SOIL SURVEY OF

Stonewall County, Texas

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

Issued January 1975

Major fieldwork for this soil survey was done in the period 1965–69. 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 King-Stonewall 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, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; 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 Stonewall 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 capability unit, range site, and pasture 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 range sites and capability units.

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

Ranchers and others can find, under "Range Management," 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 "Engineereing Uses of the Soils" and "Use of the Soils as Recreational Areas."

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 Stonewall County may wish to refer to the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "Additional Facts About the County."

Cover: **Contour farming cotton on Clairemont and Yomont soils.**

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SOIL SURVEY OF STONEWALL COUNTY, TEXAS

BY A. R. GOERDEL AND LONNIE WATSON, SOIL CONSERVATION SERVICE

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

Stonewall County is in the northwestern part of the State (fig. 1). It has a total area of 593,280 acres, or 927 square miles. Aspermont is the county seat. The county is in the Rolling Plains section of the Southern Great Plains. The soils are used both for range and crops.

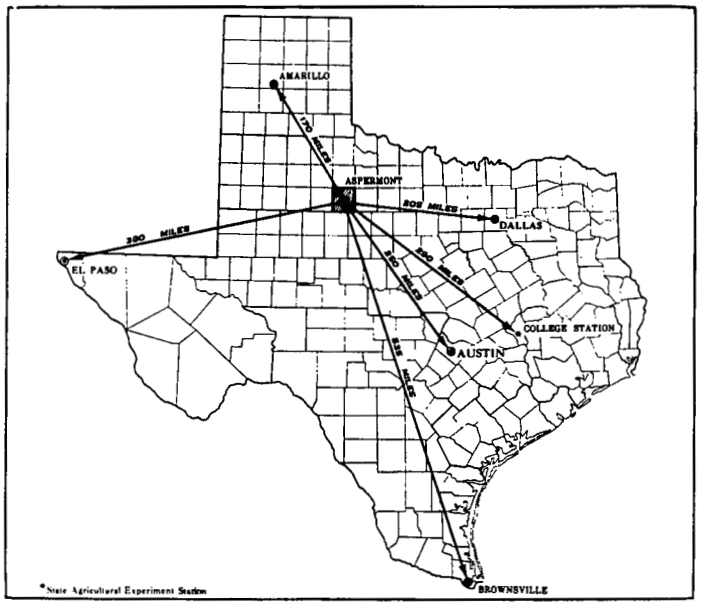

Figure 1.—**Location of Stonewall County in Texas.**

Ranching is the most important agricultural enterprise, and cotton is the main cash crop. About 128,000 acres in the county is cultivated. Stonewall County has periods of drought and only occasional years of adequate rainfall. During the dry years, satisfactory yields are obtained only from the best soils. Both water erosion and soil blowing are hazards in most areas.

The county is thoroughly dissected by deeply entrenched channels that drain to the east. Even on the smaller forks, the rivers are entrenched. Two flowing rivers, the Salt Fork and the Double Mountain Fork of the Brazos River, traverse the county in well-defined channels.

Most of the soils formed in unconsolidated, deep, red, slightly calcareous materials of Permian age. Eight formations or groups of Permian age are exposed in a general north to south line. The Clear Fork Group forms a narrow band along the eastern side of the county. In this band are heavy clay beds that are covered by Pleistocene deposits in most areas. Immediately overlying the Clear Fork Clays is a thin, narrow exposure of the San Angelo Sandstone formation. The Double Mountain Group makes up the rest of the area to the west. The Dog Creek Shale and the Blaine Gypsum are above the San Angelo Sandstone and extend west to slightly west of the central part of the area. The western part is largely of the Quartermaster, Cloud Chief, and Whitehorse Sandstone formations. On this part are large areas of very fine sandy loams and of soils that are silty throughout (*3*).[1]

In the west-central part of Stonewall County, on the south side of the Salt Fork of the Brazos River, are large areas of sand dunes of Pleistocene and Recent age.

In the northwestern part of the county are Croton and Salt Croton Creeks. From 1957 to 1960, Salt Croton Creek contributed an average of 485 tons of chloride and 30 tons of sulfate per day to the Brazos River. From August 1959 to June 1961, Croton Creek contributed an estimated 70 tons of chloride and 100 tons of sulfate per day to the Brazos River (*2*). These chlorides and sulfates are inherent in the geological formations. They affect the quality of the water in the Brazos River, not only in Stonewall County, but downriver, also.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Stonewall 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

[1] Italic numbers in parentheses refer to Literature Cited, page 79.

procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

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. Aspermont and Rotan, 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 slope, 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, Miles fine sandy loam, 1 to 3 percent slopes, is one of several phases within the Miles 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 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.

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 Stonewall 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. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Yomont-Quinlan complex 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. Cottonwood-Owens association 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 purposes 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." Cosh and Spade soils, 1 to 3 percent slopes, 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. Rough broken land is a land type in Stonewall County.

While a soil survey is in progress, soil samples are taken as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils suitable for cultivation.

Soil scientists observe how soils behave when used to grow native and cultivated plants, and when used as material for structures, as foundations for structures, or as covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a particular kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. The capability units and range sites described in this survey were derived in this way.

General Soil Map

The general soil map at the back of this publication shows, in color, the soil associations in Stonewall County. A soil association is a landscape that has a distinctive proportional pattern of soils. It 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 the county, who want to compare different parts of the county, or who want to know the location of large tracts that are suitable for a certain kind of use. Such a map is not suitable for planning the management of a farm or field, or choosing the site for a building or other structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

Stonewall County has nine soil associations; six are made up of soils formed in Permian materials, and three of soils formed in outwash materials. These nine associations are described in the following pages.

Soils Formed in Permian Materials

Soils that formed in Permian materials have a clayey or loamy surface layer that is underlain by clay, shale, sandstone, limestone, or gypsum. These soils are in associations 1 through 6. This group of associations makes up about 69 percent of the county. Almost half of the total acreage is shallow; some areas are stony; and many have slopes greater than 5 percent. Badlands and escarpments are common. Most of the soils in this group are best suited to range or to wildlife management. About 13 percent of the total acreage is cultivated.

1. Tillman-Vernon association

Deep and moderately deep, nearly level to gently sloping, loamy soils over clay

This association consists of soils on uplands. It makes up about 20 percent of the county. The main soils in this association are the Tillman and Vernon (fig. 2). Tillman soils cover about 55 percent of the association, and Vernon soils 10 percent. The other 35 percent is made up of several other soils of minor extent.

The Tillman soils are nearly level to gently sloping and have a reddish-brown, calcareous clay loam surface layer about 7 inches thick. This layer overlies a layer of calcareous clay about 39 inches thick. It is reddish brown in the upper part and red in the lower part. The next layer, about 19 inches thick, is weak-red calcareous clay. The underlying material begins at a depth of 65 inches and is weak-red shaly clay.

The Vernon soils are gently sloping and have a reddish-brown, calcareous clay loam surface layer about 7 inches thick. This layer overlies a layer of calcareous clay, which is about 23 inches thick and is reddish brown in the upper part and red in the lower part. The underlying material, beginning at a depth of 30 inches, is red shaly clay.

Areas of Mangum and Colorado soils are on some of the flood plains of larger drainageways. Treadway soils are on alluvial fans below escarpments, and Hollister soils are in concave areas. Acme and Cottonwood soils are near creeks and larger drainageways, and Aspermont soils are on ridges. Areas of the Owens-Badland association also are in this association.

