that are moderately slowly permeable.
Unit VIe–2. Gently undulating to gently rolling loamy to stony, clayey soils that are slowly permeable.
Subclass VIs. Soils that have severe limitations because of shallow root zone.
Unit VIs–1. Undulating, calcareous, loamy soils that are moderately slowly permeable.
Unit VIs–2. Gently undulating to gently rolling clayey soils and stony clayey soils that are moderately slowly permeable.
Unit VIs–3. Gently undulating to gently rolling, gravelly loamy soils that are rapidly permeable.
Unit VIs–4. Undulating, cobbly loamy soils that are slowly permeable.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and restrict their use largely to range or wildlife habitat.
Subclass VIIs. Soils that have very severe limitations because they have a shallow root zone.
Unit VIIs–1. Undulating to hilly clayey soils that are moderately slowly permeable.
Unit VIIs–2. Gently sloping to gently undulating to hilly, loamy to gravelly soils and stony loamy soils that are moderately slowly to moderately rapidly permeable.
Unit VIIs–3. Rolling to hilly loamy soils and land types that are moderately slowly permeable.

Class VIII. Soils and landforms having limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, or esthetic purposes.
Subclass VIIIs. Land type consisting of rock outcrop.
Unit VIIIs–1. Rolling land types that have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or esthetic purposes.

Estimated Yields

Table 2 lists the soils of Gillespie County and gives the estimated average acre yields of the principal crops under improved management. These estimates are not the maximum yields obtainable.

The improved management used to obtain the yields given includes the following practices: (1) using soil-improving crops, cover crops, and crops that consistently produce large amounts of residue; (2) managing crop residue to prevent erosion, increase water infiltration, and enhance seedling emergence; (3) applying fertilizer in amounts and at times determined by soil tests and crop needs; (4) tilling, seeding, and harvesting at the proper times; (5) controlling weeds, insects, and plant diseases; (6) planting improved and adapted crop varieties at recommended rates and times.

Oats, wheat, grain sorghum, peaches, sudangrass, and coastal bermudagrass are the main crops in the county. Although crops other than those shown in table 2 are grown, their estimated yields are not included because they are grown only in small acreage, and adequate data therefore are not available.

TABLE 2.—*Estimated average yields per acre of principal crops grown under improved management*

[Absence of data indicates that the crop is not commonly grown on the soil. Soils not listed are not under cultivation or the acreage is not large enough for accurate estimates]

Soil	Oats	Wheat	Grain sorghum	Peaches	Pasture	
					Sudangrass	Coastal bermudagrass
	Bu	*Bu*	*Lbs*	*Bu*	*AUM*[1]	*AUM*[1]
Altoga silty clay, 3 to 5 percent slopes	25		2,500		2	4
Bastrop fine sandy loam, 1 to 3 percent slopes	50		3,000	90	3	5
Bastrop loamy fine sand, 1 to 5 percent slopes	30			100	3	4
Blanket clay loam	55	30	3,250	60	4	5
Bonti loamy sand, 3 to 5 percent slopes	40		2,000		3	4
Castell gravelly sandy loam, 1 to 5 percent slopes					3	3
Cobb fine sandy loam, 1 to 5 percent slopes					3	3

TABLE 2.—*Estimated average yields per acre of principal crops grown under improved management*—Continued

Soil	Oats	Wheat	Grain sorghum	Peaches	Pasture	
					Sudangrass	Coastal bermudagrass
	Bu	*Bu*	*Lbs*	*Bu*	*AUM*[1]	*AUM*[1]
Demona fine sand, 1 to 5 percent slopes	30				2	4
Denton silty clay, 1 to 3 percent slopes	60	30	3, 500		4	6
Denton silty clay, 3 to 5 percent slopes	50	25	2, 750		4	5
Denton silty clay, 3 to 5 percent slopes, eroded	30	20	1, 750		3	3
Doss silty clay, 1 to 5 percent slopes	60	20			3	
Doss soils, 1 to 5 percent slopes, eroded	30				3	
Frio silty clay loam	60	30			4	6
Guadalupe loam	50		2, 500		4	5
Heatly loamy fine sand	35			110	3	4
Hensley soils, 1 to 3 percent slopes	30				2	3
Katemcy clay loam, 1 to 5 percent slopes			900			3
Krum silty clay, 1 to 3 percent slopes	60		3, 750		4	7
Krum silty clay, 3 to 5 percent slopes	45		2, 750		3	5
Lewisville clay loam, 0 to 1 percent slopes	60	30	3, 250		4	6
Lewisville clay loam, 1 to 3 percent slopes	60	25	3, 250		4	6
Lewisville clay loam, 3 to 5 percent slopes	50	20	2, 750		3	5
Ligon clay loam, 1 to 5 percent slopes					2	3
Luckenbach clay loam, 1 to 3 percent slopes	50	25	3, 000	60	4	5
Luckenbach clay loam, 3 to 5 percent slopes	45	20	2, 750	55	4	5
Luckenbach clay loam, 2 to 5 percent slopes, eroded	30	20	1, 750	40	3	3
Oben fine sandy loam, 1 to 3 percent slopes	30				3	3
Pedernales fine sandy loam, 1 to 3 percent slopes	50	25		90	3	4
Pedernales fine sandy loam, 3 to 5 percent slopes	30	25		85	3	3
Speck stony clay, 1 to 8 percent slopes					2	2
Tobosa clay	50	25	2, 000		4	4
Topia clay, 1 to 3 percent slopes	35	25			3	3
Topia clay, 3 to 5 percent slopes	25	20			3	2
Vashti fine sandy loam, 1 to 3 percent slopes	50		2, 500		3	5
Vashti loamy fine sand, 1 to 5 percent slopes	35		2, 000		2	5

[1] Animal-unit-month is a term used to express the carrying capacity of pasture. It is the number of animal units carried per acre multiplied by the number of months the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 2 months of grazing for 2 cows has a carrying capacity of 4 animal-unit-months.

Use of Soils for Pasture and Hayland

Pasture and hay are important in Gillespie County because raising livestock is the main enterprise. The most important grass is Coastal bermudagrass. In Gillespie County, the present trend is to convert cropland to improved pasture and hayland. An improved pasture is one in which introduced grasses are used to obtain high yields of forage.

Coastal bermudagrass is a high-producing, high-quality grass that is established by sprigging. The grass requires a high level of management.

Good management of pasture or meadow requires rotation grazing to insure that plants retain vigor; control of weeds and insects; applying fertilizer according to soil tests, forage needs, and amount of moisture available; and providing adequate water for livestock. Supplemental irrigation can be used to good advantage in years when rainfall is below average.

Good management of hayland requires application of fertilizer at the proper time and rate and cutting forage when it is at the stage of growth that furnishes the most nutritious hay.

Pasture and hayland suitability groups

The soils in Gillespie County have been placed in pasture and hayland groups according to their suitability for the growth of forage. The soils in each group are enough alike to be suited to the same grasses, to require similar management, and to produce similar yields. These groups are a convenient method of recommending management for all soils in that group. The Guide to Mapping Units shows the pasture and hayland suitability group for each soil in the county.

Pasture and hayland suitability groups are generally assigned locally but are a part of a statewide system. All of the groups in the system are not represented by soils in Gillespie County, and for this reason, the numbers and letters assigned to the groups in this county are not consecutive. Each pasture and hayland suitability group represented by soils in Gillespie County is described in the following paragraphs.

PASTURE AND HAYLAND GROUP IC

This group is made up of loamy, nearly level to gently undulating soils. These soils have high available water capacity and, in some places, are subject to overflow unless protected. These soils are best suited to warm-season forage production and use. Nitrogen and phosphorus are needed to maintain the productivity of these soils. The potential production is high for such grasses as improved bermudagrass, Kleingrass-75, and johnson grass.

PASTURE AND HAYLAND GROUP 2A

This group is made up of loamy soils that are nearly level to gently sloping and gently undulating. These soils are subject to overflow unless protected. The available water capacity is moderate. The hazard of overflow and seasonal winter wetness make this group best suited to warm-season production and use of forage. Soils in this group are productive, but to maintain this productivity they require fertilizer that contains nitrogen, phosphorus, and potassium. Forage production is high for grasses such as improved bermudagrass, Kleingrass–75, johnsongrass, and indiangrass.

PASTURE AND HAYLAND GROUP 7A

The soils in this group are clayey and are nearly level to gently sloping. These soils crack when dry and expand when wet. They have high available water capacity and are seasonally wet and seasonally droughty. If grazed when wet, they become puddled.

Seedbed preparation is difficult because these soils are clayey. Fertilizer containing nitrogen and phosphorus is needed to maintain adequate forage production. These soils are best suited to warm-season forage production and use. The potential production is high for such grasses as improved bermudagrass and Kleingrass. Other adapted grasses are K.R. bluestem and Kleberg bluestem.

PASTURE AND HAYLAND GROUP 7C

The soils of this group are clayey to loamy and cobbly loamy and are nearly level to gently sloping and undulating. These soils have moderate to high available water capacity. Additions of nitrogen and phosphorus are needed to maintain adequate forage production. The potential production of these soils is high for production of such grasses as improved bermudagrass, Kleingrass, (fig. 16) indiangrass, switchgrass, and weeping lovegrass. Other adapted grasses that grow well are K.R. bluestem and Kleberg bluestem.

PASTURE AND HAYLAND GROUP 8A

This group is made up of loamy to gravelly loamy soils that are gently sloping. These soils have moderate to high available water capacity. They are seasonally wet or seasonally droughty. They need a complete fertilizer containing nitrogen, phosphorus, and potassium to maintain forage production. Their potential is medium to high for production of such grasses as improved bermudagrass and weeping lovegrass. Introduced bluestems such as K.R. bluestem also are adapted.

PASTURE AND HAYLAND GROUP 8C

The soils of this group are loamy and gravelly loamy. They are gently sloping and gently undulating to gently

Figure 16.—**An area of Kleingrass on Lewisville clay loam, 1 to 3 percent slopes.**

rolling. They have a low to high available water capacity. These soils need a complete fertilizer containing nitrogen, phosphorus, and potassium to maintain adequate production of forage. Quick surface drying, soil blowing, and some crusting are hazards to establishment of grass. The potential production is medium to high for such grasses as improved bermudagrass and weeping lovegrass.

PASTURE AND HAYLAND GROUP 9A

This group is made up of sandy, gently sloping soils that have low to high available water capacity.

The cutting action of blowing sand and the difficulty in packing the soils to hold moisture after planting make it hard to establish perennial grass by seeding on a clean seedbed.

A complete fertilizer containing nitrogen, phosphorus, and potassium is needed to maintain adequate production of forage. The potential of these soils is medium to high for production of such grasses as improved bermudagrass and weeping lovegrass.

PASTURE AND HAYLAND GROUP 13A

Loamy to clayey and stony to gravelly clayey soils that are gently sloping to gently undulating to gently rolling make up this group. These soils have a low available water capacity.

Fertilizer containing nitrogen and phosphorus is needed to maintain adequate forage production. The potential production is low to medium for such grasses as improved bermudagrass, K.R. bluestem, and Kleberg bluestem.

PASTURE AND HAYLAND GROUP 14A

This group is made up of loamy to stony loamy soils that are gently sloping. Their available water capacity is low. A complete fertilizer containing nitrogen, phosphorus, and potassium is needed to maintain adequate production of forage. The potential production is medium to low for such grasses as improved bermudagrass, K.R. bluestem, Kleberg bluestem, and weeping lovegrass.

Use of the Soils for Range [2]

About 573,000 acres, or 85 percent of the agricultural land in Gillespie County, is range. The range is made up mainly of native vegetation which is used for the production of domestic livestock and deer and other wildlife. This subsection discusses the use of native range in the county. It also explains range condition classes and describes individual range sites.

Range is the major renewable natural resource in the county, and the raising of livestock is the major enterprise. Cattle and sheep are grazed throughout the county. Angora goats are raised primarily in the southwestern part. Recreation and hunting of deer and wild turkey, which use the range for food and cover, are additional profitable enterprises in many areas.

The soils on the limestone hills produce live oak, shin oak, and other browse plants, as well as grasses and forbs. This area is well suited to grazing by sheep, goats, and cattle. The deeper soils in the valleys and lower lying plains have a natural potential to produce a true prairie of mid and tall grasses intermixed with some forbs and woody plants. Soils associated with sandstone and granitic hills produce tall grasses, forbs, and post oak trees.

On all the soils, it is necessary to keep livestock numbers in balance with forage yield, which fluctuates according to seasonal and annual changes in rainfall. Dry years result in greatly decreased forage yield and in deterioration in the plant cover. Seasonal rainfall has varying effect, depending on the time it falls. Rainfall in spring and early in summer is critical because 60 to 70 percent of the total forage is produced during this period. Another period of growth follows the rains in August, September, and October. The deep, more fertile soils produce some grasses and forbs that grow late in winter and early in spring in those years when winter rainfall is favorable.

Range sites

Soils differ in their capacity to produce native vegetation, and are grouped into range sites according to this difference. A range site, therefore, is a distinctive kind of range. It differs from other kinds of range in its potential to produce native plants, and it is the product of several environmental factors responsible for its development. In the absence of abnormal disturbance and resulting physical deterioration, a range site supports an association of plants that differs from the association on other range sites in kinds of plants, proportion of plants, and total annual yield of vegetation.

The plant community growing on a range site in the absence of abnormal disturbances and significant physical site deterioration is the *climax plant community* for that site. This plant community is capable of reproducing itself and does not greatly change, so long as the environment remains unchanged.

The plant community changes when it is subjected to continuous heavy grazing. The degree of change is affected by the kind and number of livestock and wildlife grazing the site. Animals graze the palatable plants first and repeatedly. These plants lose vigor, grow smaller root systems, and produce fewer seed. If continually closely grazed, they die out and are replaced by other, less palatable plants.

Range condition

Range condition is a rating that indicates to what degree the present kind of vegetation on a range site is different from and less desirable than the climax plant community for that site. Range condition shows approximate amount of deterioration or improvement that has taken place in the plant community.

Four range condition classes are used to indicate the degree of departure from the potential or climax plant community brought about by grazing or other use. The classes show the present kinds of vegetation on a range site in relation to the native vegetation that could grow there. The site is in *excellent condition* if 76 to 100 percent of the present vegetation is of the same kind as the climax vegetation. It is in *good condition* if the percentage is between 51 and 75; in *fair condition* if the percentage is between 26 and 50; and in *poor condition*

[2] By RUDY J. PEDERSON, range conservationist, Soil Conservation Service.

if the percentage is less than 25. A site in good condition is shown in figure 17. Most of the range in this county is in fair condition.

One of the main objectives of good range management is to improve fair and poor condition and to maintain excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected.

Knowing the range site and range condition is useful in deciding how much improvement can be made and what grazing management or treatment is needed to improve or maintain a satisfactory range condition. Natural plant succession is directed toward reestablishment of the climax plant community. Grazing management is designed to permit this to happen to the desired degree. Improvement is speeded up by the appropriate application of such practices as brush control and range seeding.

Descriptions of range sites

In this section the range sites in Gillespie County are described and the climax plant community on each range site is given. The approximate total annual yield in air-dry weight is given for each site in excellent condition in years of favorable and unfavorable growing conditions. Yields for favorable years are approximate averages of years when forage growth is above average. Yields for unfavorable years are for below-average growth.

The range site for each soil is listed in the "Guide to Mapping Units" at the back of this survey.

ADOBE RANGE SITE

This site consists of Brackett soils, undulating. These soils are loamy and shallow and have a low available water capacity. Where the plant cover is reduced, the soils erode.

The climax plant community is mainly grasses and Texas oak, live oak, and shrubs. Where the site is continuously heavily grazed by cattle, little bluestem, indiangrass, and tall grama decrease. Shrubs, forbs, and grasses decrease where heavily grazed by sheep, goats, and deer. Juniper invades from the rocky slopes onto this site. The oaks can be controlled, and the site responds well to grazing management.

Where this site is in excellent condition, the potential

Figure 17.—An area of Low Stony Hill range site in good condition. Soils are of the Tarrant series.

acre yield of air-dry herbage ranges from 3,500 pounds in wet years to 1,500 pounds in dry years. The approximate relative percentages of plants are little bluestem, 55; indiangrass, 5; tall grama, 5; side-oats grama, 5; meadow dropseed, 5; seep muhly, 5; Texas oak, shin oak, and live oak, 15; other shrubs, 2; other forbs and grasses, 3.

BOTTOMLAND RANGE SITE

This range site is made up of deep, loamy soils that are nearly level to gently undulating. These soils receive extra moisture from stream overflow and runoff from adjacent higher areas. The available water capacity of these soils is moderate to high. In dry seasons, plants stay green longer on this site than on other sites, and livestock generally prefer to graze this site.