Most of this association is in range, but about 20 percent is cultivated. The hazard of soil blowing is slight, and the hazard of water erosion is slight to high.

2. Owens-Cottonwood association

Shallow and very shallow, gently sloping to strongly sloping, clayey and loamy soils over clay or gypsum

This association consists of soils on uplands that cover about 18 percent of the county. The main soils are the

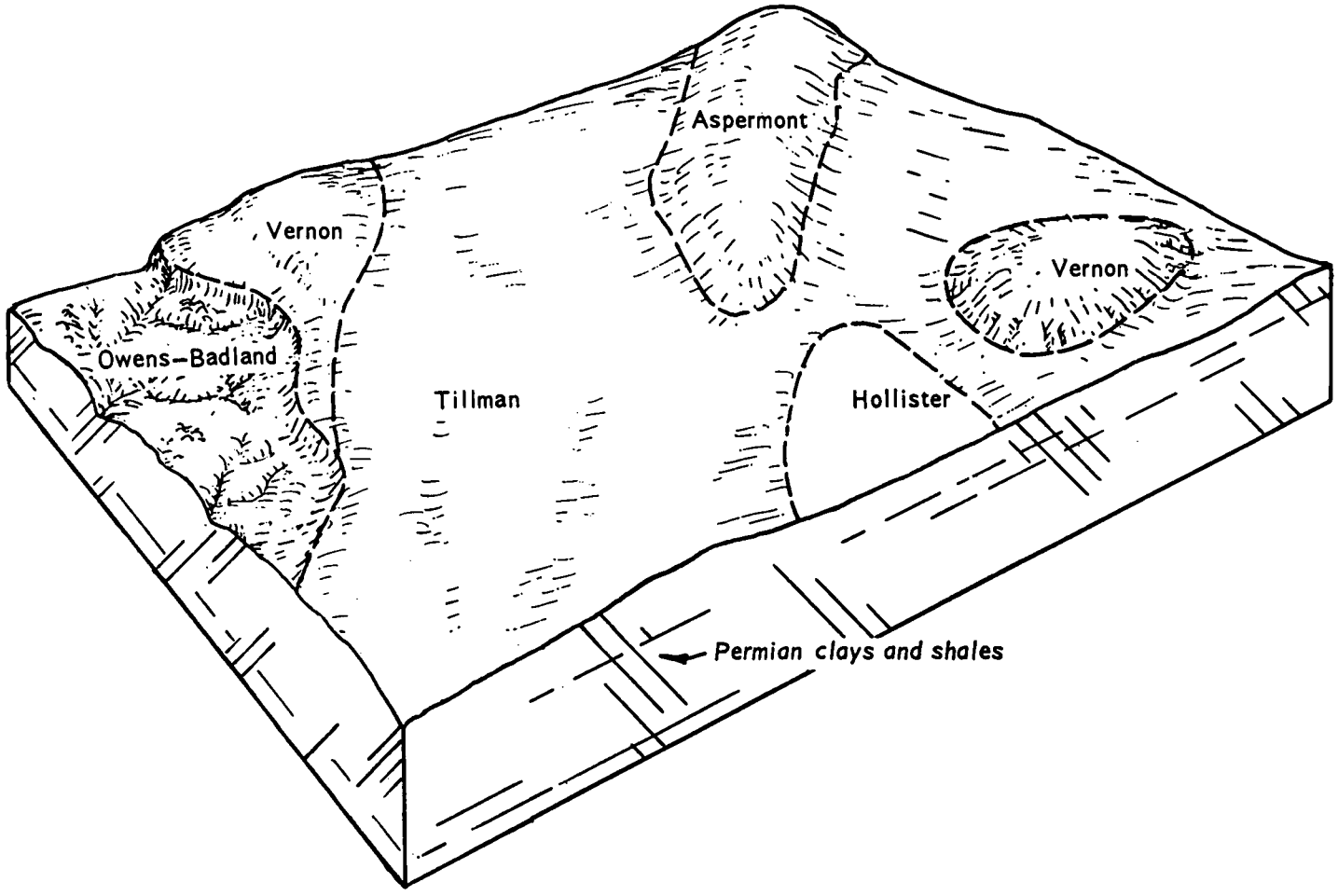

Figure 2.—Tillman-Vernon soil association.

Owens and Cottonwood (fig. 3). The Owens soils form about 33 percent of the association, the Cottonwood soils about 18 percent, and other soils of minor extent 49 percent.

The Owens soils are gently sloping to strongly sloping and have a brown, calcareous clay surface layer about 16 inches thick. The underlying material is shaly clay.

The Cottonwood soils are gently sloping and have a surface layer of brown, calcareous loam about 8 inches thick. The underlying material is soft, calcareous gypsum.

Less extensive areas of Clairemont, Lincoln, Mangum, and Yomont soils are on the flood plains of streams. Some areas of Aspermont, Talpa, Tillman, Treadway, Vernon, and Yates soils and Badlands also are in this association.

Nearly all of this association is in range. The hazard of soil blowing is slight, and the hazard of water erosion is moderate to high.

3. *Paducah-Obaro association*

Deep and moderately deep, nearly level to gently sloping, loamy soils over sandstone

This association consists of soils on uplands and forms about 11 percent of the county. The main soils are the Paducah and Obaro (fig. 4). Paducah soils make up about 50 percent of the association, Obaro soils about 40 percent, and minor soils about 10 percent.

The Paducah soils are nearly level to gently sloping and have a reddish-brown, neutral very fine sandy loam surface layer about 9 inches thick. This layer overlies a layer of sandy clay loam, about 39 inches thick, that is reddish brown and neutral in the upper part and red and mildly alkaline in the lower part. The next lower layer is light-red loam about 20 inches thick. The underlying material, extending to a depth of 75 inches, is weakly consolidated red-bed material of Permian age.

The Obaro soils are gently sloping and have a reddish-brown, calcareous very fine sandy loam surface layer about 10 inches thick. The next lower layer is calcareous loam, about 24 inches thick, that is reddish brown in the upper part and yellowish red in the lower part. The underlying material, extending to a depth of 48 inches, is weakly cemented silt and sandstone.

Some areas of Clairemont, Lincoln, and Yomont soils are on the flood plains of streams and drains. Areas of Hilgrave, Quinlan, St. Paul, and Woodward soils also are in this association.

About 50 percent of this association is cultivated. The hazard of soil blowing is slight, and the hazard of water erosion is slight to moderate.

4. *Quinlan-Woodward association*

Shallow to deep, sloping to moderately steep, loamy soils over sandstone and packsand

This associaiton consists of soils on uplands and makes up about 9 percent of the county. The main soils are the Quinlan and Woodward (fig. 5). Quinlan soils cover about 60 percent of the association, Woodward soils 30 percent, and minor soils about 10 percent.

The Quinlan soils are strongly sloping to moderately steep. They have a surface layer of red, calcareous very fine sandy loam about 8 inches thick. The next lower layer is red, calcareous very fine sandy loam about 8 inches thick. The underlying material, extending to a depth of 30 inches, is red, calcareous, weakly cemented packsand.

The Woodward soils are sloping to strongly sloping. They have a reddish-brown, calcareous very fine sandy loam surface layer about 9 inches thick, that is reddish brown in the upper part and red in the lower part. The

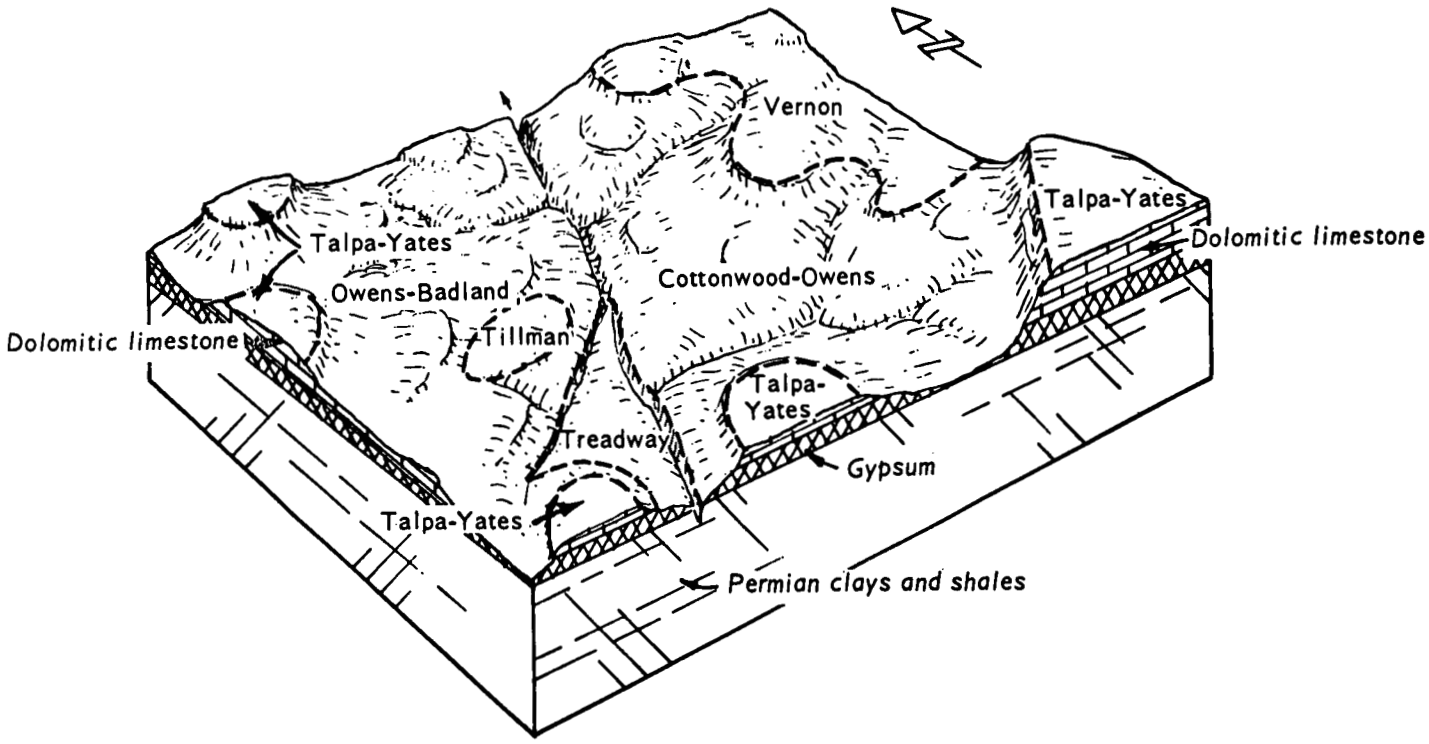

Figure 3.—Owens-Cottonwood soil association.

underlying material, extending to a depth of 50 inches, is red, calcareous, weakly cemented sandstone.

Included in this association are areas of Paducah and Obaro soils on the lower, less sloping landscapes, and areas of Yomont soils on the flood plains of drains and creeks. Patches of Rough broken land are in the steep areas.

Most of this association is in range. The hazard of soil blowing is slight, and the hazard of water erosion is high.

5. *Talpa-Yates association*

Shallow and very shallow, gently sloping, loamy soils over limestone

This association consists of soils on uplands and forms about 7 percent of the county. Talpa and Yates, the main soils of this association, are both gently sloping (fig. 6). The Talpa soils make up about 38 percent of the association, the Yates soils 10 percent, and minor soils about 52 percent.

The Talpa soils have a grayish-brown, calcareous clay loam surface layer about 8 inches thick. The underlying material is indurated limestone.

The Yates soils have a reddish-brown, noncalcareous clay loam surface layer, about 6 inches thick, that is 45 percent limestone fragments. The underlying material is hard limestone.

Less extensive areas of Aspermont, Hensley, Nipsum, Owens, Tillman, and Vernon soils also are in this association.

Almost all of this association is in range. The soils are too shallow for cultivation. The hazard of soil blowing is