The potential plant community varies in relation to the moisture received. The most productive area is adjacent to the stream. These soils produce trees and taller grasses such as switchgrass, indiangrass, and little bluestem.

When heavily grazed by cattle, indiangrass, switchgrass, and big bluestem, and other tall grasses decrease; Texas wintergrass increases; and buffalograss and annual weeds invade. When it is necessary, this site can be reseeded successfully after dozing the trees and brush.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 6,500 pounds in wet years to 3,500 pounds in dry years. The approximate relative percentages of plants are indiangrass, 15; little bluestem, 15; big bluestem, 5; switchgrass, 10; Virginia and Canada wildrye, 10; Texas wintergrass and sedge, 5; meadow dropseed, 5; vine-mesquite, 5; Lindheimer muhly, 5; elm, pecan, oak, and hackberry trees, wild grape, and many kinds of shrubs, 15; forbs and other plants, 10.

DEEP UPLAND RANGE SITE

This site consists of moderately deep and deep, loamy to clayey soils that are nearly level to gently sloping (fig. 18). These soils have a high available water capacity.

The climax plant community is an open grassland prairie that contains motts of live oak. When the site is continuously closely grazed by cattle, the indiangrass,

Figure 18.—An area of Deep Upland range site in good condition. The soil is Denton silty clay, 1 to 3 percent slopes.

bluestem, and wildrye decrease; Texas wintergrass and buffalograss increase; and plants such as prairie-coneflower, mesquite, and three-awn invade. Seedbeds can be prepared, and range seeding is successful on this site.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 5,500 pounds in wet years to 3,500 pounds in dry years. The approximate relative percentages of plants are little bluestem, 35; indiangrass, 20; side-oats grama, 10; Canada wildrye, 5; Texas wintergrass, 5; meadow dropseed, 10; vine mesquite, 5; live oak, 3; forbs and other plants, 7.

GRANITE GRAVEL RANGE SITE

Click gravelly sandy loam, 1 to 8 percent slopes, is the only soil in this range. This soil is moderately deep to deep, gently undulating to gently rolling, and gravelly. Gravel makes up 20 to 30 percent of the surface layer and 35 to 60 percent of the lower layers. Areas of Granite outcrop are on this site. The available water capacity is low.

The climax plant community is an open savannah of grasses and forbs that contains clumps of post oak, blackjack oak, and live oak. When this site is continuously overgrazed by sheep, goats, and deer, the perennial forbs decrease. Under continuous grazing by cattle, the sprangletop, bluestem, purpletop, and sand lovegrass decrease. Plants that invade this site where the range condition is lowered are red lovegrass, gummy lovegrass, Texas grama, upright prairie coneflower, and ragweed. Annual forbs and grasses increase and invade, and they may dominate where the site is in poor condition. Mesquite and juniper also invade.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 1,900 pounds in wet years to 1,200 pounds in dry years. The approximate relative percentages of plants are little bluestem and indiangrass, 20; side-oats grama, 10; green sprangletop, 10; sand lovegrass, 10; purpletop, 3; fringed leaf paspalum, 3; Wright's three-awn, 3; sedge, 3; kinds of dropseed, 3; pinhole bluestem, 3; vine-mesquite and cotton top, 12; post oak and blackjack oak, 10; perennial and annual forbs, 10. Some of the perennial forbs are sagewort, lespedeza, dotted gayfeather, and heath aster.

LOW STONY HILL RANGE SITE

This site consists of very shallow to shallow, gently undulating to gently rolling soils that are clay and stony clay (fig. 19). Runoff is excessive where the range has been overgrazed and cover depleted. This site has a low available water capacity.

The potential or climax plant community is a mixture of grasses and forbs with shin oak, live oak, sumac, and other browse plants. When the site is continuously overgrazed by sheep, goats, and deer, the browse plants and perennial forbs such as gaura and Engelmanndaisy decrease. Heavy cattle grazing pressure causes the bluestems to decrease. Plants that invade are juniper, three-awn, hairy tridens, Texas persimmon, and annual forbs and grasses.

Oak can be selectively controlled with chemicals or by mechanical uprooting.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 1,700 pounds in wet years to 900 pounds in dry years. The approximate relative percentages of plants are little bluestem, 30; indiangrass, 5; side-oats grama, 20; green sprangletop, 5; plains lovegrass, 5; Canada wildrye and sedge, 5; hairy and tall dropseed, 5; fall witchgrass, 5; live oak and shin oak, 10; sumac, elbowbush, kidneywood, honeysuckle, hackberry, and wild plum, 5; perennial forbs and annuals, 5.

REDLAND RANGE SITE

This site consists of shallow to deep, gently sloping and gently undulating to gently rolling soils that are either clayey or stony and clayey. The surface layer of these soils is as much as 20 percent, by volume, limestone cobbles, stones, and chert fragments. The available water capacity is low to high.

The potential plant community is a mixture of grasses and scattered clumps of live oak and post oak trees. Where this site is overgrazed by cattle, the perennial grasses decrease, oak increases, and juniper and annual grasses and forbs invade. Reduction of the oak increases forage production.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 5,000 pounds in wet years to 2,000 pounds in dry years. The approximate relative percentages of plants are little bluestem, 30; indiangrass, 17; side-oats grama, 10; Canada wildrye, 5; Texas wintergrass, 5; meadow dropseed, 10; pinhole bluestem, 5; post oak and other oaks, 10; other woody plants, 5; perennial forbs and other plants, 3.

SANDSTONE HILL RANGE SITE

This site consists of gently sloping and gently undulating to hilly, loamy and stony loamy soils that are very shallow to shallow. These soils have low available water capacity.

The climax plant community is made up of grasses and forbs mixed with clumps of post oak and live oak. Three-awn, tumble windmillgrass, red lovegrass, mat sandbur, basin sneezeweed, mesquite, catclaw, whitebrush, Texas persimmon, and cactus invade the site where it is overgrazed. The oaks increase also, but they can be controlled.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 3,500 pounds in wet years to 1,700 pounds in dry years. The approximate relative percentages of plants are little bluestem, 35; side-oats grama, 5; green sprangletop, 5; fringeleaf paspalum, 5; hairy grama, 5; sand lovegrass, 10; purpletop, 5; Arizona cottontop, pinhole bluestem, hooded windmillgrass, and wildrye, 10; perennial and annual forbs, 5; post oak and live oak, 15. Sagewort, lespedeza, sundrop, and bluebonnet are introduced forbs that grow on this site.

SANDY RANGE SITE

This site consists of moderately deep to deep, gently sloping soils that are sandy. These soils have low to high available water capacity.

The climax plant community is a mixture of oak, grasses, and forbs. Three-awn, red lovegrass, gummy lovegrass, and a large variety of annual forbs and grasses, such as basin sneezeweed, pepperweed, croton, dozedaisy, mat sandbur, and mesquite, invade this site when it is in a lower condition. The vegetation deteri-

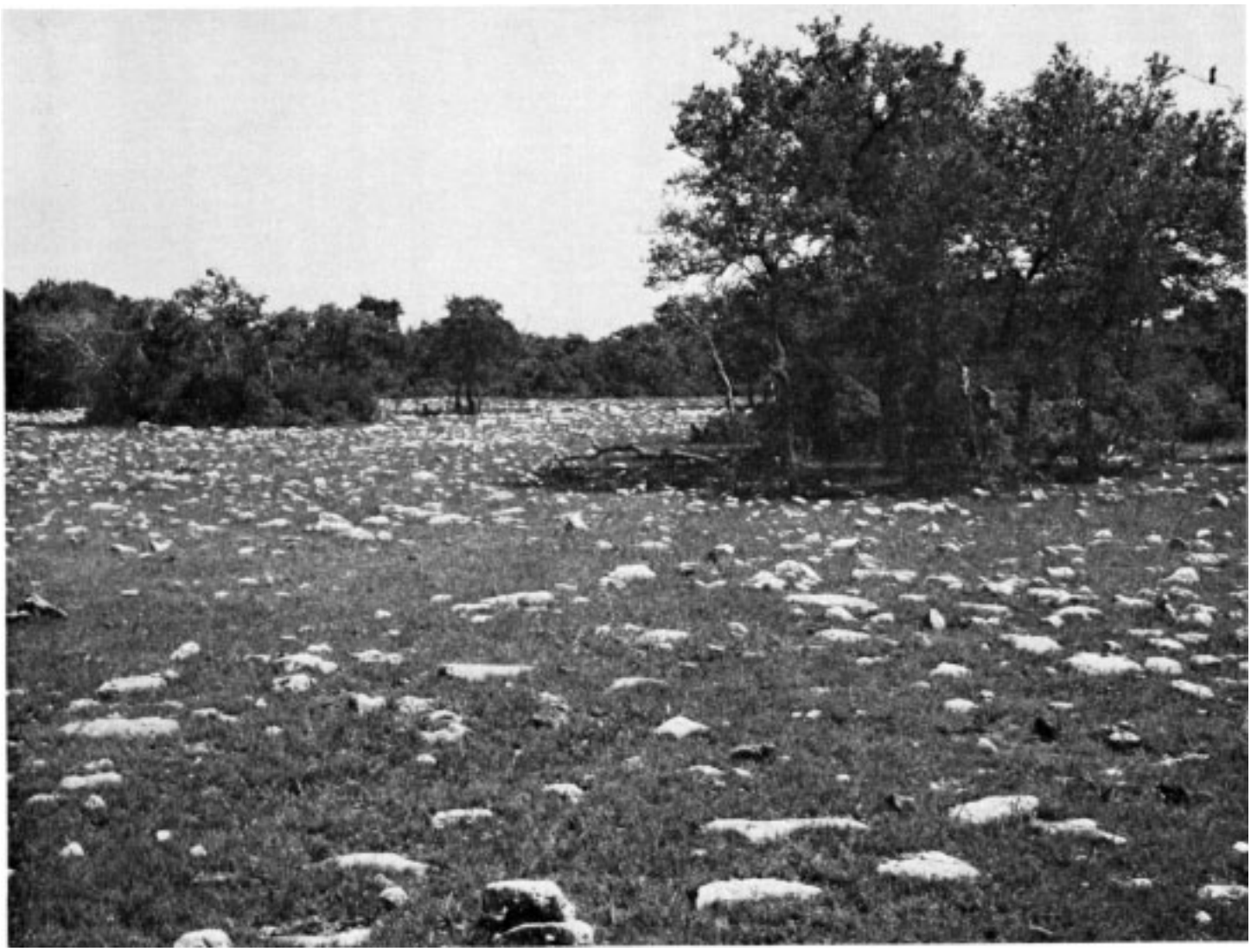

Figure 19.—An area of Low Stony Hill range site. Soils are of the Tarrant series.

orates to an annual type under continued overgrazing by cattle. A seed source of the better plants is preserved in the shade of woody plants on most sites. This allows rapid recovery of the site under good grazing management.

Oak can be controlled on this site by girdling, with chemicals, and by mechanical means.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 4,000 pounds in wet years to 2,000 pounds in dry years. The approximate relative percentages of plants are little bluestem, 40; indiangrass, 5; fringeleaf paspalum, 5; meadow dropseed, 5; sand lovegrass, 15; fall witchgrass, 5; purpletop, 5; post oak and blackjack oak, 15; perennial forbs, annuals, and other plants, 5.

SANDY LOAM RANGE SITE

This site consists of gently sloping, loamy and gravelly loamy soils that are shallow to deep. These soils have low to high available water capacity.

The climax plant community is mainly grasses, scattered oaks, and many forbs. When continuously overgrazed by cattle, the taller grasses decrease, and hooded windmillgrass increases greatly. Plants that invade are catclaw acacia, Texas persimmon, whitebrush, mesquite, and cactus. This site can be successfully reseeded, and brush can be controlled by mechanical uprooting and by chemicals.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 4,000 pounds in wet years to 2,000 pounds in dry years. The approximate relative percentages of plants are little bluestem, 30; indiangrass, 5; side-oats grama, 10; fringeleaf paspalum, 5; pinhole bluestem, 10; sand lovegrass, 5; fall witchgrass, 5; hooded windmillgrass, 5; plains bristlegrass, 5; post oak and blackjack oak, 5; perennial forbs, 5; annuals and other plants, 10.

SCHIST RANGE SITE

This range site consists of shallow to moderately deep, gently sloping and undulating soils that are loamy.

These soils have low to moderate available water capacity.

The climax plant community is a grassland with some low shrubs and forbs. Forage quality is good.

When this site is overgrazed by cattle, side-oats grama, plains lovegrass, and cottontop decrease and buffalograss and curly mesquite increase. Plants that invade are red grama, Texas grama, several unpalatable annual forbs, mesquite, tasajillo, Texas colubrina, and whitebrush.

This site recovers slowly from poor condition because the uncovered soil crusts severely and a natural seed source is limited or absent.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 3,500 pounds in wet years to 1,000 pounds in dry years. The approximate relative percentages of plants are side-oats grama, 20; Arizona cottontop, 5; green sprangletop, 5; hairy grama, 5; plains lovegrass, 5; Texas wintergrass, 10; vine mesquite, 10; pinhole bluestem, 10; buffalograss and curly mesquite, 10; fall witchgrass, 5; three-awn, 5; plains bristlegrass, 5; perennial forbs and annuals, 5. A few woody plants such as live oak, Texas persimmon, kidneywood, and whitebrush also are native to this site.

SERPENTINE HILLS RANGE SITE

Renick stony clay loam, 5 to 12 percent slopes, is the only soil in this range site (fig. 20). It is very shallow to shallow and gently rolling to rolling. It has low available water capacity.

The climax plant community is mainly grasses. The cobbly surface limits grazing to a degree and thus preserves many of the preferred species. Little bluestem and indiangrass decrease when grazed heavily by cattle. Catclaw invades to some degree.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 3,000 pounds in wet years to 1,500 pounds in dry years. The approximate relative percentages of plants are little bluestem, 40; side-oats grama, 15; indiangrass, 5; green sprangletop, 5; hairy grama, 5; plains lovegrass, 5; meadow dropseed, 10; feathery bluestem, 5; buffalograss, 5; forbs and other plants, 5.

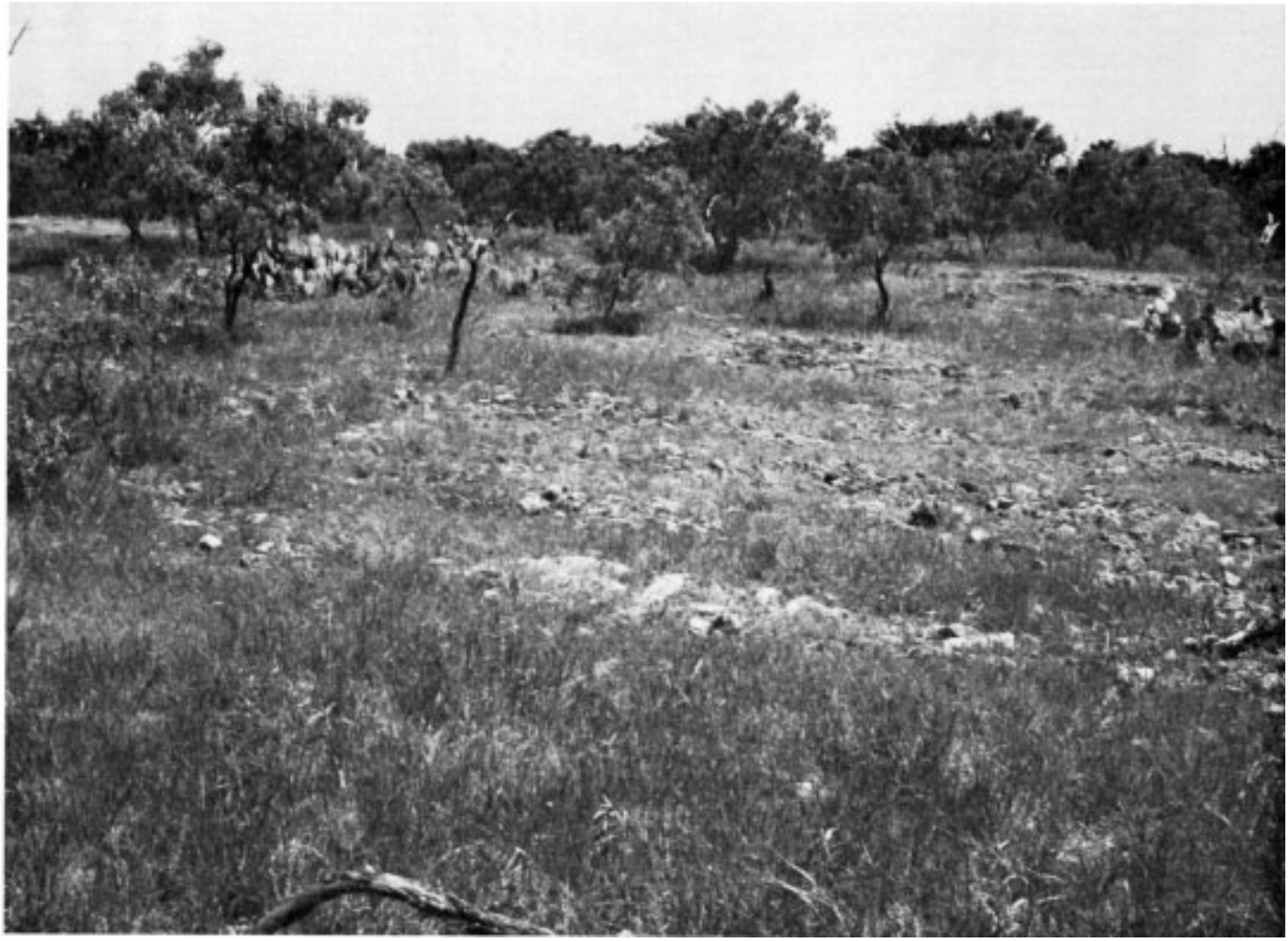

Figure 20.—An area of Serpentine Hills range site. The soil is Renick stony clay loam, 5 to 12 percent slopes.