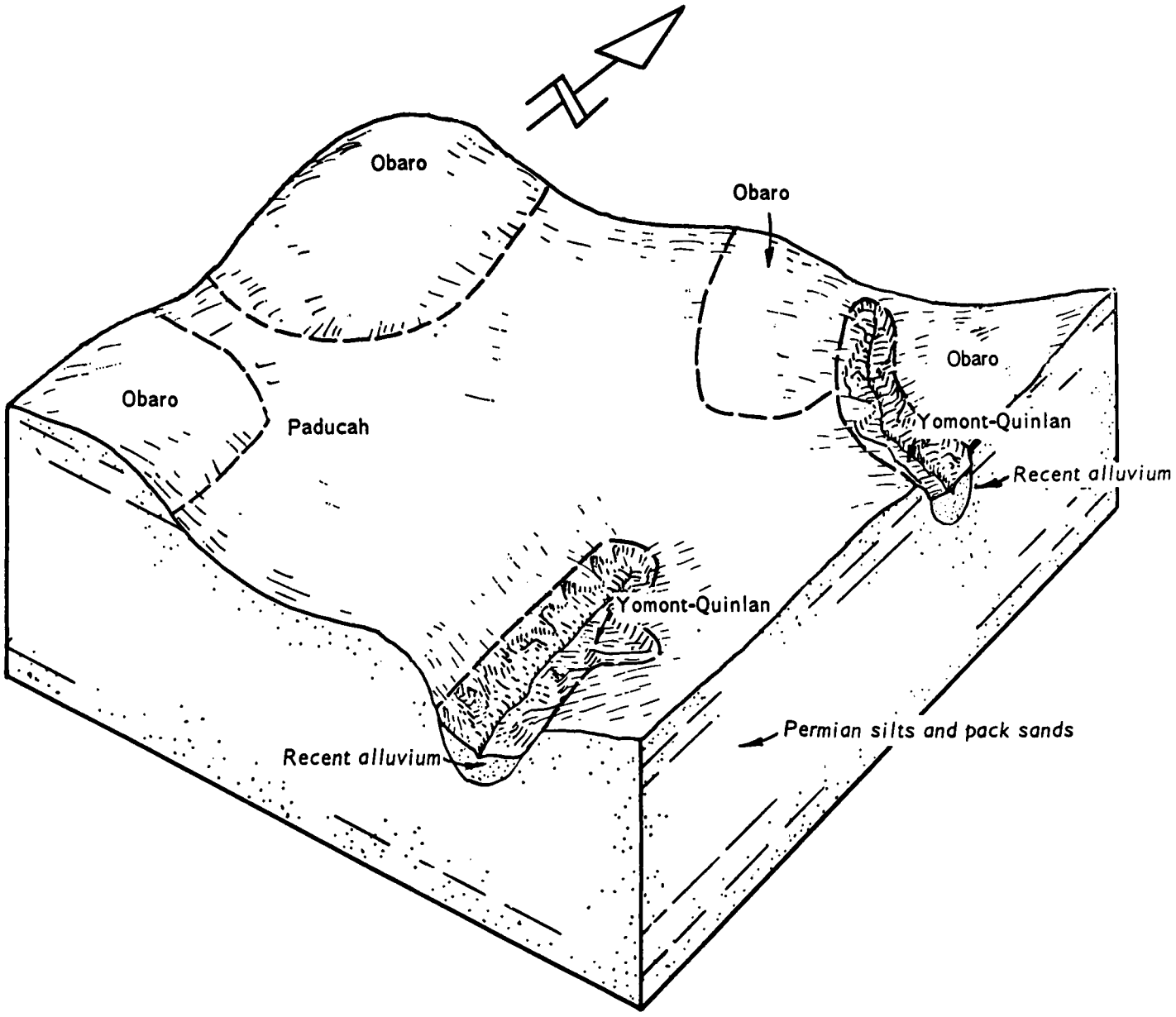

***Figure 4.*—Paducah-Obaro soil association.**

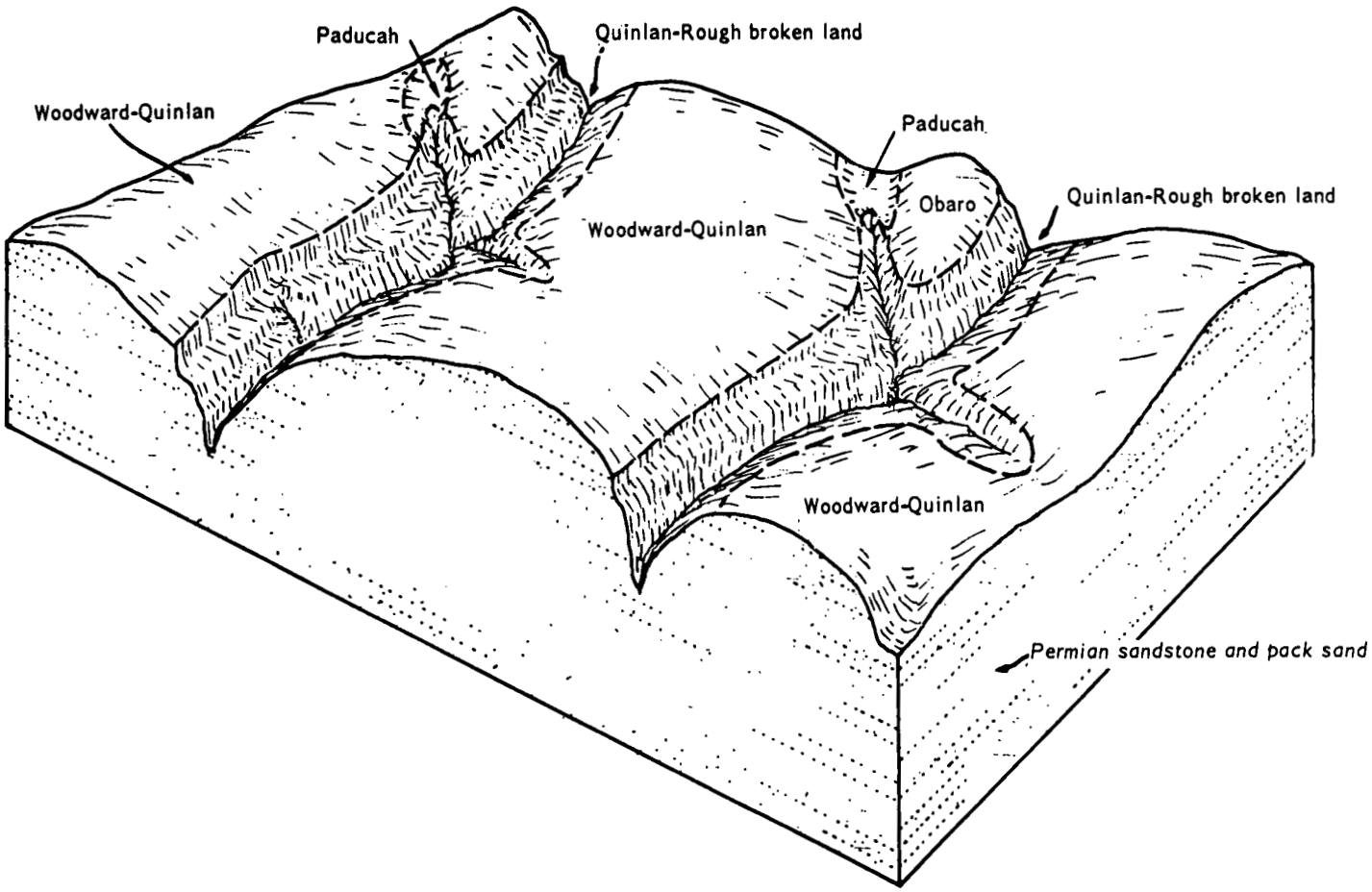

Figure 5.—**Quinlan-Woodward soil association.**

slight, and the hazard of water erosion is slight to moderate.

6. Cobb-Latom association

Moderately deep to very shallow, gently sloping to sloping, loamy soils over sandstone

This association consists of soils on uplands and covers about 4 percent of the county. The main soils are the Cobb and Latom.

The Cobb soils make up about 44 percent of this association, the Latom soils 16 percent, and minor soils about 40 percent.

The Cobb soils are gently sloping and have a reddish-brown, slightly acid, fine sandy loam surface layer about 6 inches thick. This layer overlies a layer of reddish-brown sandy clay loam about 30 inches thick. The underlying material is red sandstone.

The Latom soils are gently sloping to sloping. They have a surface layer of brown, calcareous loam about 8 inches thick. The underlying material is hard, cemented sandstone.

Less extensive areas of Cosh, Frankirk, Miles, Rotan, Spade, and Tillman soils are in this association. The areas of rock outcrop are on escarpments, and severely eroded areas are below escarpments.

Most of this association is in range. About 10 percent is cultivated. The hazards of soil blowing and water erosion are slight to moderate.

Soils Formed in Outwash Materials

Soils that formed in outwash materials have a loamy or sandy surface layer that overlies clayey, loamy, or sandy material. These soils are in associations 7, 8, and 9, which make up about 31 percent of the county. The soils are mainly deep, and slopes are dominantly less than 5 percent.

Much of the acreage is suitable for crops, and about 42 percent of the total is cultivated. These associations are also well suited to range or wildlife habitat.

7. Miles-Devol-Springer association

Deep, nearly level to sloping and gently undulating, loamy and sandy soils that have loamy or sandy lower layers

This association consists of soils on uplands and occupies about 17 percent of the county. The main soils are the Devol, Miles, and Springer.

The Miles soils make up about 34 percent of the association, Devol soils about 6 percent, Springer soils about 5 percent, and minor soils about 55 percent.

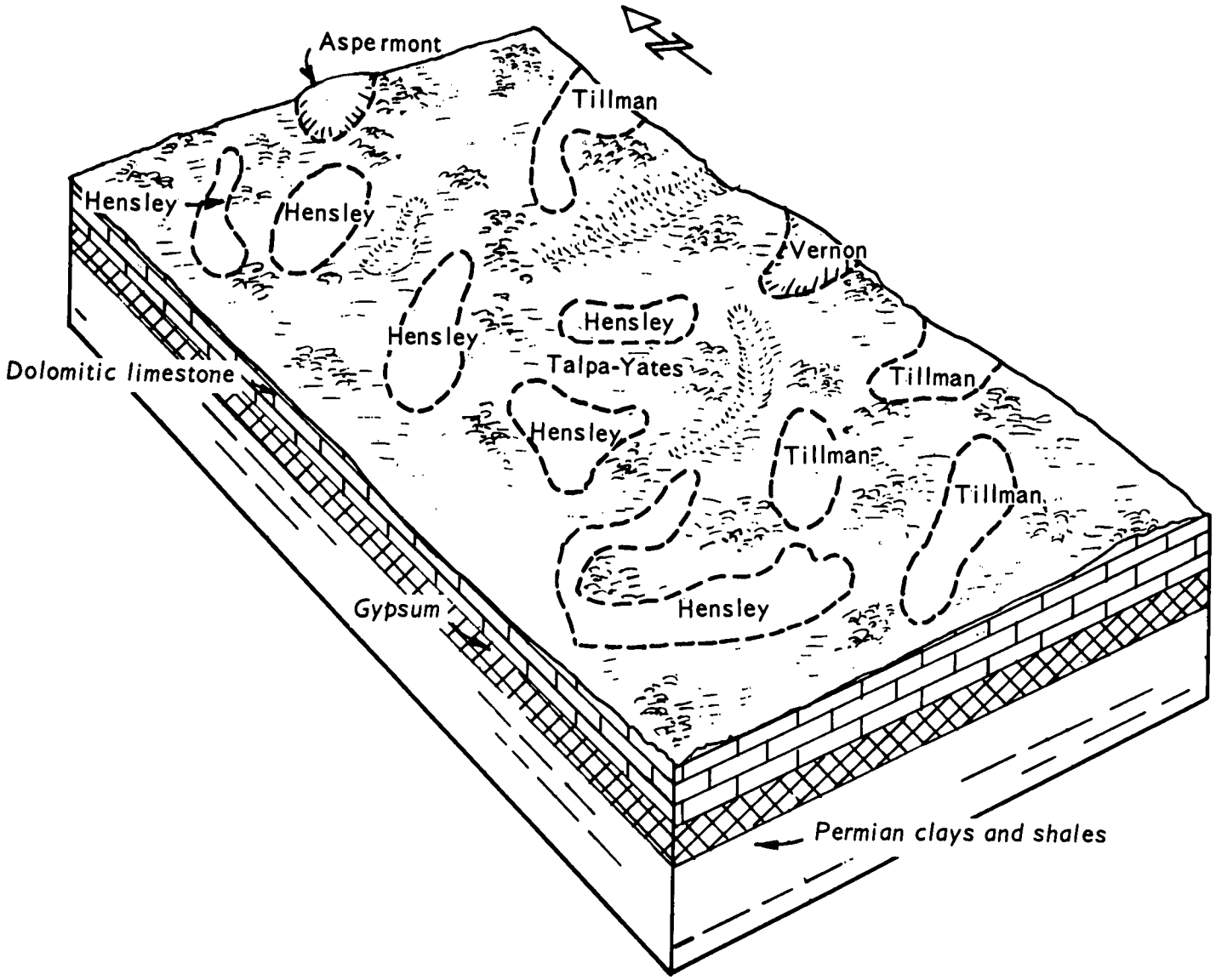

***Figure 6.*—Talpa-Yates soil association.**

The Miles soils are nearly level to sloping. Their surface layer is reddish-brown, neutral fine sandy loam about 8 inches thick. The next layer, extending to a depth of about 60 inches, is sandy clay loam that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is reddish-yellow, calcareous sandy clay loam.

The Devol soils are nearly level to gently sloping and gently undulating. They have a yellowish-brown, neutral loamy fine sand surface layer about 18 inches thick. Below this layer is about 32 inches of fine sandy loam that is yellowish red in the upper part and reddish yellow in the lower part. The underlying material is reddish-yellow, mildly alkaline, loose loamy fine sand.

The Springer soils are nearly level to gently sloping and gently undulating. They have a yellowish-brown, neutral loamy fine sand surface layer about 18 inches thick. This layer overlies a layer of fine sandy lom, about 42 inches thick, that is reddish brown in the upper part and reddish yellow in the lower part. The underlying material is fine sandy loam that is reddish brown in the upper part and yellowish red in the lower part.

Areas of Clairemont, Lincoln, and Yomont soils are on the flood plains of streams in this association. Also, there are small areas of Altus, Enterprise, Hardeman, Hilgrave, Likes, and Tipton soils.

About 40 percent of this association is cultivated, and the rest is in range. The hazard of soil blowing is moderate to high, and the hazard of water erosion is slight to high.

8. Nobscot association

Deep, nearly level to gently undulating, sandy soils that have sandy lower layers

This association consists of soils on uplands and makes up about 8 percent of the county. The Nobscot soils cover

about 75 percent of the association, and minor soils the remaining 25 percent.

The Nobscot soils have a slightly acid fine sand surface layer, about 32 inches thick, that is brown in the upper part and very pale brown in the lower part. Below the surface layer is yellowish-red, slightly acid fine sandy loam about 16 inches thick. The underlying material is yellow, slightly acid loamy sand and fine sand.

Areas of Miles and Springer soils are in some of the smoother parts of this association.

Nearly all of this association is in range. The hazard of water erosion is slight, and the hazard of soil blowing is high.

9. Rotan-Frankirk association

Deep, nearly level to gently sloping, loamy soils that have clayey lower layers

This association consists of soils on uplands and makes up about 6 percent of the county. The main soils are the Rotan and Frankirk.

The Rotan soils make up about 33 percent of this association, the Frankirk soils 29 percent, and minor soils the remaining 38 percent.

The Rotan soils are nearly level and have a surface layer of dark grayish-brown clay loam about 8 inches thick. This overlies a layer of clay, about 40 inches thick, that is dark grayish brown in the upper part and dark brown in the lower part. The next layer, extending to a depth of 70 inches, is reddish-yellow clay. The underlying material is yellowish-red clay loam.

The Frankirk soils are nearly level to gently sloping. They have a reddish-brown clay loam surface layer about 7 inches thick. This overlies a layer of reddish-brown clay loam 9 inches thick. Below this is a layer of reddish-brown clay about 19 inches thick. The next lower layer is red clay loam that is 13 inches thick. Below this, and extending to a depth of 85 inches, is sandy clay loam that is yellowish red in the upper part and reddish yellow in the lower part. The underlying material, extending to a depth of 100 inches, is yellowish-red loam.

Areas of Clairemont, Colorado, Lincoln, and Yomont soils are on the flood plains of the streams in this association. Also, there are small areas of Aspermont, Cosh, Spade, and Vernon soils.

Most of this association is cultivated. The hazard of soil blowing is slight, and the hazard of water erosion is slight to moderate.