SHALLOW RANGE SITE

This site consists of gently sloping and undulating, clayey soils that are shallow (fig. 21). These soils have low available water capacity.

The potential plant community consists of a mixture of short and mid grasses and a few forbs and motts of live oak trees. If this site is continuously overgrazed by cattle, the bluestems and indiangrass decrease; annuals, three-awn, and hairy tridens invade along with Texas persimmon, agarito, and juniper. Machinery can be used for brush removal and reseeding on this site.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 4,800 pounds in wet years to 2,400 pounds in dry years. The approximate relative percentages of plants are little bluestem, 40; indiangrass, 5; side-oats grama, 15; plains lovegrass, 5; Texas wintergrass, 5; meadow dropseed, 5; pinhole bluestem, 5; fall witchgrass, 5; Canada wildrye, 5; live oak, 5; perennial forbs and other plants, 5.

SHALLOW GNEISS RANGE SITE

This site consists of gently undulating to hilly, gravelly loamy soils. These soils are shallow and have low available water capacity.

The climax plant community is scrub oak, grasses, and forbs. When the site is overgrazed by cattle, the little bluestem and sprangletop decrease and annual forbs and grasses increase or invade and may dominate in some seasons. Low brush such as whitebrush, juniper, and Texas persimmon invade and dominate in some places.

Boulders and steep topography limit use of mechanical equipment on this site. These factors also cause cattle to graze the site unevenly.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 1,500 pounds in wet years to 1,000 pounds in dry years. The approximate relative percentages of plants are little bluestem, 25; side-oats grama, 10; indiangrass, 10; green sprangletop, 5; hairy grama, 5; Canada wildrye, 5; hairy and tall dropseed, 5; sand lovegrass, 5; fall witchgrass, 5; three-awn, 5; post oak and live oak, 10; other woody plants, 5; perennial and annual forbs, 5.

STEEP ADOBE RANGE SITE

This site consists of rolling to hilly, loamy soils and land types. The soils are shallow, and the available water capacity is low.

The climax plant community has more woody plants

Figure 21.—An area of Shallow range site in good condition. The soils are of the Purves series.

than the Adobe range site and is valued for cover and food for deer. The palatable forbs and browse plants decrease when the site is grazed heavily by sheep, goats, and deer. The bluestem and indiangrass decrease when grazed heavily by cattle. Texas stillingia, seep muhly, and juniper increase or invade as the palatable plants decrease.

Juniper and oak are controlled mainly by hand cutting on this site. It is difficult to get even distribution of grazing by cattle where this site is associated with other, more accessible and preferred range sites.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 3,000 pounds in wet years to 1,000 pounds in dry years. The approximate relative percentages of plants are little bluestem, 50; indiangrass, 5; tall grama, 5; meadow dropseed, 5; sedges, 5; seep muhly, 5; Texas oak, live oak, and shin oak, 15; shrubs such as sumac, silk tassel, honeysuckle, elbow bush, wild grape, and yucca, 5; forbs and other annual and perennial plants, 5.

STEEP ROCKY RANGE SITE

This site consists of rolling to hilly, clayey soils (fig. 22). These soils are very shallow to shallow and have low available water capacity.

The climax plant community is grasses, forbs, low shrubs, and live oak trees. Continuous heavy grazing by sheep, goats, and deer causes decrease of the low-growing shrubs and perennial forbs. Juniper, Texas persimmon, three-awn, and annual plants increase and invade if overgrazing continues. Woody plants can be hand cut to improve forage production.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 1,500 pounds in wet years to 1,000 pounds in dry years. The approximate relative percentages of plants are little bluestem, 25; indiangrass, 5; side-oats grama, 15; green sprangletop, 5; Canada wildrye, 5; sedge, 5; fall witchgrass, 5; Wright's three-awn, 5; live oak, shin oak, Texas oak, 15; other woody plants such as elbow bush, evergreen sumac,

Figure 22.—**An area of Steep Rocky range site in good condition. Soils are of the Tarrant-Rock outcrop association, steep.**

hackberry, silk tassel, and kidneywood, 5; perennial and annual forbs and other plants, 10.

STONY LOAM RANGE SITE

Eckert stony soils, rolling, are the only soils in this range site. These soils are very shallow to shallow and stony loamy. The available water capacity is low.

The climax plant community is a mixture of low shrubs, scrub trees, grasses, and annual plants. This is the least productive range site in the county, but forage is of good quality.

When the range is overgrazed by cattle, side-oats grama, sprangletop, and bluestems decrease. Plants that invade and increase are croton, pricklypear, tasajillo, Texas persimmon, annual weeds, and mesquite. Careful grazing management is needed to maintain or improve this range site.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 1,200 pounds in wet years to 600 pounds in dry years. The approximate relative percentages of plants are side-oats grama, 20; green sprangletop, 15; feathery bluestems, 10; little bluestem, 5; three-awn, 5; fall witchgrass, 5; Arizona cottontop, 5; hairy dropseed, 5; hooded windmillgrass, 5; live oak, persimmon, scrubby dalea, kidneywood, yucca, and other shrubs 10; perennial forbs such as sagewort, gaura, Riddell dozedaisy, 5; annual forbs, grasses and other plants, 10.

TIGHT SANDY LOAM RANGE SITE

This site consists of deep, gently sloping, loamy soils. These soils have high available water capacity.

The climax plant community is grassland that contains scattered oak trees. Plants that decrease when the site is continuously overgrazed by cattle are little bluestem, side-oats grama, plains lovegrass, and Canada wildrye. Buffalograss, Texas wintergrass, and hooded windmillgrass increase when this site is overgrazed. Invaders are mesquite, annual weeds, red lovegrass, filly and halls panicum, and upright prairie coneflower.

Mechanical and chemical methods can be used for brush and weed control on this site, and range seeding is feasible.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 3,800 pounds in wet years to 2,000 pounds in dry years. The approximate relative percentages of plants are little bluestem, 15; side-oats grama, 15; fringeleaf paspalum, 5; plains lovegrass, 5; Canada wildrye, 5; sedge, 5; Texas wintergrass, 5; meadow dropseed, 5; vine-mesquite, 5; purpletop, 5; buffalograss, 5; fall witchgrass, 5; hooded windmillgrass, 5; post oak, live oak, and other oak, 10; perennial forbs and other plants, 5.

Use of the Soils for Wildlife [3]

The principal kinds of wildlife in Gillespie County are whitetail deer, turkey, squirrel, bobwhite quail, dove, cottontail rabbits, jackrabbits, and numerous kinds of nongame birds. Also present are raccoons, foxes, ringtail cats, skunks, oppossum, and other furbearers. Common predators are bobcats and coyotes. Intermittent lakes, streams, ponds, and grainfields attract ducks and geese during migration. Most farm and ranch ponds are stocked with channel catfish, black bass, and sunfish. The Pedernales River and creeks afford good fishing. Fish and wildlife resources are of great economic importance to landowners in this county.

Soil interpretations for wildlife habitat

Successful management of wildlife on any tract of land requires that food, cover, and water be available in a suitable combination. Lack of any one of these necessities, unfavorable balance among them, or inadequate distribution of them may limit the reproduction and dissemination of desired kinds of wildlife. Soils information provides a valuable tool in creating, improving, or maintaining suitable food, cover, and water for wildlife.

Most wildlife habitats are managed by planting suitable vegetation, by managing existing vegetation so as to bring about natural establishment, increase, or improvement of desired plants, or by combinations of these measures. The influence of a soil on the growth of plants is known for many kinds of soils, and can be inferred for others from a knowledge about the characteristics and behavior of the soil. In addition, water areas can be created or natural ones improved as wildlife habitats. Soil information is useful for these purposes.

Soil interpretations for wildlife habitat aid in selecting the more suitable sites for various kinds of management. They serve as indicators of the intensity of management needed to achieve satisfactory results. They also serve as a means of showing why it may not be generally feasible to manage a particular area for a given kind of wildlife. Interpretations also serve in broad-scale planning of wildlife management areas, parks, and nature areas, or for acquiring wildlife lands.

Soil properties that affect the growth of wildlife habitat are: thickness of soil useful to crops; texture of the surface layer; available water capacity; wetness; number and size of stones on the surface; flood hazard; and slope.

The soil areas shown on the soil survey maps are rated without regard to their position in relation to adjoining delineated areas. The size, shape, or location of the outlined area does not affect the rating. Certain influences on habitats, such as elevation and aspect, must be appraised at the site.

In table 3 the soils of Gillespie County are rated for the creation, improvement, or maintenance of six wildlife habitat elements. These ratings are based on limitations imposed by the characteristics or behavior of the soil. Four levels of suitability are recognized.

Suitability rating of soils for wildlife

The following definitions are given for habitat suitability ratings:

Well suited indicates that habitats are easily created, improved, or maintained; that the soil has few or no limitations that affect management; and that satisfactory results can be expected.

Suited indicates that habitats can be created, improved, or maintained in most places; that the soil has moderate limitations that affect management; and that moderate intensity of management and fairly frequent attention may be required for satisfactory results.

[3] By JAMES HENSON, biologist, Soil Conservation Service.

TABLE 3.—*Suitability of the soils for elements of wildlife habitat and kinds of wildlife*

Soil series and map symbols	Elements of wildlife habitat				Kinds of wildlife	
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees and shrubs	Openland	Brushland
Altoga: AlC	Suited	Suited	Suited	Suited	Well suited	Suited.
Bastrop:						
BaC	Well suited	Well suited	Well suited	Poorly suited	Well suited	Suited.
BfB	Well suited	Well suited	Well suited	Well suited	Well suited	Well suited.
Blanket: Bk	Well suited	Well suited	Well suited	Suited	Well suited	Well suited.
Bonti: BoC	Suited	Well suited	Well suited	Suited	Well suited	Well suited.
Brackett: BrC, BrE, BtE	Poorly suited	Poorly suited	Suited	Suited	Poorly suited	Suited.
For Tarrant part of BtE, see Tarrant series.						
Castell: CaC	Suited	Suited	Well suited	Poorly suited	Suited	Suited.
Click: ClD	Poorly suited	Poorly suited	Suited	Suited	Suited	Suited.
Cobb: CoC	Suited	Well suited	Well suited	Suited	Well suited	Well suited.
Demona: DeC	Suited	Suited	Well suited	Poorly suited	Suited	Suited.
Denton: DnB, DnC, DnC2	Suited	Suited	Suited	Well suited	Suited	Suited.
Doss: DoC, DsC2	Poorly suited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Eckert: EcD	Unsuited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Frio: Fr	Suited	Well suited	Well suited	Suited	Well suited	Well suited.
Granite outcrop: Gn	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited	Unsuited.
Guadalupe: Gp, Gr	Well suited	Well suited	Well suited	Suited	Well suited	Well suited.
For Frio part of Gr, see Frio series.						
Gullied land: Gu	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited	Poorly suited.
Harper: HaD	Unsuited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Heatly: He	Suited	Well suited	Well suited	Poorly suited	Well suited	Suited.
Hensley: HnD, HsB	Poorly suited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Katemcy: KaC	Suited	Well suited	Well suited	Suited	Well suited	Well suited.
Keese: KrD, KrF	Unsuited	Poorly suited	Poorly suited	Suited	Poorly suited	Suited.
Krum: KuB, KuC	Suited	Suited	Suited	Suited	Suited	Well suited.
Lewisville: LeA, LeB, LeC	Well suited	Well suited	Well suited	Suited	Well suited	Well suited.
Ligon: LgC, LlC	Poorly suited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Lindy: LnD	Suited	Well suited	Well suited	Suited	Well suited	Well suited.
Luckenbach: LuB, LuC, LuC2	Well suited	Well suited	Well suited	Suited	Well suited	Well suited.
Nebgen: NrD, NrF	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited	Poorly suited.
Oben: ObB, OeC	Poorly suited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Pedernales: PeB, PeC	Well suited	Well suited	Well suited	Suited	Well suited	Well suited.
Purves: PuC	Poorly suited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Renick: ReE	Poorly suited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Speck: SpC, SsD	Poorly suited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Tarrant: TaC, TkE	Unsuited	Poorly suited	Suited	Suited	Poorly suited	Suited.
Tobosa: To	Suited	Suited	Suited	Suited	Suited	Well suited.
Topia: TpB, TpC	Suited	Suited	Suited	Suited	Suited	Well suited.
Vashti: VaC, VhB	Suited	Suited	Well suited	Suited	Well suited	Well suited.

Poorly suited indicates that habitats can be created, improved, or maintained in most places; that the soil has rather severe limitations; that habitat management is difficult and expensive and requires intensive effort; and that results are not always satisfactory. (For short-term usage, soils rated as "poorly suited" may provide easy establishment and temporary values.)

Unsuited indicates that the soil limitation is so extreme that it is impractical to manage the designated habitat element.

Elements of wildlife habitat

The six habitat elements are defined and exemplified in the following paragraphs. All of the soils in the county are rated unsuited for shallow water development.

Grain and seed crops are agricultural grains or seed-producing annuals planted to produce food for wildlife. Examples are corn, sorghum, millet, soybeans, wheat, oats, and sunflower.

Grasses and legumes are domestic perennial grasses and legumes that are established by planting and that furnish food and cover for wildlife. Examples are bahiagrass, ryegrass, fescue, and panicgrass. Legumes include clovers, annual lespedezas, and bush lespedezas.

Wild herbaceous upland plants are perennial grasses, forbs, and weeds that provide food and cover for wildlife. Examples of these are beggarweed, perennial lespedezas, wild bean, indiangrass, wild ryegrass, and bluestems.

Hardwood trees and shrubs are nonconiferous trees, shrubs, and woody vines that produce fruits, nuts, buds, catkins, or foliage (browse) used extensively as food by wildlife. These plants commonly become established through natural processes, but may be planted. Examples are oak, mesquite, whitebrush, granjeno, catclaw, cherry grape, honeysuckle, greenbrier, autumn-olive, and multiflora rose.

Kinds of wildlife

The three general kinds of wildlife are defined as follows:

Openland wildlife is birds and mammals that frequent cropland, pastures, and areas overgrown with grasses, herbs, and shrubby growth. Examples of this kind of wildlife are quail, cottontail rabbits, jackrabbits, meadowlarks, and lark sparrows.

Brushland wildlife is birds and mammals that frequent wooded areas of hardwood trees and shrubs. Examples of brushland wildlife are deer, turkey, squirrel, and raccoon.

Wetland wildlife is birds and mammals that frequent such areas as ponds, streams, and ditches. Examples of this kind of wildlife are ducks, geese, rails, shorebirds, and snipe. All soils are rated unsuited for wetland wildlife in the county, and the soils are not rated for wetland wildlife in table 3. A few small areas can be made suitable for wetland wildlife, but these sites require a careful onsite examination to determine cost of development.

Engineering Uses of the Soils [4]

The information in this section can be used by those who have an interest in the engineering features of soils.

This section provides information of special interest to engineers, contractors, farmers, and others who use soil as structural material or as foundation material upon which structures are built. In this section are stressed those properties of the soils that affect construction and maintenance of roads and airports, building foundations, water-storage facilities, erosion-control structures, and sewage-disposal systems. Among the soil properties most important in engineering are permeability, compressibility, shear strength, compactibility, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, corrosivity, and reaction.

Information concerning these and related soil properties is furnished in tables 4, 5, 6, and 7.

The estimates and interpretations of soil properties in these tables can be used in:

1. Planning of farm ponds, irrigation systems, terraces and diversions, and other structures for controlling water and conserving soil.
2. Selecting potential locations for highways, airports, pipelines, and underground cables.
3. Locating probable sources of sand, gravel, or rock suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreational areas.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers reported. The estimated values for traffic-supporting capacity expressed in words should not be assigned specific values. There are small areas of other soils and contrasting situations included in the mapping units that may have different engineering properties than those listed. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that may be expected.

Some terms used by soil scientists may be unfamiliar to engineers, and some words have different meanings in soil science than they have in engineering. Among the terms that have special meaning in soil science are gravelly soil material, sand, silt, clay, loam, surface soil, subsoil, and horizon. These and other terms are defined in the Glossary at the back of this survey.

Neither seasonal high water table nor salinity has been a problem in any of the soils in Gillespie County. Soil slope and structure also make drainage adequate on all of these soils.

The soils of Gillespie County generally are not suited as sources of sand and gravel. Click soils are a source of gravel; Bastrop, Demona, Heatly, and Vashti soils are possible sources of sand, but they contain excessive fines.

Engineering classification systems

The two systems most commonly used in classifying samples of soil horizons for engineering are the AASHO system adopted by the American Association of State Highway Officials, and the Unified Soil Classification System used by the SCS engineers, Department of Defense, and others.

The AASHO system is used to classify soils according to those properties that affect use in highway construction. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index (*1*). In group A–1 are gravelly soils of high shear strength, or the best soils for subgrade (foundation), and in group A–7 are clay soils that have low strength when wet. The best soils for subgrade are therefore classified as A–1, the next A–2, and so on to class A–7, the poorest soils for subgrade.

Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. If soil material is near a classification boundary, it is given a symbol showing both classes; for example, A–2 or A–4. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indices range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 6; the estimated classification without group index numbers is given in table 4 for all soils in the county.

In the Unified Soil Classification System, soils are classified according to particle-size distribution, plasticity index, liquid limit, and organic matter. Soils are grouped in 15 classes (*8*). There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example CH–MH.

[4] By J. C. WARD, area engineer, Soil Conservation Service.

531–432—75——4

TABLE 4.—*Estimated soil properties*

[Absence of an entry in a column indicates properties were too variable to rate. An asterisk in the first column indicates that at least one limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
		Inches	*Inches*			
Altoga: AlC	C	>63	0–26	Silty clay	CL or CH	A–6 or A–7
			26–47	Silty clay	CL	A–6 or A–7
			47–63	Silty clay loam	CL	A–6
Bastrop:						
BaC	B	>82	0–18	Loamy fine sand	SM	A–2–4, A–4
			18–82	Sandy clay loam	SC, CL	A–6
BfB	B	>80	0–15	Fine sandy loam	SM, ML, CL–ML	A–4
			15–80	Sandy clay loam	CL, SC	A–6
Blanket: Bk	C	>80	0–5	Clay loam	CL	A–6
			5–42	Clay	CH, CL	A–7–6
			42–80	Clay loam	CL	A–6 or A–7–6
Bonti: BoC	C	20–38	0–10	Loamy sand	SM, SM–SC	A–2–4
			10–36	Gravelly clay	CL	A–6
			36–38	Indurated sandstone.		
*Brackett: BrC, BrE, BtE, For the Tarrant part of BtE; see Tarrant series.	C	10–20	0–14	Loam	CL or SC	A–6
			14–50	Loam and fractured limestone.		
Castell: CaC	C	20–40	0–17	Gravelly sandy loam	SM or SM–SC	A–2–4
			17–38	Gravelly clay and very gravelly clay.	SC or CL	A–7 or A–6
			38–41	Indurated gneiss.		
Click: ClD	A	38–56	0–14	Gravelly sandy loam	SM	A–2–4 or A–1
			14–46	Very gravelly sandy loam	SM–SC, SC	A–2–4 or A–1
			46–50	Indurated granite.		
Cobb: CoC	B	26–48	0–10	Fine sandy loam	SM	A–2–4 or A–4
			10–36	Sandy clay loam	SC or CL	A–6
			36–40	Weakly cemented sandstone.		
Demona: DeC	C	>63	0–26	Fine sand	SM, SP–SM	A–2–4
			26–56	Sandy clay	CL or CH	A–7
			56–63	Sandy clay loam	SC	A–6 or A–2–6
Denton: DnB, DnC, DnC2	D	22–40	0–38	Silty clay	CH	A–7
			38–43	Strongly cemented limestone.		
Doss: DoC, DsC2	C	11–20	0–19	Silty clay	CH	A–7–6
			19–48	Weakly cemented limestone.		
Eckert: EcD	D	4–14	0–12	Silt loam	ML or ML–CL	A–4
			12–15	Indurated limestone.		
Frio: Fr	B	>63	0–63	Silty clay loam or silty clay	CL	A–6 or A–7–6
Granite outcrop: Gn. Properties too variable to rate.						
*Guadalupe: Gp, Gr For Frio part of Gr, see Frio series.	B	>63	0–7	Loam	ML	A–4
			7–17	Fine sandy loam	SM or SM–SC	A–2–4 or A–4
			17–31	Loam	ML	A–4
			31–37	Fine sandy loam	SM or SM–SC	A–2–4 or A–4
			37–63	Loamy sand	SM	A–2–4

significant in engineering

mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and that appear in the first column of this table. The symbol > means more than. The symbol < means less than]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				
				Inches per hour	*Inches per inch of soil*	*pH*	
95–100	90–100	85–95	80–95	0. 63–2. 0	0. 15–0. 18	7. 9–8. 4	High.
95–100	90–100	85–95	75–80	0. 63–2. 0	0. 15–0. 18	7. 9–8. 4	Moderate.
95–100	90–100	85–95	75–80	0. 63–2. 0	0. 13–0. 17	7. 9–8. 4	Low.
95–100	95–100	75–95	20–50	2. 0–6. 3	0. 07–0. 11	6. 1–7. 3	Low.
95–100	95–100	80–100	40–65	0. 63–2. 0	0. 15–0. 19	6. 6–8. 4	Low.
95–100	95–100	80–100	40–70	2. 0–6. 3	0. 11–0. 17	6. 1–6. 5	Low.
95–100	95–100	80–100	40–65	0. 63–2. 0	0. 15–0. 19	6. 6–7. 3	Low.
95–100	95–100	90–95	70–80	0. 20–0. 63	0. 15–0. 20	6. 6–7. 3	Low.
95–100	95–100	85–95	75–85	0. 20–0. 63	0. 15–0. 20	7. 4–8. 4	Moderate.
95–100	90–100	70–90	51–80	0. 20–0. 63	0. 15–0. 20	7. 9–8. 4	Moderate.
80–100	80–100	70–95	15–35	2. 0–6. 3	0. 07–0. 10	6. 1–6. 5	Low.
70–90	70–90	65–85	51–75	0. 20–0. 63	0. 15–0. 20	5. 6–6. 0	Moderate.
70–100	65–100	55–95	40–85	0. 20–0. 63	0. 10–0. 15	7. 9–8. 4	Low.
75–100	70–95	50–70	13–25	2. 0–6. 3	0. 07–0. 11	6. 1–6. 5	Low.
50–100	40–90	40–80	36–65	0. 06–0. 20	0. 14–0. 18	6. 1–6. 5	Moderate.
90–100	45–65	35–50	15–35	6. 3–20. 0	0. 05–0. 10	6. 6–7. 3	Low.
90–100	40–60	35–50	20–35	6. 3–20. 0	0. 05–0. 10	5. 6–6. 5	Low.
100	98–100	75–90	30–50	2. 0–6. 3	0. 10–0. 14	6. 1–6. 5	Low.
95–100	90–99	90–98	40–60	0. 63–2. 0	0. 12–0. 16	6. 1–6. 5	Low.
90–100	90–100	60–95	7–30	2. 0–6. 3	0. 05–0. 10	6. 1–7. 3	Low.
90–100	90–100	90–100	51–85	0. 20–0. 63	0. 15–0. 18	5. 6–6. 0	Moderate.
90–100	90–100	90–100	20–40	0. 20–0. 63	0. 14–0. 18	5. 6–6. 0	Low.
80–100	80–100	80–100	75–98	0. 06–0. 20	0. 15–0. 20	7. 9–8. 4	High.
90–100	90–100	85–100	80–95	0. 20–0. 63	0. 15–0. 20	7. 9–8. 4	Moderate.
80–95	80–95	85–95	60–80	0. 63–2. 0	0. 10–0. 15	6. 6–8. 4	Low.
95–100	95–100	75–100	70–95	0. 20–0. 63	0. 15–0. 20	7. 9–8. 4	Moderate.
80–95	80–95	75–85	60–75	2. 0–6. 3	0. 10–0. 15	7. 9–8. 4	Low.
95–100	95–100	75–85	30–45	2. 0–6. 3	0. 10–0. 13	7. 9–8. 4	Low.
80–95	80–95	75–85	60–75	2. 0–6. 3	0. 10–0. 15	7. 9–8. 4	Low.
95–100	95–100	75–85	30–45	2. 0–6. 3	0. 10–0. 13	7. 9–8. 4	Low.
95–100	95–100	75–85	20–30	2. 0–6. 3	0. 06–0. 10	7. 9–8. 4	Low.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
		Inches	*Inches*			
Gullied land: Gu. Properties too variable to rate.						
Harper: HaD	D	11–20	0–17	Clay	CH	A–7
			17–18	Indurated limestone.		
Heatly: He	A	>90	0–28	Loamy fine sand	SM	A–2–4
			28–90	Sandy clay loam	SC, SM	A–6, A–2
Hensley: HnD, HsB	D	13–19	0–4	Loam	CL, SC	A–6, A–7–6
			4–18	Clay	CL	A–7
			18–21	Indurated limestone.		
Katemcy: KaC	C	20–44	0–9	Clay loam	CL	A–4 or A–6
			9–35	Clay	CL	A–7
			35–50	Schist.		
Keese: KrD, KrF	D	11–20	0–19	Gravelly sandy loam	SM, SW–SM, SM–SC	A–2–4, A–1
			19–21	Indurated granite.		
Krum: KuB, KuC	C	>63	0–54	Silty clay	CH or MH–CH	A–7–6 or A–7–5
			54–63	Clay	CH	A–7–6
Lewisville: LeA, LeB, LeC	B	>63	0–19	Clay loam	CL	A–6 or A–7–6
			19–47	Silty clay	CL or CH	A–6 or A–7–6
			47–63	Silty clay loam	CL	A–6 or A–7–6
Ligon: LgC, LlC	D	12–20	0–4	Clay loam	SC or CL	A–6
			4–17	Clay loam	CL	A–6
			17–19	Soft schist.		
Lindy: LnD	C	22–34	0–5	Cobbly clay loam	ML–CL, CL	A–6 or A–4
			5–26	Clay	CH	A–7
			26–28	Indurated limestone.		
Luckenbach: LuB, LuC, LuC2	C	>80	0–18	Clay loam	CL	A–6
			18–38	Clay	CL or CH, CL–CH	A–6 or A–7–6
			38–80	Clay loam	SC or CL	A–7–6, A–6
Nebgen: NrD, NrF	D	4–14	0–9	Fine sandy loam	SM, SM–SC, or ML–CL	A–4
			9–12	70 percent soft and weakly cemented sandstone.		
			12–16	Strongly cemented sandstone.		
Oben: ObB, OeC	C	10–20	0–5	Fine sandy loam	ML, ML–CL, CL, SC, SM–SC	A–4
			5–14	Fine sandy loam	CL or SC	A–6
			14–19	Sandy clay loam	CL	A–6
			19–30	Strongly cemented sandstone.		
Pedernales: PeB, PeC	C	>63	0–11	Fine sandy loam	SM, ML, CL–ML	A–4
			11–37	Sandy clay	CH or CL	A–6 or A–7
			37–63	Sandy clay loam	SC or CL	A–6, A–7
Purves: PuC	D	10–20	0–14	Clay, cobbly clay loam, and clay loam.	CH	A–7–6
			14–19	Fractured limestone.		

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				
				Inches per hour	*Inches per inch of soil*	*pH*	
99–100	99–100	90–100	75–95	0. 20–0. 63	0. 15–0. 20	7. 9–8. 4	High.
100	98–100	70–90	15–25	6. 3–20. 0	0. 05–0. 09	6. 6–7. 3	Low.
99–100	97–100	78–90	25–45	0. 63–2. 0	0. 14–0. 16	6. 1–7. 3	Low.
93–99	90–98	85–95	36–65	2. 0–6. 3	0. 14–0. 18	7. 4–7. 8	Low.
80–95	80–95	80–90	60–75	0. 06–0. 20	0. 15–0. 19	7. 9–8. 4	Moderate.
85–100	85–100	70–85	51–75	0. 63–2. 0	0. 15–0. 20	6. 6–7. 3	Moderate.
85–100	85–100	65–85	65–85	0. 06–0. 20	0. 15–0. 20	6. 6–7. 3	Moderate.
75–95	70–90	30–45	10–20	2. 0–6. 3	0. 05–0. 10	5. 6–6. 0	Low.
95–100	95–100	95–100	85–95	0. 20–0. 63	0. 15–0. 20	7. 9–8. 4	High.
85–100	75–100	70–95	65–90	0. 20–0. 63	0. 15–0. 20	7. 9–8. 4	High.
100	98–100	70–100	70–90	0. 63–2. 0	0. 15–0. 20	7. 9–8. 4	Moderate.
95–100	95–100	90–95	80–90	0. 63–2. 0	0. 15–0. 20	7. 9–8. 4	Moderate.
83–100	80–100	75–95	65–90	0. 63–2. 0	0. 15–0. 20	7. 9–8. 4	Moderate.
80–100	80–100	70–80	40–75	0. 63–2. 0	0. 10–0. 15	6. 1–7. 3	Low.
80–95	80–95	70–85	55–75	0. 20–0. 63	0. 10–0. 15	6. 1–7. 3	Moderate.
80–100	75–95	75–95	60–75	0. 63–2. 0	0. 11–0. 14	6. 6–7. 3	Low.
80–100	80–100	80–98	75–90	0. 06–0. 20	0. 12–0. 17	6. 6–7. 3	High.
95–100	95–100	75–90	55–65	0. 63–2. 0	0. 15–0. 17	7. 4–7. 8	Low.
95–100	95–100	71–96	51–80	0. 20–0. 63	0. 16–0. 18	7. 9–8. 4	High.
75–96	65–93	45–80	36–61	0. 20–0. 63	0. 13–0. 15	7. 9–8. 4	Moderate.
90–100	90–100	70–85	40–55	2. 0–6. 3	0. 10–0. 15	6. 1–6. 5	Low.
90–100	90–100	70–85	40–55	0. 63–2. 0	0. 10–0. 15	6. 6–7. 3	Low.
90–100	90–100	85–95	45–75	0. 63–2. 0	0. 10–0. 15	6. 6–7. 3	Low.
90–100	90–100	85–95	60–75	0. 63–2. 0	0. 10–0. 15	6. 6–7. 3	Moderate.
95–100	90–100	75–100	36–55	0. 63–2. 0	0. 12–0. 17	6. 6–7. 3	Low.
90–100	90–100	85–100	55–75	0. 20–0. 63	0. 15–0. 20	7. 4–7. 8	High.
95–100	90–100	80–90	36–55	0. 20–0. 63	0. 15–0. 20	7. 9–8. 4	Moderate.
90–100	80–100	80–95	70–90	0. 20–0. 63	0. 12–0. 18	7. 9–8. 4	High.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
		Inches	*Inches*			
Renick: ReE	D	2–20	0–19	Clay loam and clay	CH	A–7–6
			19–22	Indurated fractured serpentine.		
Speck: SpC, SsD	D	14–19	0–7	Cobbly clay	CL	A–6 or A–7–6
			7–17	Clay	CL or CH	A–7–6
			17–20	Indurated limestone.		
Tarrant: TaC, TkE	D	7–16	0–12	Cobbly clay	MH or CH	A–7–5 or A–7–6
			12–15	Indurated limestone.		
Tobosa: To	D	>60	0–60	Clay	CH	A–7–6
Topia: TpB, TpC	D	23–28	0–32	Clay	CL or CH	A–7–6
			32–35	Indurated limestone.		
Vashti: VaC, VhB	C	29–45	0–14	Loamy fine sand	SM	A–2–4
			14–38	Sandy clay loam	CL or SC	A–6
			38–40	Strongly cemented sandstone.		

significant in engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				
				Inches per hour	*Inches per inch of soil*	*pH*	
75–90	65–90	60–80	55–75	0. 20–0. 63	0. 15–0. 20	6. 6–7. 3	High.
90–100	90–100	80–95	75–90	0. 20–0. 63	0. 15–0. 20	6. 1–7. 8	Low.
75–95	75–95	75–95	60–95	0. 06–0. 20	0. 15–0. 20	6. 1–7. 8	Moderate.
80–100	80–100	70–90	70–90	0. 20–0. 63	0. 15–0. 17	7. 9–8. 4	High.
98–100	95–100	90–100	75–95	<0. 06	0. 15–0. 20	7. 9–8. 4	High.
85–100	85–100	80–95	75–90	<0. 06	0. 15–0. 20	7. 9–8. 4	High.
100	90–100	70–95	15–35	2. 0–6. 3	0. 07–0. 10	6. 1–7. 3	Low.
100	90–100	85–95	35–55	0. 63–2. 0	0. 14–0. 18	6. 1–7. 3	Low.