Descriptions of the Soils

This section describes the soil series and mapping units in Stonewall 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, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. The profile described for the series is representative for the mapping units in that series. If a given mapping unit has a profile in some ways different from the one described in the series, these differences are stated in the description of the mapping unit. Colors are for dry soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are of a soil series. Rough broken 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 group in which the mapping unit has been placed. The page on which each capability unit, range site, and pasture group is described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The 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 at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*6*).

Acme Series

The Acme series consists of shallow, nearly level soils on uplands. These soils formed in friable, calcareous gypsum.

In a representative profile, the surface layer is calcareous clay loam about 18 inches thick. The upper part is grayish brown, and the lower part is dark brown. The underlying material is soft, calcareous gypsum.

Acme soils are moderately permeable and moderately well drained. Runoff is slow, and the available water capacity is low.

Representative profile of Acme clay loam, in an area of Acme-Cottonwood complex, in range, 100 feet north of a point on U.S. Highway 380 that is 3.35 miles northwest of Aspermont.

A11—0 to 8 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak to moderate, fine, subangular blocky and granular structure; slightly hard, friable, slightly sticky; many roots; calcareous; moderately alkaline; gradual, smooth boundary.

A12—8 to 18 inches, dark-brown (7.5YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderately fine, subangular blocky structure; slightly hard, friable, slightly sticky; common roots; calcareous; moderately, alkaline; abrupt, wavy boundary.

C—18 to 56 inches, white, calcareous, soft gypsum.

The A11 horizon ranges from 5 to 16 inches in thickness and from brown to dark grayish brown in color.

The A12 horizon ranges from 5 to 10 inches in thickness and from brown to dark brown in color. Depth to the C horizon is 10 to 20 inches.

Acme-Cottonwood complex (Ac).—This mapping unit is made up of nearly level soils that are in broad upland areas 50 to 150 acres in size. Slopes are 0 to 1 percent.

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

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Acme-Cottonwood complex	5, 307	1. 0	Miles fine sandy loam, 0 to 1 percent slopes	3, 547	0. 6
Altus fine sandy loam, 0 to 1 percent slopes	2, 712	. 5	Miles fine sandy loam, 1 to 3 percent slopes	15, 232	2. 6
Aspermont silty clay loam, 1 to 3 percent slopes	4, 561	. 8	Miles fine sandy loam, 3 to 5 percent slopes	5, 001	. 8
Aspermont silty clay loam, 3 to 5 percent slopes	1, 806	. 3	Miles fine sandy loam, 5 to 8 percent slopes	1, 877	. 3
Aspermont silty clay loam, 5 to 12 percent slopes	1, 130	. 2	Nipsum clay, 1 to 3 percent slopes	3, 395	. 6
Bukreek loam, 0 to 1 percent slopes	960	. 2	Nobscot association	49, 437	8. 3
Bukreek loam, 1 to 3 percent slopes	2, 756	. 5	Obaro very fine sandy loam, 1 to 3 percent slopes	1, 732	. 3
Bukreek loam, gravelly substratum, 0 to 1 percent slopes	1, 041	. 2	Obaro very fine sandy loam, 3 to 5 percent slopes	28, 276	4. 8
Bukreek loam, gravelly substratum, 1 to 3 percent slopes	1, 272	. 2	Owens-Badland association	51, 415	8. 6
Clairemont silt loam	3, 001	. 5	Paducah very fine sandy loam, 0 to 1 percent slopes	708	. 1
Cobb fine sandy loam, 1 to 3 percent slopes	11, 231	1. 9	Paducah very fine sandy loam, 1 to 3 percent slopes	25, 025	4. 2
Colorado soils	6, 940	1. 2	Paducah very fine sandy loam, 3 to 5 percent slopes	9, 333	1. 6
Cosh and Spade soils, 1 to 3 percent slopes	762	. 1	Quanah silt loam, 1 to 3 percent slopes	500	. 1
Cosh and Spade soils, 3 to 5 percent slopes	1, 279	. 2	Quinlan-Rough broken land complex	29, 594	5. 0
Cottonwood-Owens association	43, 539	7. 3	Randall clay	123	(1)
Devol loamy fine sand, 0 to 3 percent slopes	7, 059	1. 2	Rotan clay loam, 0 to 1 percent slopes	12, 158	2. 0
Enterprise very fine sandy loam, 0 to 1 percent slopes	2, 261	. 4	Rough broken land	1, 549	. 2
Enterprise very fine sandy loam, 1 to 3 percent slopes	2, 675	. 5	Rowena clay loam, 0 to 1 percent slopes	869	. 1
Enterprise very fine sandy loam, 3 to 5 percent slopes	2, 420	. 4	Springer loamy fine sand, 0 to 3 percent slopes	5, 726	1. 0
Frankirk clay loam, 0 to 1 percent slopes	8, 583	1. 4	St. Paul silt loam, 0 to 1 percent slopes	3, 463	. 6
Frankirk clay loam, 1 to 3 percent slopes	1, 713	. 3	Talpa-Yates complex	26, 689	4. 5
Frio silty clay loam	1, 213	. 2	Tillman clay loam, 0 to 1 percent slopes	30, 300	5. 1
Hardeman fine sandy loam, 5 to 12 percent slopes	1, 766	. 3	Tillman clay loam, 1 to 3 percent slopes	40, 556	6. 7
Hensley loam, moderately deep variant, 0 to 1 percent slopes	1, 034	. 2	Tipton loam, 0 to 1 percent slopes	2, 334	. 4
Hilgrave gravelly sandy loam, 3 to 8 percent slopes	9, 254	1. 6	Treadway soils	3, 945	. 7
Hollister silty clay loam, 0 to 1 percent slopes	3, 000	. 5	Vernon clay loam, 1 to 3 percent slopes	11, 784	2. 0
Latom-Rock outcrop complex	6, 419	1. 1	Vernon clay loam, 3 to 5 percent slopes	441	. 1
Likes fine sand	356	(1)	Woodward-Quinlan complex, rolling	41, 336	6. 8
Lincoln soils	9, 317	1. 6	Yomont very fine sandy loam	6, 305	1. 0
Mangum silty clay loam	6, 244	1. 1	Yomont very fine sandy loam, frequently flooded	3, 719	. 6
Miles loamy fine sand, 0 to 3 percent slopes	9, 449	1. 6	Yomont-Quinlan complex	7, 587	1. 3
Miles loamy fine sand, 3 to 5 percent slopes	1, 506	. 3	Riverbeds, water areas, and salt flats	6, 758	1. 2
			Total	593, 280	100. 0

[1] Less than 0.1 percent.

Acme clay loam covers 57 percent of this complex, Cottonwood loam 33 percent, and other soils 10 percent.

Acme clay loam is in broad, flat areas. Cottonwood loam occupies the higher convex areas. The profiles of the soils in this mapping unit are the same as those described as representative of the Acme and Cottonwood series.

Included in mapping are areas of gypsum outcrop on low ridges. Color and texture are the same as for Cottonwood loam, and thickness of the surface layer is less than 3 inches. Areas of soils similar to Acme soils, but 20 to 48 inches deep and in rounded sinkholes, and spots of nearly level Rotan soils also are included.

This mapping unit is mainly used for range, although small areas are cultivated. Soil blowing and water erosion are slight hazards. Capability unit IVe–1; Deep Hardland range site; pasture group 13A.

Altus Series

The Altus series consists of deep, nearly level soils on uplands. These soils formed in calcareous loamy materials.