TABLE 5.—*Interpretations of engineering properties of the soils*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table. Absence of entry in a column indicates that properties were not rated]

Soil series and map symbols	Suitability as source of—		Degree of limitation and soil features affecting farm ponds		Soil features affecting—		
	Topsoil	Road fill	Reservoir area	Embankment	Irrigation	Terraces and diversions	Grassed waterways
Altoga: AlC	Poor: silty clay surface layer.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Moderate: moderate permeability.	Moderate: medium compressibility.	Slope	All features favorable.	Hazard of erosion; slope.
Bastrop: BaC	Poor: loamy fine sand surface layer.	Fair: fair traffic-supporting capacity.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	Slope	Loamy fine sand texture.	Hazard of erosion; slope.
BfB	Fair: 13 to 18 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	All features favorable.
Blanket: Bk	Fair: clay loam surface layer.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: moderately slow permeability.	Moderate: medium compressibility.	Moderately slow permeability.	Slope	All features favorable.
Bonti: BoC	Poor: loamy sand surface layer.	Fair where 24 to 38 inches of material; fair traffic-supporting capacity. Poor where 20 to 24 inches of material.	Severe where 20 to 36 inches deep to bedrock. Moderate where 36 to 38 inches deep to bedrock; moderately slow permeability.	Moderate where 24 to 38 inches of material; fair resistance to piping and erosion. Severe where 20 to 24 inches of material.	Moderately slow permeability.	Loamy sand texture.	Loamy sand texture; slope.
*Brackett: BrC, BrE, BtE. For Tarrant part of BtE, see Tarrant series.	Poor: excess lime.	Fair: fair traffic-supporting capacity.	Severe: seepage.	Severe: 10 to 20 inches of material.	Slope	Slope	Slope.

Castell: CaC	Poor: coarse fragment content of surface layer is 10 to 15 percent.	Fair where 24 to 40 inches inches of material; moderate shrink-swell potential. Poor where 20 to 24 inches of material.	Severe: bedrock at a depth of 20 to 40 inches.	Moderate where 24 to 40 inches of material; poor resistance to piping and erosion. Severe where 20 to 24 inches of material.	Slope	Gravelly sandy loam texture.	Silt hazard; slope.
Click: ClD	Poor: coarse fragment content of surface layer is 20 to 30 percent.	Fair: 36 to 56 inches of material.	Severe: rapid permeability.	Moderate: 36 to 56 inches of material; seepage loss.	Slope	Slope	Slope.
Cobb: CoC	Fair: 8 to 12 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate where bedrock is at a depth of 36 to 48 inches; moderate permeability. Severe where bedrock is at a depth of 26 to 36 inches.	Moderate: fair to poor resistance to piping and erosion.	Slope	All features favorable.	All features favorable.
Demona: DeC	Poor: fine sand surface layer.	Fair: fair traffic-supporting capacity; moderately well drained.	Moderate: moderately slow permeability.	Moderate: fair resistance to piping and erosion.	Subject to erosion.	Fine sand texture.	Fine sand texture; slope.
Denton; DnB, DnC, DnC2	Poor: silty clay surface layer.	Poor: high shrink-swell potential.	Severe: limestone at a depth of 22 40 inches.	Moderate where 24 to 40 inches of material; fair stability. Severe where 22 to 24 inches of material.	Slope; slow permeability.	All features favorable.	All features favorable.
Doss: DoC, DsC2	Poor: silty clay surface layer.	Poor: 11 to 20 inches of material; poor traffic-supporting capacity.	Severe: permeable substrata below a depth of 20 inches; seepage.	Severe: 11 to 20 inches of material.	11 to 20 inches of material.	11 to 20 inches of material.	All features favorable.

TABLE 5.—*Interpretations of engineering properties of the soils*—Continued

Soil series and map symbols	Suitability as source of—		Degree of limitation and soil features affecting farm ponds		Soil features affecting—		
	Topsoil	Road fill	Reservoir area	Embankment	Irrigation	Terraces and diversions	Grassed waterways
Eckert: EcD	Poor: coarse fragment content of surface layer is 35 to 70 percent.	Poor: 4 to 14 inches of material; coarse fragment content is 35 to 70 percent.	Severe: bedrock at a depth of 4 to 14 inches.	Severe: 4 to 14 inches of material.	Bedrock at a depth of 4 to 14 inches.	Bedrock at a depth of 4 to 14 inches; slope.	Bedrock at a depth of 4 to 14 inches; slope.
Frio: Fr	Fair: silty clay loam surface layer.	Fair: moderate shrink-swell potential; fair traffic-supporting capacity.	Moderate: moderately slow permeability.	Moderate: medium compressibility.	Subject to flooding.	Slope; subject to flooding.	Subject to flooding.
Granite outcrop: Gn. Properties too variable to rate.							
*Guadalupe: Gp, Gr. For Frio part of Gr, see Frio series.	Good	Fair: fair traffic-supporting capacity.	Severe: moderately rapid permeability.	Moderate: medium compressibility; fair stability.	Subject to flooding; moderately rapid permeability.	Subject to flooding; slope.	Subject to flooding.
Gullied land: Gu. Properties too variable to rate.							
Harper: HaD	Poor: coarse fragment content of surface layer 45 to 70 percent; clay surface layer.	Poor: 11 to 20 inches of material; stoniness; high shrink-swell potential.	Severe: bedrock at a depth of 11 to 20 inches.	Severe: 11 to 20 inches of material.	Bedrock at a depth of 11 to 20 inches.	Bedrock at a depth of 11 to 20 inches.	Bedrock at a depth of 11 to 20 inches.
Heatly: He	Poor: loamy fine sand surface layer.	Fair: fair traffic-supporting capacity.	Moderate: moderate permeability.	Moderate: medium compressibility.	Subject to erosion.	Loamy fine sand texture.	Loamy fine sand texture.
Hensley: HnD, HsB	Fair: clay surface layer.	Poor: 13 to 19 inches of material.	Severe: bedrock at a depth of 13 to 19 inches.	Severe: 13 to 19 inches of material.	Bedrock at a depth of 13 to 19 inches.	Bedrock at a depth of 13 to 19 inches.	Bedrock at a depth of 13 to 19 inches.

Katemcy: KaC	Fair: clay loam surface layer.	Fair: fair traffic-supporting capacity.	Severe: bedrock at a depth of 20 to 44 inches.	Moderate where 24 to 44 inches of material; fair resistance to piping and erosion. Severe where 20 to 24 inches of material.	Slow permeability.	All features favorable.	All features favorable.
Keese: KrD, KrF	Poor: coarse fragment content of surface layer is 10 to 30 percent.	Poor: 11 to 20 inches of material.	Severe: bedrock at a depth of 11 to 20 inches.	Severe: 11 to 20 inches of material.	Bedrock at a depth of 11 to 20 inches.	Bedrock at a depth of 11 to 20 inches.	Bedrock at a depth of 11 to 20 inches.
Krum: KuB, KuC	Poor: silty clay surface layer.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Moderate: moderately slow permeability.	Moderate: fair stability.	Moderately slow permeability.	All features favorable.	All features favorable.
Lewisville: LeA, LeB, LeC	Fair: clay loam surface layer.	Poor: poor traffic-supporting capacity.	Moderate: moderately slow permeability.	Moderate: fair stability.	All features favorable.	All features favorable.	All features favorable.
Ligon: LgC, LlC	Fair: clay loam surface layer.	Poor: 12 to 20 inches of material.	Severe: bedrock at a depth of 12 to 20 inches.	Severe: 12 to 20 inches of material.	Bedrock at a depth of 12 to 20 inches.	Bedrock at a depth of 12 to 20 inches.	Bedrock at a depth of 12 to 20 inches.
Lindy: LnD	Poor: coarse fragment content of surface layer is 10 to 30 percent.	Poor: high shrink-swell potential.	Severe: bedrock at a depth of 22 to 34 inches.	Moderate: 22 to 34 inches of material; fair stability.	Coarse fragments; slow permeability; slope.	Bedrock at a depth of 22 to 34 inches; slope.	Slope.
Luckenbach: LuB, LuC, LuC2	Fair: clay loam surface layer.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Moderate: moderately slow permeability.	Moderate: fair stability.	Slope	All features favorable.	All features favorable.
Nebgen: NrD, NrF	Poor: coarse fragment content of surface layer is 10 to 25 percent.	Poor: 4 to 14 inches of material; stoniness.	Severe: bedrock at a depth of 4 to 14 inches; moderately rapid permeability.	Severe: 4 to 14 inches of material; stoniness.	Bedrock at a depth of 4 to 14 inches; stoniness.	Bedrock at a depth of 4 to 14 inches.	Bedrock at a depth of 4 to 14 inches.

TABLE 5.—*Interpretations of engineering properties of the soils*—Continued

Soil series and map symbols	Suitability as source of—		Degree of limitation and soil features affecting farm ponds		Soil features affecting—		
	Topsoil	Road fill	Reservoir area	Embankment	Irrigation	Terraces and diversions	Grassed waterways
Oben: ObB, OeC	Fair where coarse fragment content of surface layer is 3 to 10 percent. Poor where coarse fragment content of surface layer is 10 to 30 percent.	Poor: 10 to 20 inches of material.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: 10 to 20 inches of material.	Bedrock at a depth of 10 to 20 inches.	Bedrock at a depth of 10 to 20 inches.	Bedrock at a depth of 10 to 20 inches.
Pedernales: PeB, PeC	Fair: 6 to 15 inches of fine sandy loam.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Moderate: moderately slow permeability.	Moderate: fair stability; compressibility.	Moderately slow permeability.	All features favorable.	All features favorable.
Purves: PuC	Poor: coarse fragment content of surface layer is 10 to 20 percent; clay surface layer.	Poor: 10 to 20 inches of material; high shrink-swell potential.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: 10 to 20 inches of material; stoniness.	Bedrock at a depth of 10 to 20 inches; slope.	Bedrock at a depth of 10 to 20 inches.	Bedrock at a depth of 10 to 20 inches; slope.
Renick: ReE	Poor: coarse fragment content of surface layer is 10 to 35 percent.	Poor: 2 to 20 inches of material; high shrink-swell potential.	Severe: bedrock at a depth of 2 to 20 inches.	Severe: 2 to 20 inches of material; rockiness.	Bedrock at a depth of 2 to 20 inches; slope.	Bedrock at a depth of 2 to 20 inches; slope.	Bedrock at a depth of 2 to 20 inches; slope.

Speck: SpC, SsD	Poor: clay surface layer.	Poor: 14 to 19 inches of material.	Severe: bedrock at a depth of 14 to 19 inches.	Severe: 14 to 19 inches of material.	Bedrock at a depth of 14 to 19 inches; slope.	Bedrock at a depth of 14 to 19 inches.	Bedrock at a depth of 14 to 19 inches.
Tarrant: TaC, TkE	Poor: coarse fragment content of surface layer is 35 to 65 percent; clay surface layer.	Poor: bedrock at a depth of 7 to 16 inches; stoniness; high shrink-swell potential.	Severe: bedrock at a depth of 7 to 16 inches.	Severe: 7 to 16 inches of material; stoniness.	Bedrock at a depth of 7 to 16 inches; slope.	Bedrock at a depth of 7 to 16 inches.	Bedrock at a depth of 7 to 16 inches; slope.
Tobosa: To	Poor: clay surface layer.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Slight	Moderate: fair slope stability.	Very slow permeability.	Clay texture	Very slow permeability.
Topia: TpB, TpC	Poor: clay surface layer.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Severe: seepage.	Moderate: 23 to 38 inches of material; fair slope stability.	Very slow permeability; slope.	All features favorable.	Very slow permeability.
Vashti: VaC, VhB	Poor where surface layer is loamy fine sand. Fair where surface layer is fine sandy loam.	Fair: 29 to 45 inches of material; fair traffic-supporting capacity.	Moderate where sandstone is at a depth of 36 to 45 inches; seepage. Severe where sandstone is at a depth of 29 to 36 inches.	Moderate: 29 to 45 inches of material.	Loamy fine sand texture; slope.	Loamy fine sand texture.	Silt hazard; slope.

TABLE 6.—*Engineering*

[Tests performed by Texas Highway Department in accordance with standard

Soil name and location	Parent material	Texas report number	Depth from surface	Shrinkage		
				Limit	Lineal	Ratio
			Inches	*Percent*	*Percent*	
Castell gravelly sandy loam: 6.2 miles east of Willow City, Tex., on Ranch Road 1323; 6.1 miles northeast on Althaus Road; 1.6 miles northwest on pasture road; west 900 feet on pasture road; 200 feet south of pasture road. (modal)	Gneiss.	65–25–R	13–20	15	12. 6	1. 88
Denton silty clay: 2.25 miles east of Harper, Tex., on U.S. Highway 290; north of highway in road cut. (nonmodal, heavy)	Soft limestone.	65–17–R	12–28	12	22. 0	1. 88
13.6 miles northeast on Ranch Road 1631 from intersection of Ranch Road 1631 and U.S. Highway 290 in Fredericksburg, Tex.; 250 feet south in cultivated field. (nonmodal, light)	Soft limestone.	65–14–R	12–24	12	21–1	1. 92
6.6 miles east of Fredericksburg, Tex., on U.S. Highway 290; 2.8 miles southeast on Ranch Road 1376; 40 feet north in cultivated field. (modal)	Soft limestone.	65–28–R	6–20	11	20. 3	1. 99
Heatly loamy fine sand: 2.8 miles northeast of Fredericksburg, Tex., on Texas Highway 16; 0.9 mile north on county road in road cut. (nonmodal, light)	Sandy formations.	65–20–R 65–21–R 65–22–R	0–20 30–38 38–60	14 14 14	2. 3 4. 2 7. 2	1. 85 1. 88 1. 88
1.3 miles north of intersection of Texas Highway 16 and U.S. Highway 87 in Fredericksburg, Tex., on Texas Highway 16; 2.9 miles north on Lower Crabapple Road; 100 feet east in pasture. (modal)	Sandy formations.	65–8–R 65–9–R 65–10–R	0–13 25–35 35–54	15 13 12	1. 3 5. 6 5. 6	1. 81 1. 93 1. 93
Lewisville clay loam: 0.2 mile south of Albert, Tex., on Ranch Road 1623; west side of road. (nonmodal, heavy)	Calcareous alluvium.	65–29–R 65–30–R	12–42 42–70	14 13	18. 4 15. 0	1. 89 1. 98
9.4 miles southwest of the courthouse in Fredericksburg, Tex., on Texas Highway 16; 800 feet west on private road; 200 feet southeast in a cultivated field. (modal)	Calcareous alluvium.	65–1–R 65–2–R	16–33 33–60	12 14	14. 9 12. 0	1. 92 1. 87
Luckenbach clay loam: 2.2 miles southwest of Fredericksburg, Tex., on Texas Highway 16; 8.4 miles west on Ranch Road 2093; north of road in road cut. (nonmodal, heavy)	Limy earth.	65–23–R 65–24–R	10–28 34–60	14 14	18. 0 14. 4	1. 90 1. 91
17 miles northwest of Fredericksburg, Tex., on U.S. Highway 87; 2.4 miles east on county road; north side of road. (nonmodal, light)	Limy earth.	65–34–R 65–35–R	10–28 33–60	12 14	18. 4 11. 6	1. 93 1. 86
9.4 miles southwest of Fredericksburg, Tex., on Texas Highway 16; 3.4 miles west on Morris Ranch Road; 100 feet south in cultivated field. (modal)	Limy earth.	65–3–R	16–28	11	17. 4	1. 98

See footnotes at end of table.

test data

procedures of the American Associaton of State Highway Officials (AASHO)]