In a representative profile, the surface layer is brown fine sandy loam about 10 inches thick. Below this is a layer of friable sandy clay loam about 42 inches thick. It is dark brown in the upper part and yellowish brown in the lower part. The underlying material is light-gray, calcareous, very friable sandy clay loam.

Altus soils are moderately permeable. They are well drained, their available water capacity is high, and runoff is slow.

Representative profile of Altus fine sandy loam, 0 to 1 percent slopes, in a cultivated field, 200 feet northeast of a point on a county road that is 7.6 miles north of Old Glory, by Farm Road 1835, and 1.6 miles past the end of Farm Road 1835.

Ap—0 to 10 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak, fine, granular structure; slightly hard, very friable; neutral; abrupt, smooth boundary.

B21t—10 to 24 inches, dark-brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure; hard, friable; few clay films; neutral; gradual, smooth boundary.

B22t—24 to 36 inches, dark-brown (7.5YR 4/4) sandy clay loam, dark brown (7.5YR 3/4) moist; weak to moderate, medium, subangular blocky structure; hard, friable; few clay films; neutral; gradual, smooth boundary.

B23t—36 to 42 inches, dark-brown (7.5YR 4/4) sandy clay loam, dark brown (7.5YR 3/4) moist; weak subangular blocky structure; hard, friable; few thin clay films; mildly alkaline; gradual, smooth boundary.

B3—42 to 52 inches, yellowish-brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak, fine, granular structure; hard, friable; calcareous; moderately alkaline; gradual, smooth boundary.

C—52 to 64 inches, light-gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

The solum ranges from 42 to 80 inches in thickness. The A horizon ranges from brown to dark brown in color and from 5 to 15 inches in thickness.

The B21t horizon ranges from 8 to 26 inches in thickness, from brown to dark brown in color, and from neutral to mildly alkaline in reaction. The B22t horizon is 8 to 20 inches thick and dark brown or dark reddish brown. It is neutral or mildly alkaline in reaction. The B23t horizon is 4 to 10 inches thick and brown or reddish brown. The B3 horizon is 8 to 35 inches thick and yellowish brown, reddish brown, or reddish yellow.

The C horizon is light gray or yellowish red sandy clay loam to fine sandy loam.

These soils are outside the range of the Altus series in that the B3 horizon is yellower and the C horizon is lighter in color than is within the range for the series. This difference does not alter use, management, or behavior.

Altus fine sandy loam, 0 to 1 percent slopes (AlA).—This soil is in smooth areas 150 to 200 acres in size on uplands. Slopes are commonly 0.5 percent and plane or slightly concave.

Included with this soil in mapping are small areas of Miles soils that have convex slopes.

Most of this Altus fine sandy loam is cultivated, but a few areas are in range. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. Capability unit IIe–5; Sandy Loam range site; pasture group 8C.

Aspermont Series

The Aspermont series consists of moderately deep and deep, gently sloping to strongly sloping soils on uplands. These soils formed in calcareous loamy materials.

In a representative profile, the surface layer is reddish-brown, calcareous silty clay loam about 8 inches thick. The next layer is firm, calcareous silty clay loam, about 32 inches thick, that is reddish brown in the upper part and yellowish red in the lower part. The underlying material, which begins at a depth of 40 inches and extends to a depth of 60 inches, is red, firm, calcareous silty clay loam.

These soils are moderately permeable. They are well drained, runoff is medium to rapid, and the available water capacity is high.

Representative profile of Aspermont silty clay loam, 1 to 3 percent slopes, in range, 100 feet west of a point on U.S. Highway 83 that is 2.3 miles south of Aspermont.

A1—0 to 8 inches, reddish-brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; hard, friable; few worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B21—8 to 20 inches, reddish-brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate, fine, subangular blocky structure; hard, firm; common roots; many very fine pores; common worm casts; thin films and threads of calcium carbonate on ped faces; few calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B22ca—20 to 40 inches, yellowish-red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; moderate, medium and fine, subangular blocky structure; hard, firm; estimated 15 percent, by volume, soft masses and few concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—40 to 60 inches, red (2.5YR 4/6) silty clay loam, dark red (2.5YR 3/6) moist; massive; hard, firm; few soft masses of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon ranges from 5 to 10 inches in thickness and from reddish brown to brown in color.

The B21 horizon ranges from 7 to 22 inches in thickness, from reddish brown to light brown in color, and from clay loam to silty clay loam in texture.

The B22ca horizon is 12 to 24 inches thick, reddish brown to yellowish red, and 5 to 15 percent calcium carbonate.

The solum ranges from 24 to 50 inches in thickness. The C horizon is clayey shale to silty clay loam material of Permian red bed origin.

Aspermont silty clay loam, 1 to 3 percent slopes (AsB).—This gently sloping soil is on ridges in areas 20 to 50 acres in size. Slopes are weakly convex and are commonly 2 percent.

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

Included with this soil in mapping are less extensive areas of Tillman soils in lower, less sloping positions, and of Vernon soils in higher, more sloping positions.

About half of this Aspermont silty clay loam is cultivated. The rest is used for range. This soil is well drained, and runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Capability unit IIIe–5; Shallow Redland range site; pasture group 7C.

Aspermont silty clay loam, 3 to 5 percent slopes (AsC).—This gently sloping soil is on ridges in areas 20 to 40 acres in size. Slopes are convex and commonly 4 percent.

This soil has a surface layer of reddish-brown, calcareous silty clay loam about 6 inches thick. This overlies a layer of calcareous silty clay loam, about 24 inches thick, that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is red, calcareous silty clay loam sediments.

Included with this soil in mapping are small areas of Tillman soils in lower positions, and areas of Vernon soils in higher and more convex positions.

Most of this Aspermont silty clay loam is in range. Runoff is medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Capability unit IVe–1; Shallow Redland range site; pasture group 7C.

Aspermont silty clay loam, 5 to 12 percent slopes (AsD).—This sloping to strongly sloping soil is in areas about 50 acres in size that are adjacent to drains and creeks. Slopes are convex and commonly 8 percent.

The surface layer is reddish-brown, calcareous silty clay loam about 5 inches thick. Beneath this is a layer of

firm, calcareous silty clay loam, about 20 inches thick, that is reddish brown in the upper part and yellowish red in the lower part. The underlying material is red, calcareous silty clay loam sediments.

Mapped with this soil are areas of Vernon soils and some areas of Aspermont soils that have slopes of less than 5 percent.

Nearly all of this Aspermont silty clay loam is in range. This soil is well drained, and runoff is rapid. The hazard of soil blowing is slight, but the hazard of water erosion is high. Some areas have gullies 1 to 5 feet deep. Capability unit VIe–2; Shallow Redland range site; not placed in a pasture group.

Badland

Badland consists of nearly barren outcrops of red-bed shaly clay (fig. 7). In Stonewall County Badland is mapped only in association with the Owens soils. It is on escarpments and on smooth, severely eroded areas below the scarps.

Badland is not suitable for cultivation and supports such sparse vegetation that it has little value as range.

Bukreek Series

The Bukreek series consists of deep, nearly level and gently sloping soils on uplands. These soils formed in calcareous, loamy sediments.

In a representative profile, the surface layer is reddish-brown, neutral loam about 8 inches thick. The next layer is firm clay loam about 32 inches thick. It is reddish brown in the upper part and yellowish red in the lower part. The layer below this is about 24 inches of yellowish-red loam. The underlying material, extending to a depth of 74 inches, is yellowish-red, massive, calcareous loam.