Mechanical analysis [1]										Liquid limit	Plasticity index	Classification [2]	
Percentage passing sieve—							Percentage smaller than—						
1 inch	¾ inch	⅜ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHO [3]	Unified [4]
										Percent			
100	97	92	86	77	58	38	33	21	19	41	24	A-7-6(4)	SC
------	--------	--------	--------	100	99	98	95	62	53	70	44	A-7-6(20)	CH
------	--------	--------	100	99	93	88	88	70	58	66	40	A-7-6(20)	CH
------	100	99	98	98	94	86	83	62	49	60	39	A-7-6(20)	CH
------	--------	--------	100	99	81	24	18	7	5	17	3	A-2-4(0)	SM
------	--------	--------	100	99	84	35	33	19	18	21	8	A-2-4(0)	SC
------	--------	100	99	97	79	35	30	20	18	27	15	A-2-6(1)	SC
------	--------	--------	100	99	71	20	13	3	1	17	2	A-2-4(0)	SM
------	--------	--------	100	98	88	45	37	19	17	22	11	A-6(2)	SC
------	--------	--------	100	97	78	39	32	17	16	22	11	A-6(2)	SC
------	100	99	99	98	94	90	88	67	53	57	37	A-7-6(19)	CH
------	--------	--------	100	97	91	84	83	56	37	45	28	A-7-6(17)	CL
------	--------	100	99	97	94	81	76	52	40	45	27	A-7-6(16)	CL
------	100	90	83	80	78	69	65	42	30	39	22	A-6(12)	CL
------	--------	--------	100	99	96	79	75	60	54	56	34	A-7-6(19)	CH
100	97	91	78	65	52	43	42	27	20	45	27	A-7-6(6)	SC
------	--------	100	99	96	71	52	51	42	40	55	33	A-7-6(12)	CH
------	--------	100	96	93	79	61	58	38	25	38	23	A-6(10)	CL
------	100	99	99	98	91	74	71	49	44	50	31	A-7-6(18)	CL–CH

TABLE 6.—*Engineering*

Soil name and location	Parent material	Texas report number	Depth from surface	Shrinkage		
				Limit	Lineal	Ratio
Topia clay:			*Inches*	*Percent*	*Percent*	
9 miles northwest of Fredericksburg, Tex., on U.S. Highway 87; 1.7 miles north on Ranch Road 2323; 50 feet south of livestock underpass, west side of road. (nonmodal, heavy)	Limestone.	65–31–R 65–32–R 65–33–R	0–18 18–35 35–40	11 8 11	21. 0 24. 5 20. 6	1. 97 2. 06 1. 98
6.7 miles northwest of Fredericksburg, Tex., on U.S. Highway 87; 2.3 miles north on Cherry Mountain Road; west of road, 50 feet south of small field. (nonmodal, light)	Limestone.	65–36–R 65–37–R	8–23 23–30	11 14	24. 7 17. 4	1. 97 1. 83
14.7 miles southwest of courthouse in Fredericksburg, Tex., on Texas Highway 16, 75 feet northeast in cultivated field. (modal)	Limestone.	65–5–R 65–6–R	0–17 17–31	13 13	22. 2 22. 5	1. 90 1. 91

[1] Mechanical analyses according to the AASHO Designation T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

TABLE 7.—*Interpretations of the soils*

[Absence of an entry in a column indicates properties were too variable to rate. An asterisk in the first column indicates that at least one limitations, and for this reason it is necessary to follow carefully the instructions for

Soil series and map symbols	Degree of limitations and soil features affecting—			
	Roads and streets	Dwellings	Light industry	Septic tank filter fields
Altoga: AlC	Severe: poor traffic- supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Moderate: moderate permeability.
Bastrop:				
BaC	Moderate: fair traffic-supporting capacity.	Slight	Slight where slopes are 1 to 4 percent. Moderate where slopes are 4 to 5 percent.	Moderate: moderate permeability.
BfB	Moderate: fair traffic-supporting capacity.	Slight	Slight	Moderate: moderate permeability.
Blanket: Bk	Moderate: moderate shrink-swell potential; fair traffic-supporting capacity.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.

test data—Continued

Mechanical analysis [1]										Liquid limit	Plasticity index	Classification [2]	
Percentage passing sieve—							Percentage smaller than—						
1 inch	¾ inch	⅜ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHO [3]	Unified [4]
										Percent			
------	100	98	96	95	89	82	78	48	42	63	41	A–7–6(20)	CH
------	------	100	99	98	92	87	86	66	61	73	51	A–7–6(20)	CH
94	93	90	88	86	81	75	75	57	49	61	39	A–7–6(20)	CH
------	------	100	99	98	96	93	92	69	62	79	49	A–7–5(20)	CH
100	98	96	93	88	79	71	70	56	45	57	34	A–7–6(18)	CH
------	------	100	99	99	98	93	91	63	53	73	45	A–7–6(20)	CH
------	100	99	98	97	94	91	88	69	61	73	46	A–7–6(20)	CH

[2] Unified and AASHO classification made by SCS personnel.
[3] Based on standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1. Ed.): The Classification of Soils and Soil-Aggregate.
[4] Based on the Unified Soil Classification System (*8*).

for use in town and country planning

mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and referring to other series that appear in the first column of this table]

Degree of limitations and soil features affecting—Continued						Corrosivity class for uncoated steel and contributing soil features
Sewage lagoons	Sanitary landfill	Camp areas	Picnic areas	Paths and trails	Playgrounds	
Moderate: moderate permeability	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	Moderate: resistivity.
Moderate: moderate permeability.	Slight	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand; 1 to 5 percent slopes.	Moderate: sandy clay loam.
Moderate: moderate permeability.	Slight	Slight	Slight	Slight	Slight where slopes are 1 to 2 percent. Moderate where slopes are 2 to 3 percent.	Moderate: sandy clay loam.
Slight	Moderate: clay loam. Severe where slopes are 15 to 20 percent.	Moderate: clay loam; moderately slow permeability.	Moderate: clay loam.	Moderate: clay loam.	Moderate: clay loam; moderately slow permeability.	Moderate: resistivity; clay loam.

TABLE 7.—*Interpretations of the soils for use*

Soil series and map symbols	Degree of limitations and soil features affecting—			
	Roads and streets	Dwellings	Light industry	Septic tank filter fields
Bonti: BoC	Moderate: bedrock at depth of 20 to 38 inches; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderate: bedrock at a depth of 20 to 38 inches; moderate shrink-swell potential.	Severe: bedrock at a depth of 20 to 38 inches; moderately slow permeability.
*Brackett: BrC, BrE, BtE For Tarrant part of BtE, see Tarrant series.	Moderate where slopes are 1 to 15 percent; fair traffic-supporting capacity.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: moderately slow permeability.
Castell: CaC	Moderate: bedrock at a depth of 20 to 40 inches; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Severe: bedrock at a depth of 20 to 40 inches.
Click: ClD	Slight	Slight where slopes are 1 to 6 percent. Moderate where slopes are 6 to 8 percent; granite from 40 to 56 inches below the surface. Severe where slopes are 6 to 8 percent; granite from 38 to 40 inches below the surface.	Slight where slopes are 1 to 4 percent. Moderate where slopes are 4 to 8 percent.	Severe: rapidly permeable; inadequate filtration.
Cobb: CoC	Moderate: fair traffic-supporting capacity.	Slight	Slight where slopes are 1 to 4 percent. Moderate where slopes are 4 to 5 percent.	Severe: bedrock at a depth of 26 to 48 inches.
Demona: DeC	Moderate: fair traffic-supporting capacity.	Moderate: moderately well drained.	Moderate: high corrosivity; moderately well drained.	Severe: moderately slow permeability.
Denton: DnB, DnC, DnC2	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential; high corrosivity.	Severe: bedrock at a depth of 22 to 40 inches; slow permeability.
Doss: DoC, DsC2	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.

in town and country planning—Continued

Degree of limitations and soil features affecting—Continued						Corrosivity class for uncoated steel and contributing soil features
Sewage lagoons	Sanitary landfill	Camp areas	Picnic areas	Paths and trails	Playgrounds	
Severe: bedrock at a depth of of 20 to 38 inches.	Severe: bedrock at a depth of 20 to 38 inches.	Moderate: loamy sand; moderate permeability.	Moderate: loamy sand.	Moderate loamy sand.	Moderate: loamy sand; moderately slow permeability; slope.	High: gravelly clay.
Severe: seepage.	Severe: bedrock at a depth of 10 to 20 inches.	Moderate where slopes are 1 to 15 percent; moderately slow permeability. Severe where slopes are 15 to 20 percent.	Slight where slopes are 1 to 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are 15 to 20 percent.	Slight where slopes are 1 to 15 percent. Moderate where slopes are 15 to 20 percent.	Moderate where slopes are 2 to 6 percent; moderately slow permeability. Severe where slopes are 6 to 20 percent.	High: resistivity.
Severe: bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: slow permeability.	Slight----------	Slight----------	Moderate: slopes are 2 to 5 percent; slow permeability.	Low.
Severe: rapid permeability.	Severe: granite at a depth of 38 to 56 inches; rapid permeability.	Moderate: coarse fragment content of surface layer is 20 to 30 percent.	Moderate: coarse fragment content of surface layer is 20 to 30 percent.	Moderate: coarse fragment content of surface layer is 20 to 30 percent.	Severe: coarse fragment content of surface layer is 20 to 30 percent.	Low.
Severe: bedrock at a depth of 26 to 48 inches.	Moderate: bedrock at a depth of 26 to 48 inches.	Slight----------	Slight----------	Slight----------	Slight where slopes are 1 to 2 percent. Moderate where slopes are 2 to 5 percent; bedrock at a depth of 26 to 48 inches.	Low.
Severe: seepage; rapid permeability of surface layer.	Moderate: sandy clay loam.	Moderate: fine sand.	Moderate: fine sand.	Moderate: fine sand.	Severe: fine sand.	High: sandy clay.
Severe: bedrock at a depth of 22 to 40 inches.	Severe: bedrock at a depth of 22 to 40 inches.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	High: silty clay.
Severe: excess seepage below a depth of 20 inches.	Severe: bedrock at a depth of 11 to 20 inches; silty clay.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	Moderate: silty clay.

TABLE 7.—*Interpretations of the soils for use*

Soil series and map symbols	Degree of limitations and soil features affecting—			
	Roads and streets	Dwellings	Light industry	Septic tank filter fields
Eckert: EcD	Severe: bedrock at a depth of 4 to 14 inches; stone and rock content of surface layer is 35 to 70 percent.	Severe: bedrock at a depth of 4 to 14 inches.	Severe: bedrock at a depth of 4 to 14 inches.	Severe: bedrock at a depth of 4 to 14 inches.
Frio: Fr	Moderate where subject to flooding less than once in 5 years; moderate shrink-swell potential. Severe where subject to flooding once to twice each year.	Severe: subject to flooding	Severe: corrosivity; subject to flooding.	Severe: moderately slow permeability; subject to flooding.
Granite outcrop: Gn. Properties too variable to rate.				
*Guadalupe: Gp, Gr For Frio part of Gr, see Frio series.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Gullied land: Gu. Properties too variable to rate.				
Harper: HaD	Severe: bedrock at a depth of 11 to 20 inches.	Severe: bedrock at a depth of 11 to 20 inches; high shrink-swell potential.	Severe: bedrock at a depth of 11 to 20 inches; high corrosivity.	Severe: bedrock at a depth of 11 to 20 inches; moderately slow permeability.
Heatly: He	Moderate: fair traffic-supporting capacity.	Slight	Slight where slopes are 1 to 4 percent. Moderate where slopes are 4 to 5 percent.	Slight
Hensley: HnD, HsB	Severe: bedrock at a depth of 13 to 19 inches.	Severe: bedrock at a depth of 13 to 19 inches.	Severe: bedrock at a depth of 13 to 19 inches; high corrosivity.	Severe: bedrock at a depth of 13 to 19 inches.

in town and country planning—Continued

Degree of limitations and soil features affecting—Continued						Corrosivity class for uncoated steel and contributing soil features
Sewage lagoons	Sanitary landfill	Camp areas	Picnic areas	Paths and trails	Playgrounds	
Severe: bedrock at a depth of 4 to 14 inches.	Severe: bedrock at a depth of 4 to 14 inches.	Severe: stone and rock content of surface layer is 35 to 70 percent.	Severe: stone and rock content of surface layer is 35 to 70 percent.	Severe: rock content of surface layer is 35 to 70 percent.	Severe: bedrock at a depth of 4 to 14 inches; stone and rock content of surface layer is 35 to 70 percent.	Low.
Slight	Severe: subject to flooding.	Moderate: moderately slow permeability; silty clay loam. Severe: subject to flooding once to twice during season of use.	Moderate where subject to flooding once in 5 years; silty clay loam. Severe where subject to flooding once or twice during season of use.	Moderate: silty clay loam; subject to flooding once or twice during season of use.	Moderate where subject to flooding once in 5 years; silty clay loam; moderately slow permeability. Severe where subject to flooding once or twice during season of use.	High: silty clay loam; resistivity.
Severe: moderately rapid permeability.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.	Slight where subject to flooding once in 4 to 6 years. Moderate where subject to flooding once or twice each year.	Severe: subject to flooding.	Low.
Severe: bedrock at a depth of 11 to 20 inches.	Severe: bedrock at a depth of 11 to 20 inches.	Severe: clay	Severe: clay	Severe: clay	Severe: clay	High: clay.
Moderate: moderate permeability.	Slight	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Low.
Severe: bedrock at a depth of 13 to 19 inches.	Severe: bedrock at a depth of 13 to 19 inches.	Moderate: slow permeability.	Slight	Slight	Severe: bedrock at a depth of 13 to 19 inches.	High: clay.

TABLE 7.—*Interpretations of the soils for use*

Soil series and map symbols	Degree of limitations and soil features affecting—			
	Roads and streets	Dwellings	Light industry	Septic tank filter fields
Katemcy: KaC	Moderate: bedrock at a depth of 20 to 44 inches; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderate: corrosion potential; moderate shrink-swell potential.	Severe: bedrock at a depth of 20 to 44 inches; slow permeability.
Keese: KrD, KrF	Severe: bedrock at a depth of 11 to 20 inches.	Severe: bedrock at a depth of 11 to 20 inches.	Severe: bedrock at a depth of 11 to 20 inches.	Severe: bedrock at a depth of 11 to 20 inches.
Krum: KuB, KuC	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: moderately slow permeability.
Lewisville: LeA, LeB, LeC	Severe: poor traffic-supporting capacity.	Moderate: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential; high corrosivity.	Moderate: moderate permeability.
Ligon: LgC, LIC	Severe: bedrock at a depth of 12 to 20 inches.	Severe: bedrock at a depth of 12 to 20 inches.	Severe: bedrock at a depth of 12 to 20 inches.	Severe: bedrock at a depth of 12 to 20 inches.
Lindy: LnD	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: bedrock at a depth of 22 to 34 inches; slow permeability.
Luckenbach: LuB, LuC, LuC2	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: moderately slow permeability.
Nebgen: NrD, NrF	Severe: bedrock at a depth of 4 to 14 inches; stoniness.	Severe: bedrock at a depth of 4 to 14 inches.	Severe: bedrock at a depth of 4 to 14 inches.	Severe: bedrock at a depth of 4 to 14 inches.
Oben: ObB, OeC	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.

in town and country planning—Continued

Degree of limitations and soil features affecting—Continued						Corrosivity class for uncoated steel and contributing soil features
Sewage lagoons	Sanitary landfill	Camp areas	Picnic areas	Paths and trails	Playgrounds	
Severe: bedrock at a depth of 20 to 44 inches.	Severe: bedrock at a depth of 20 to 44 inches.	Moderate: clay loam; slow permeability.	Moderate: clay loam.	Moderate: clay loam.	Moderate: clay loam; slopes are 2 to 5 percent; slow permeability.	High: clay.
Severe: bedrock at a depth of 11 to 20 inches.	Severe: bedrock at a depth of 11 to 20 inches.	Moderate where slopes are 8 to 15 percent; rockiness. Severe where slopes are 15 to 20 percent.	Moderate where slopes are 8 to 15 percent; rockiness. Severe where slopes are 15 to 20 percent.	Moderate where slopes are 15 to 20 percent; rockiness.	Severe: bedrock at a depth of 11 to 20 inches.	Low.
Slight where slopes are 1 to 2 percent. Moderate where slopes are 2 to 5 percent.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	High: silty clay; resistivity.
Moderate: moderate permeability.	Moderate: clay loam.	Moderate: clay loam.	Moderate: clay loam.	Moderate: clay loam.	Moderate: clay loam.	High: resistivity.
Severe: bedrock at a depth of 12 to 20 inches.	Severe: bedrock at a depth of 12 to 20 inches.	Moderate: clay loam; moderately slow permeability.	Moderate: clay loam.	Moderate: clay loam.	Severe: bedrock at a depth of 12 to 20 inches.	Moderate: conductivity.
Severe: bedrock at a depth of 22 to 34 inches.	Severe: bedrock at a depth of 22 to 34 inches.	Moderate: clay loam; slow permeability.	Moderate: clay loam.	Moderate: clay loam.	Moderate: bedrock at a depth of 22 to 34 inches; clay loam.	Moderate: resistivity.
Slight where slopes are 1 to 2 percent. Moderate where slopes are 2 to 5 percent.	Moderate: clay loam.	Moderate: clay loam; moderately slow permeability.	Moderate: clay loam.	Moderate: clay loam.	Moderate: slopes are 2 to 5 percent; clay loam; moderately slow permeability.	Moderate: conductivity.
Severe: bedrock at a depth of 4 to 14 inches; moderately rapid permeability.	Severe: bedrock at a depth of 4 to 14 inches.	Severe: stoniness and rockiness.	Severe: stoniness and rockiness.	Severe: stoniness and rockiness.	Severe: bedrock at a depth of 4 to 14 inches; stoniness and rockiness.	Low.
Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Slight----------	Slight----------	Slight----------	Severe: bedrock at a depth of 10 to 20 inches.	Low.

TABLE 7.—*Interpretations of the soils for use*

Soil series and map symbols	Degree of limitations and soil features affecting—			
	Roads and streets	Dwellings	Light industry	Septic tank filter fields
Pedernales: PeB, PeC	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: moderately slow permeability.
Purves: PuC	Severe: bedrock at a depth of 10 to 20 inches; high shrink-swell potential.	Severe: bedrock at a depth of 10 to 20 inches; high shrink-swell potential.	Severe: bedrock at a depth of 10 to 20 inches; high shrink-swell potential.	Severe: bedrock at a depth of 10 to 20 inches.
Renick: ReE	Severe: bedrock at a depth of 2 to 20 inches; high shrink-swell potential.	Severe: bedrock at a depth of 2 to 20 inches; high shrink-swell potential.	Severe: bedrock at a depth of 2 to 20 inches; high shrink-swell potential.	Severe: bedrock at a depth of 2 to 20 inches; moderately slow permeability.
Speck: SpC, SsD	Severe: bedrock at a depth of 14 to 19 inches.	Severe: bedrock at a depth of 14 to 19 inches.	Severe: bedrock at a depth of 14 to 19 inches.	Severe: bedrock at a depth of 14 to 19 inches; slow permeability.
Tarrant: TaC, TkE	Severe: bedrock at a depth of 7 to 16 inches; stoniness; high shrink-swell potential.	Severe: bedrock at a depth of 7 to 16 inches; high shrink-swell potential.	Severe: bedrock at a depth of 7 to 16 inches; high shrink-swell potential.	Severe: bedrock at a depth of 7 to 16 inches.
Tobosa: To	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential; corrosivity.	Severe: very slow permeability.
Topia: TpB, TpC	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential; corrosivity.	Severe: very slow permeability.
Vashti: VaC, VhB	Moderate: bedrock at a depth of 29 to 45 inches; fair traffic-supporting capacity.	Moderate: moderately well drained.	Moderate: bedrock at a depth of 29 to 45 inches.	Severe: bedrock at a depth of 29 to 45 inches.

in town and country planning—Continued

Degree of limitations and soil features affecting—Continued						Corrosivity class for uncoated steel and contributing soil features
Sewage lagoons	Sanitary landfill	Camp areas	Picnic areas	Paths and trails	Playgrounds	
Slight where slopes are 1 to 2 percent. Moderate where slopes are 2 to 5 percent.	Moderate: sandy clay.	Moderate: moderately slow permeability.	Slight	Slight	Moderate: moderately slow permeability.	High: sandy clay.
Severe: bedrock at a depth of 10 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: clay	Severe: clay	Severe: clay	Severe: bedrock at a depth of 10 to 20 inches; clay.	High: clay.
Severe: bedrock at a depth of 2 to 20 inches.	Severe: bedrock at a depth of 2 to 20 inches.	Severe: rockiness.	Severe: rockiness.	Severe: rockiness.	Severe: bedrock at a depth of 2 to 20 inches; rockiness.	Moderate: conductivity.
Severe: bedrock at a depth of 14 to 19 inches.	Severe: bedrock at a depth of 14 to 19 inches.	Severe: clay; slow permeability.	Severe: clay	Severe: clay	Severe: bedrock at a depth of 14 to 19 inches; clay.	High: clay.
Severe: bedrock at a depth of 7 to 16 inches.	Severe: bedrock at a depth of 7 to 16 inches.	Severe: clay; stoniness.	Severe: clay; stoniness.	Severe: clay; stoniness.	Severe: bedrock at a depth of 7 to 16 inches; clay; stoniness.	High: clay.
Slight	Severe: clay	Severe: clay; very slow permeability.	Severe: clay	Severe: clay	Severe: clay; very slow permeability.	High: clay.
Severe: bedrock at a depth of 23 to 38 inches.	Severe: bedrock at a depth of 23 to 38 inches.	Severe: clay; very slow permeability.	Severe: clay	Severe: clay	Severe: clay; very slow permeability.	High: clay.
Moderate where bedrock is at a depth of 40 to 45 inches; moderate permeability. Severe where bedrock is at a depth of 29 to 40 inches.	Severe: bedrock at a depth of 29 to 45 inches.	Slight where fine sandy loam. Moderate where loamy fine sand.	Slight where fine sandy loam. Moderate where loamy fine sand.	Slight where fine sandy loam. Moderate where loamy fine sand.	Slight where fine sandy loam. Severe where loamy fine sand.	Moderate: sandy clay loam.

Estimated engineering properties of the soils

Table 4 provides estimates of soil properties important to engineering. The estimates are based on field classification and descriptions, physical and chemical tests of selected representative samples, test data from comparable soils in adjacent areas, and from detailed experience in working with the individual kind of soil in the survey area.

Following are explanations of the column headings in Table 4. Some of the headings are self explanatory. For others, references are listed where the reader may find more complete information.

Hydrologic soil groups give the runoff potential from rainfall. Four major hydrologic groups are used. The soils are classified on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling, and without the protective effects of vegetation. The groups range from lowest runoff potential, group A, to highest runoff potential, group D.

The major soil groups are:

Group A is made up soils having high infiltration rates even when thoroughly wetted. These consist chiefly of deep, well-drained to excessively drained sand, gravel, or both. These soils have a high rate of water transmission, in that water readily passes through them; and they have a low runoff potential.

Group B is made up of soils having moderate infiltration rates when thoroughly wetted. These consist chiefly of moderately deep to deep, moderately well drained to well drained soils of moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission and a moderate runoff potential.

Group C is made up of soils that have slow infiltration rates when thoroughly wetted. These consist chiefly of soils that have a layer that impedes downward movement of water or soils that have moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission and a high runoff potential.

Group D soils have a very slow infiltration rate when thoroughly wetted. These are chiefly clay soils that have a high swelling potential; soils that have a permanent high water table; soils that have a claypan or clay layer at or near the surface; and shallow soils that overlie nearly impervious material. These soils have a very slow rate of water transmission and a very high runoff potential.

Depth to bedrock refers to the more or less solid rock in place, either on or beneath the surface of the earth. It may be rippable or nonrippable and have a smooth or irregular surface.

Depth from surface in typical profile gives the depths of the different horizons or layers in the soil.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary at the back of this survey.

The columns headed "Percentage passing sieve" list estimates for soil materials passing sieves of four sizes. The information is useful in helping to determine suitability of the soil as material for construction purposes.

Permeability as used in table 4 relates only to movement of water downward through undisturbed and uncompacted soil. It does not include lateral seepage. The estimates are based on structure and porosity of the soil. Plowpans, surface crusts, and other properties resulting from use of the soils are not considered. This rating should not be confused with the coefficient of permeability, "K," used by engineers.

Available water capacity is the amount of water a soil can hold and make available to plants. It is the numerical difference between the percentage of water at field capacity and the percentage of water at the time plants wilt. The rate is expressed as inches of water per inch of soil depth.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and relative terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

Engineering interpretations of the soils

Table 5 contains selected information useful to engineers and others who plan to use soil material in construction of highways, farm facilities, buildings, and sewage-disposal systems. Detrimental or undesirable features are emphasized, but very important desirable features also may be listed. The ratings and other interpretations in this table are based on estimated engineering properties of the soils in table 4; on available test data, including those in table 6; and on field experience. While the information applies strictly to soil depths indicated in table 4, it is reasonably reliable to a depth of about 6 feet for most soils and several more feet for others.

Topsoil is a term used to designate a fertile soil or soil material, ordinarily rich in organic matter, used as a topdressing for lawns, gardens, roadbanks, and the like. The ratings indicate the suitability for such use. Ordinarily only the surface layer is removed for topsoil, but other layers may also be suitable.

Road fill is material used to build embankments. The ratings indicate performance of soil material moved from borrow areas for this purpose.

Farm pond reservoir areas are affected mainly by seepage loss of water and depth of soil to bedrock.

Farm pond embankments are affected by soil stability, compaction characteristics, susceptibility to piping, shrink-swell potential, compacted permeability, compressibility, erodibility, and gypsum content. Both the subsoil and substratum are evaluated, where they have different properties and are sufficiently thick to constitute a source of borrow material.

Irrigation of the soils depends largely on permeability, available water capacity, soil depth, slope, susceptibility to water erosion, and the flooding hazard.

Terraces and diversions are affected by soil features such as slope, depth to bedrock or other unfavorable material, texture, and stability of soil material.

Grassed waterways are used to carry off water from terrace and diversion outlets and as protection for natural drainageways. Soils that are shallow over limestone are poorly suited for waterways because of the trouble and expense of shaping the waterway and droughty conditions that make the establishment of vegetation difficult. If an area is frequently flooded, it is difficult to maintain a grassed waterway.

The limitations for pond reservoir areas and embankments are rated *slight*, *moderate*, or *severe*. The following are definitions of soil limitations:

Slight: Soils have properties favorable for the rated use. Limitations are so minor that they can be easily overcome. Good performance and low maintenance can be expected from these soils.

Moderate: Soils have properties favorable for the rated use. Limitations can be overcome or modified with planning, design, or special maintenance. Some of these limitations can be tolerated.

Severe: Soils have one or more properties unfavorable for the rated use. Limitations are difficult and costly to modify or overcome. Major soil reclamation, special design, or intense maintenance is required. Some of these limitations can be tolerated.

Engineering test data

Table 6 contains the results of engineering tests performed by the Texas Highway Department on several important soils in Gillespie County. The table shows the specific location where samples were taken, the depth to which sampling was done, and the results of tests to determine particle-size distribution and other properties significant in soil engineering.

Parent material is the disintegrated and partly weathered rock from which soil has formed.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops. As moisture leaves a soil, the soil shrinks and decreases in volume in direct proportion to the loss in moisture until a condition of equilibrium is reached. At this point, shrinkage stops, although additional moisture may be removed. This point of moisture content where shrinkage stops is called the shrinkage limit of the soil and is reported as the moisture content, by oven-dry weight of soil, where this condition prevails.

Lineal shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the given value to the shrinkage limit.

Shrinkage ratio is the volume change, expressed as a percentage of the volume of the dry soil, divided by the moisture loss above the shrinkage limit, and expressed as a percentage of the weight of the dry soil.

Mechanical analysis shows the percentage, by weight, of soil particles that would pass sieves of specific sizes. Sand and other coarser materials do not pass through the No. 200 sieve. Silt is that material that passes through the No. 200 sieve that is smaller than 0.05 millimeter and larger than 0.002 millimeter in diameter. The clay fraction, the material smaller than 0.002 millimeter in diameter, was determined by the hydrometer method, rather than the pipette method most soil scientists use in determining the clay in soil samples.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a solid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from solid to plastic. The liquid limit is the moisture content at which the material changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Interpretations for town and country planning

Table 7 contains information useful to engineers, contractors, planners, and others who use the existing land resources for planning residential developments, recreational areas, and other community needs. The ratings and other interpretations in this table are based on estimated engineering properties of the soils presented in other engineering tables, on available test data, and on field experience.

The limitations are rated *slight*, *moderate*, or *severe*. The following are definitions of soil limitations:

Slight: Soils have properties favorable for the rated use. Limitations are so minor that they can be easily overcome. Good performance and low maintenance can be expected from these soils.

Moderate: Soils have properties moderately favorable for the rated use. Limitations can be overcome or modified with planning, design, or special maintenance. Some of these limitations can be tolerated.

Severe: Soils have one or more properties unfavorable for the rated use. Limitations are difficult and costly to modify or overcome, or the site requires major soil reclamation, special design, or intense maintenance. Some of these limitations can be tolerated.

Roads and streets are influenced by features of the undisturbed soil that affect construction and maintenance. The soil features, favorable as well as unfavorable, are the principal ones that affect geographic location of roads and streets.

Dwellings are affected chiefly by features of the undisturbed soil that influence its capacity to support low buildings that have normal foundation loads.

Light industry is affected chiefly by ease of excavation for underground utilities and corrosion potential of uncoated steel pipe. The undisturbed soil is rated for spread footing foundations for buildings less than three stories high or foundation loads not in excess of that weight.

Septic tank filter fields are affected mainly by permeability, depth to bedrock, and susceptibility to flooding. Soils in Gillespie County do not have a high water table. The degree of limitations and main reasons for assigning moderate or severe limitations are given.

Sewage lagoons are influenced chiefly by such soil features as permeability, depth to bedrock, and slope. The degree of limitation and principal reasons for assigning moderate or severe limitations are given.

Sanitary landfills are affected by depth of the fill, shrink-swell potential, cover material, and the possibility

of pollution caused by seepage from the fill. The degree of limitation and soil features affecting the moderate or severe limitations are given.

Camp areas are those areas to be used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little site preparation other than shaping and leveling for tent and parking areas is normally required. These areas are subject to heavy foot traffic and limited vehicular traffic. The assumption is made that good vegetative cover can be established and maintained.

The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from risk of flooding during periods of heavy use, and a surface soil that is firm, even after rains, but not dusty when dry.

Picnic areas are for park-type picnic areas. These areas are subject to heavy foot traffic, but most vehicular traffic is confined to access roads. Preparation of an area consists of leveling sites for tables and fireplaces and building access roads. The assumption is made that good vegetative cover can be established and maintained. Soil limitations for waste disposal and for playgrounds are treated as separate items.

Important soil properties affecting this use are wetness, flooding, slope, texture of the surface soil, and rockiness. Prime requirements for this use are freedom from muddiness and dustiness. Strong slopes and rockiness greatly increase the cost of site leveling and building access roads.

Paths and trails applies to the use of soils for local and cross-country foot paths and trails and for bridle paths. It is assumed that the soils would be used in their natural state and that little or no cutting and filling would be done in design and layout of the trails.

Soils properties that affect paths and trails are those that affect foot traffic. Such properties are wetness, texture of the surface soil, coarse fragments, and those that affect design, construction, and maintenance, such as slope, rockiness, or stoniness. Safety features such as sheer cliffs, slippery rocks, and the like were not considered in table 7, but may be important items to consider in final evaluation of a site.

Playgrounds are those areas that are intensively used for such forms of play as baseball, football, badminton, and other organized games. These areas are subject to intensive foot traffic. The assumption is made that good vegetative cover can be established and maintained.

Soil properties that affect the use of the soil for playgrounds are those affected by intensive foot traffic and design, construction, and maintenance. The best soils for playgrounds have a nearly level surface that is free of coarse fragments and Rock outcrop, have good drainage, are free from flooding during periods of heavy use, and have a surface layer that is firm even after rains and is not dusty when dry. Depth to rock is an important consideration on uneven slopes that require grading and leveling.

Corrosivity of uncoated steel, when buried in the soil, is determined by the rate of deterioration, as a result of an electrochemical process of converting iron into its ions. Soil drainage, texture, electrical conductivity, and resistivity are the major factors affecting rate of corrosion.

Concrete placed in soil may deteriorate to varying degrees. Soil texture and acidity, and the amount of sodium, magnesium sulfate, or sodium chloride in the soil are the major factors affecting rate of corrosion. A column for concrete was not included because all of the soils in the county are rated low, except for Demona, which is rated moderate because of the sandy clay texture and medium acid reaction.

Formation and Classification of the Soils

This section contains two main parts. First, the five major factors of soil formation and the process involved in soil horizon differentiation are discussed briefly in terms of their effect on the soils of Gillespie County. Second, the system of classifying soils is discussed and the soils are placed in the system.

Formation of Soils

The properties that characterize a particular soil reflect the interacting effects of five major factors of soil formation: (1) physical and mineralogical composition of the parent material; (2) climate under which the soil material has accumulated and has existed since accumulation; (3) plant and animal life on and in the soil; (4) topography, or lay of the land; and (5) length of time the other four forces of soil formation have acted on the soil material.

Parent material

Parent material is the unconsolidated mass from which soils are formed. It determines the limits of the chemical and mineralogical composition of the soils. The Edwards Plateau part of Gillespie County is underlain by indurated limestone, caliche, calcareous earths, and alluvial sediments. The Texas Central Basin part is underlain by gneiss, granite, sandstone, and schist.

Climate

The main climatic factors that influence soil formation are temperature, amount of precipitation, and seasonal distribution of precipitation. Climate directly affects the soil through its influence on weathering, leaching of carbonates, translocation of clay, reduction and transfer of iron, and rate of erosion. Climate is also directly responsible for the kind and amount of vegetation, which is reflected in the amount and distribution of organic matter in the soil.

Living organisms

Plants, micro-organisms, earthworms, rodents, and other forms of life on or in the soil are active in soil-forming processes. They provide organic matter, help to decompose plant residues, affect the chemistry of the soil, and hasten soil formation. Living organisms also help convert plant nutrients to a form that is more readily available to higher plants.

Relief

Topography, or relief, affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. The topography of Gillespie County ranges from nearly level to steep.

Soils that formed on the nearly level to gently sloping uplands are underlain by deposits of calcium carbonates because water entered the soil and leached the carbonates so that they accumulated in the lower horizons. These soils are Blanket, Luckenbach, and Pedernales.

Shallow soils are on the steeper slopes, and geologic erosion has kept pace with the rate of soil formation. The lesser slopes and concave slopes have deeper soils because soil formation is faster than geologic erosion.

Time

Time, usually a long time, is required for the formation of soils that have distinct horizons. The differences in length of time that parent materials have been in place are commonly reflected in the degree of development of the soil profile.

The soils in Gillespie County range from young to old. The younger soils have little profile development, and the older soils have well-expressed soil horizons. Some of the soils along the Pedernales River are examples of young soils. They are still receiving sediments as the river floods.

Such soils as Altoga and Lewisville are older than the flood-plain soils. These soils developed in older alluvium washed from higher lying uplands. Plant roots formed some soil structures; carbonates have accumulated in the form of very fine concretions, films, and threads in the lower layers. Soils that are older, such as the Castell, Luckenbach, and Pedernales, have well-defined horizon development that indicates they have been there for a long time.

Classification of Soils

Soils are classified so that we may more easily remember their significant characteristics, assemble knowledge about them, see their relationships to one another and to the whole environment, and develop principles that help us understand their behavior and response to manipulation. First through classification and then through use of soil maps we can apply our knowledge of soils to specific fields and other tracts of land.

The current system of classification defines classes in terms of observable or measurable physical properties of soils. The properties chosen are primarily those that permit grouping of soils that are similar in genesis. Genesis, or mode of soil origin, does not appear in the definitions of the classes; it lies behind the classes. The classification is designed to accommodate all soils. It employs a unique nomenclature that is both connotative and distinctive.

The system of soil classification discussed in this subsection (*7*) is that adapted as standard for all soil surveys in the United States, effective January 1, 1965 (*4*). It replaces the classification of Baldwin, Kellogg, and Thorp (*2*) as revised by Thorp and Smith (*5*).

The classification has six categories. Beginning with the most inclusive, the categories are the order, suborder, great group, subgroup, family, and series. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

The classification of the series into families, subgroup, and order in Gillespie County is shown in table 8. The five soil orders in Gillespie County are Alfisols, Entisols, Inceptisols, Mollisols, and Vertisols.

Alfisols are soils containing a clay-enriched B horizon that has high base saturation.

Entisols are recent soils that do not have natural genetic horizons or that have only the beginnings of genetic horizons.

Inceptisols are beginning soils that are most often found on young but not recent land surfaces.

Mollisols have dark-colored surface horizons, have a high base saturation, have moderate to strong structure, are not hard when dry, and have a high content of organic matter.

Vertisols crack when dry and swell when wet, and a natural churning or inversion takes place because the soils have a high content of clay.

Additional Facts About the County

The present boundaries of Gillespie County were established in 1858. The population of the county grew rapidly until about 1930, but then decreased from 11,020 in 1930 to 10,520 in 1950, and to 10,048 in 1960.

Fredericksburg, the county seat, was founded by John O. Meusebach on May 8, 1846. The population of Fredericksburg is 5,326, according to the 1970 census; those of Harper and Stonewall, two other towns in the county, are 1,107 and 198, respectively.

The economy of the county is based on livestock, wildlife, and field crops.

The 1965 census showed 1,161 farms and ranches in the county. More than 90 percent of the farms and ranches in the county are owner operated and range in size from 100 to 4,000 acres. Among the major crops are oats, wheat, barley, grain sorghum, and peaches.

Industries in the county are peach packing sheds, a purse factory, a turkey processing plant, a gypsum mine, a serpentine mine, and a wood milling factory.

Points of interest in the county and nearby are Balanced Rock, Langes Mill, Nimitz Museum, Sunday Houses, the LBJ Ranch, LBJ State Park, Lady Bird Johnson Municipal Park, Pioneer Museum (Kammlah House), and Vereins Kirche.

Geology

Many kinds of rock, ranging in date of origin from Precambrian to Cenozoic, are in Gillespie County, which is on the south flank of the Llano Uplift. The Llano Uplift was formed by an upward bulging of the earth that brought to the surface rocks normally covered by several miles of younger rocks. These rocks exposed by uplift are Precambrian, a billion years or so old, as well as rocks a half billion years old and younger (*3*). The exposed rocks in the range of a billion years old are re-

TABLE 8.—*Soil series classified by higher categories*

[Current as of November, 1970]

Series	Family	Subgroup	Order
Altoga	Fine-silty, carbonatic, thermic	Typic Ustochrepts	Inceptisols.
Bastrop	Fine-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Blanket	Fine, mixed, thermic	Pachic Argiustolls	Mollisols.
Bonti	Fine, mixed, thermic	Ultic Paleustalfs	Alfisols.
Brackett	Loamy, carbonatic, thermic, shallow	Typic Ustochrepts	Inceptisols.
Castell	Fine, mixed, thermic	Ultic Paleustalfs	Alfisols.
Click	Loamy-skeletal, mixed, thermic	Udic Haplustalfs	Alfisols.
Cobb	Fine-loamy, mixed, thermic	Udic Haplustalfs	Alfisols.
Demona	Clayey, mixed, thermic	Aquic Arenic Paleustalfs	Alfisols.
Denton	Fine, montmorillonitic, thermic	Vertic Haplustolls	Mollisols.
Doss	Clayey, carbonatic, thermic, shallow	Typic Calciustolls	Mollisols.
Eckert	Loamy-skeletal, mixed, thermic	Lithic Haplustolls	Mollisols.
Frio	Fine, mixed, thermic	Cumulic Haplustolls	Mollisols.
Guadalupe	Coarse-loamy, mixed, thermic	Fluventic Ustochrepts	Inceptisols.
Harper	Clayey, montmorillonitic, thermic	Lithic Vertic Haplustolls	Mollisols.
Heatly	Loamy, mixed, thermic	Arenic Paleustalfs	Alfisols.
Hensley	Clayey, mixed, thermic	Lithic Rhodustalfs	Alfisols.
Katemcy	Fine, mixed, thermic	Udic Haplustalfs	Alfisols.
Keese	Loamy, mixed, thermic	Lithic Ustochrepts	Inceptisols.
Krum	Fine, mixed, thermic	Vertic Haplustolls	Mollisols.
Lewisville	Fine-silty, carbonatic, thermic	Typic Haplustolls	Mollisols.
Ligon	Loamy, mixed, thermic, shallow	Udic Rhodustalfs	Alfisols.
Lindy	Fine, mixed, thermic	Udic Haplustalfs	Alfisols.
Luckenbach	Fine, mixed, thermic	Typic Argiustolls	Mollisols.
Nebgen	Loamy, mixed, nonacid, thermic, shallow	Typic Ustorthents	Entisols.
Oben	Loamy, mixed, thermic, shallow	Udic Haplustalfs	Alfisols.
Pedernales	Fine, mixed, thermic	Udic Paleustalfs	Alfisols.
Purves	Clayey, montmorillonitic, thermic	Lithic Vertic Haplustolls	Mollisols.
Renick	Clayey, montmorillonitic, thermic	Ruptic-Entic Lithic Haplustolls	Mollisols.
Speck	Clayey, mixed, thermic	Lithic Argiustolls	Mollisols.
Tarrant	Clayey-skeletal, montmorillonitic, thermic	Lithic Haplustolls	Mollisols.
Tobosa	Fine, montmorillonitic, thermic	Typic Chromusterts	Vertisols.
Topia	Very fine, mixed, thermic	Vertic Argiustolls	Mollisols.
Vashti	Fine-loamy, mixed, thermic	Aquic Haplustalfs	Alfisols.

crystallized as a result of high pressure and temperature during their deep burial beneath other rocks. Also, local melting produced granite and various other types of igneous rock.

Rocks of the Precambrian Era in this county are Town Mountain Granite (Click and Keese soils), Red Mountain Granite (Castell soils), Packsaddle Schist (Katemcy and Ligon soils), and Coal Creek Serpentine (Renick soils).

The rocks of the Paleozoic Era in the county are Hickory Sandstone (Bonti, Cobb, Nebgen, Oben, and Vashti soils) and Cap Mountain and Ellenburger Limestones (Eckert and Harper soils).

The rocks of the Mesozoic Era in the county are Edwards Limestone (Hensley, Lindy, Purves, Speck, Tarrant, and Topia soils) and Glen Rose Limestone (Brackett, Denton, and Doss soils).

Those materials of the Cenozoic Era from which soils have formed are mainly of the Pleistocene and Recent Epochs, and are not further divided here. Altoga, Krum, Lewisville, and Tobosa soils formed in old outwash from limestone. Demona and Heatly soils formed in old outwash from sandstone. Bastrop, Blanket, Luckenbach, and Pedernales soils formed in ancient materials derived from a mixture of limestones and sandstones. Frio and Guadalupe soils formed in recent stream alluvium.

Climate [5]

Gillespie County consists of plateaus and hills covered with cedar, oak, and other timber, and broken by the spring-fed Pedernales River. Elevations range from 1,100 to 2,250 feet above sea level.

Gillespie County, at latitude 30° north, is far enough south to escape harsh winters. At an elevation of 1,747 feet and a distance of more than 200 miles inland from the coast, Gillespie County escapes the hot, humid summers characteristic of many southern climates. Summer temperatures are more characteristic of the High Plains than of southern Texas. Smog is unkown, and severe storms are very rare.

Total annual precipitation averages 27.44 inches. Yearly amounts have ranged from 48.22 inches in 1880 to only 11.29 inches in 1956. Prevailing winds are southerly during all months. Relative humidity is fairly uniform throughout the year, but varies considerably during the day. The mean annual relative humidity is 79 percent at 6 a.m., 52 percent at noon, and 47 percent at 6 p.m., Central Standard Time. The area receives about 62 percent of the total possible sunshine annually.

[5] By ROBERT B. ORTON, State climatologist, U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Austin, Texas.

Winter temperatures are mild. When polar air masses move through the area, they give the climate a continental flavor and disrupt briefly the prevailing southerly flow. These colder air masses undergo considerable warming by the time they reach the Hill Country, so that the average daily maximum in January is 60° F., or sufficiently mild for most outdoor activities. Winter is not marked by any prolonged periods of cold weather, rather by short spans lasting 1 or 2 days. Often there is considerable cloudiness in the morning, but the overcast ordinarily breaks up about noon, and sunshine and warmer temperatures prevail in the afternoon. Winter is a comparatively dry season. Precipitation is often in the form of light rain or drizzle. Snowfall is usually of little or no consequence. It often melts as rapidly as it falls.

Spring weather changes rapidly during March and becomes more uniform during April and May as fewer cold fronts penetrate the Texas Hill Country. Rainfall increases significantly in April, as thundershowers are then more frequent. The early morning cloudiness, typical of winter, begins to break up earlier, so that skies are usually sunny throughout the late morning and afternoon. The profusion of wildflowers creates a riot of color in spring.

The summer climate in Gillespie County is characterized by the warm days and cool nights typical of the Southern High Plains. Day-to-day weather is rather uniform, except for an occasional afternoon or evening thundershower. Total monthly rainfall decreases in midsummer, and July is one of the drier months. Summer nights at Fredericksburg average 4° to 5° F. cooler than at lower elevations east of the Hill Country.

Daytime fall temperatures continue warm in September, and few cold fronts reach the area. Precipitation increases significantly during the month as weather disturbances occasionally move eastward from the Gulf of Mexico across the Hill Country. Cold fronts are more frequent after mid-October, and the variation in weather increases. November is normally a dry month. The combination of moderate temperatures, low wind velocities, and the frequent intrusions of mild, dry, polar air masses makes fall a pleasant season in the Hill Country.

The growing season (freeze-free period) in Gillespie County averages 219 days. The average date of the last occurrence of 32° in spring and the first occurrence in fall are April 1 and November 6, respectively. Significant departures from these values exist locally because of differences in topography, exposure, soil condition, and plant cover. The average annual lake evaporation is 62 inches. Table 9 gives the temperature and precipitation data recorded at Fredericksburg, Tex.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available water capacity. The amount of water a soil can hold and make available to plants. It is the numerical difference between the percentage of water at field capacity and the percentage of water at the time plants wilt. The rate is expressed as inches of water per inch of soil depth.

Badlands. Areas of rough, irregular land where most of the surface is occupied by ridges, gullies, and deep channels. Land hard to traverse.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Broad-base terrace. A ridge-type terrace 10 to 20 inches high and 15 to 30 feet wide that has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. This kind of terrace controls erosion by diverting runoff along the contour at a nonscouring velocity. It may be nearly level or have a grade toward one or both ends.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Climax vegetation. The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

TABLE 9.—*Temperature*

[All data from Fredericksburg, Tex. Elevation 1,747 feet.

Month	Temperature [1]				Precipitation			
	Average daily maximum	Average monthly maximum	Average daily minimum	Average monthly minimum	Probability, in percent, of receiving selected amounts			
					Average total [1]	0 inch or trace	0.50 inch or more	1.00 inch or more
	°F	°F	°F	°F	Inches			
January	60.4	78.9	35.8	16.0	1.21	<1	80	63
February	64.4	81.9	39.9	20.8	1.90	<1	90	72
March	71.7	87.5	45.6	25.7	1.37	<1	83	71
April	79.0	91.8	54.6	37.1	2.85	<1	92	81
May	84.7	94.5	61.8	47.5	3.06	<1	99	96
June	90.9	97.9	67.7	58.7	3.17	<1	90	74
July	94.9	101.0	69.5	63.2	1.47	<1	82	65
August	95.1	102.2	68.8	61.6	2.69	1	76	61
September	88.6	98.4	64.2	50.9	3.61	<1	90	70
October	80.2	90.7	55.0	37.3	3.00	4	81	81
November	69.2	84.2	44.2	25.5	1.57	<1	80	62
December	62.9	78.7	38.0	20.9	1.54	4	90	73
Year	78.5	90.6	53.8	38.8	27.44			

[1] Based on a 29-year period of record.
[2] Based on a 12-year period of record.

Loose.—Noncoherent; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard and brittle; little affected by moistening.

Deferred grazing. The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Gravelly soil material. From 15 to 50 percent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are as much as 3 inches in diameter.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has (1) distinctive characteristics caused by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

and precipitation data

Period of record, 1939–67. The symbol < means less than]

Precipitation—Continued									
Probability, in percent, of receiving selected amounts—Continued					Average [2] number of days in which precipitation will equal or exceed—			Snow, sleet	
2.00 inches or more	3.00 inches or more	4.00 inches or more	5.00 inches or more	6.00 inches or more	0.10 inch	0.50 inch	1.00 inch	Average total [1]	Maximum [1]
								Inches	*Inches*
35	22	11	7	3	3	(3)	(3)	0. 5	5. 0
43	20	10	6	2	4	1	1	. 8	6. 0
40	21	11	5	2	2	1	(3)	. 1	3. 0
61	42	24	15	11	4	2	1	(4)	1. 2
82	62	44	31	11	4	2	1	0	0
54	35	24	16	11	3	2	1	0	0
40	25	14	10	6	2	1	(3)	0	0
36	22	14	8	6	3	1	1	0	0
60	50	40	30	20	5	2	1	0	0
50	31	21	20	11	4	2	1	0	0
30	10	4	2	1	4	1	(3)	. 2	4. 5
43	23	10	5	2	3	1	(3)	. 1	1. 5
					41			1. 7	6. 0

[3] Less than one-half day.
[4] Less than one-half inch.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state. In engineering, a high liquid limit indicates that the soil has a high content of clay and a low capacity for supporting loads.

Loam. Soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Miscellaneous land type. A mapping unit for areas of land that have little or no natural soil; or that are too nearly inaccessible for orderly examination; or that occur where, for other reasons, it is not feasible to classify the soil.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Narrow-base terrace. A terrace similar to a broad-base terrace except for the width of the ridge and channel. The base of a narrow-base terrace is ordinarily 4 to 8 feet wide.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all the time and, in Podzolic soils, commonly have mottlings below 6 to 16 inches, in the lower A horizon, and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Poorly graded. A soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Range condition. The state of health or productivity of both soil and forage in a given range, in terms of what productivity could or should be under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor.* The classification is based on

the percentage of original, or climax, vegetation on the site, as compared to what ought to grow on it if management were good.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind of climax vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Saprolite. Decomposed rock.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Soil variant. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

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