Bukreek soils are moderately permeable, and their available water capacity is high. They are well drained, and runoff is slow.

Representative profile of Bukreek loam, 1 to 3 percent slopes, in range, 100 feet south of a point on Farm Road 610. This point is 8.3 miles southwest of Aspermont.

A1—0 to 8 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak, fine, granular structure; slightly hard, friable; many roots; neutral; abrupt, smooth boundary.

B21t—8 to 14 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate, fine, subangular blocky structure; hard, firm; common roots; few thin clay films; mildly alkaline; clear, smooth boundary.

B22t—14 to 32 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate, medium, blocky structure; very hard, firm; common roots; few patchy clay films; mildly alkaline; gradual, smooth boundary.

B23t—32 to 40 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak, subangular blocky structure; hard, firm; common roots; few thin clay films; calcareous; moderately alkaline; clear, smooth boundary.

B24tca—40 to 64 inches, yellowish-red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky and granular structure; hard, friable; few roots; few thin clay films; 5 percent fine

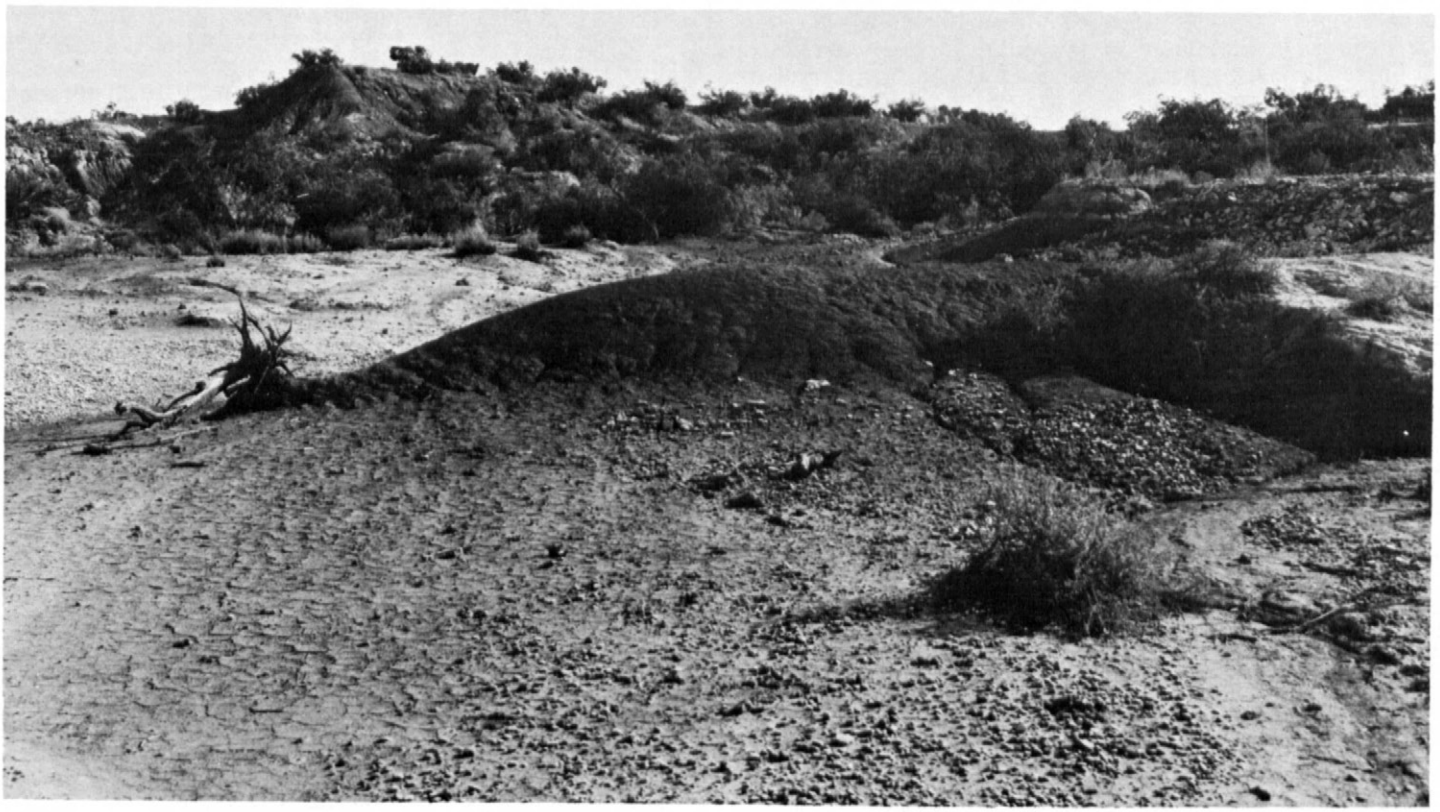

Figure 7.—**Badland in an area of the mapping unit Owens-Badland association.**

calcium carbonate concretions and films; calcareous; moderately alkaline; gradual, smooth boundary.

C—64 to 74 inches, yellowish-red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; massive; few calcium carbonate concretions and films; calcareous; moderately alkaline.

The solum ranges from 60 to 80 inches in thickness. The A horizon ranges from 6 to 10 inches in thickness and from brown to reddish brown in color.

The B21t horizon ranges from 6 to 10 inches in thickness and from yellowish red to reddish brown in color. The B22t horizon is 6 to 15 inches thick and yellowish red to red. The B24tca horizon is 10 to 30 inches thick, red to yellowish red, and loam to clay loam.

The C horizon is red to reddish yellow.

These soils are outside the range of the Bukreek series in that secondary carbonates are slightly deeper than is within the range defined for the series. This difference does not alter use, management, or behavior.

Bukreek loam, 0 to 1 percent slopes (BuA).—This soil is in broad, smooth, dominantly flat areas 50 to 100 acres in size. Slopes are commonly 0.2 to 0.7 percent.

The surface layer is reddish-brown, neutral loam about 8 inches thick. Below this is a layer of firm clay loam, about 36 inches thick, that is reddish brown in the upper part and yellowish red in the lower part. The next lower layer, about 24 inches thick, is yellowish-red loam. The underlying material is yellowish-red, calcareous loam.

Included with this soil in mapping are small areas of Rotan soils that are flat to slightly concave.

This Bukreek loam is mainly cultivated, although a few areas are used for range. The soil blowing and water erosion hazards are slight. Capability unit IIc–3; Mixedland range site; pasture group 7C.

Bukreek loam, 1 to 3 percent slopes (BuB).—This gently sloping soil is in smooth areas 100 to 300 acres in size. Slopes are commonly 2 percent.

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

Included with this soil in mapping are small areas of Rotan soils that have flat, slightly concave surfaces and areas of Bukreek soils that have slopes of less than 1 percent.

This Bukreek loam is mainly cultivated, although a few areas are used for range. The soil blowing hazard is slight, and the water erosion hazard is moderate. Capability unit IIe–4; Mixedland range site; pasture group 7C.

Bukreek Series, Gravelly Substratum

The Bukreek series, gravelly substratum, consists of deep, nearly level and gently sloping soils on uplands. These soils are underlain by sand and gravel beds at a depth of 5 to 10 feet (fig. 8).

In a representative profile, the surface layer is reddish-brown, noncalcareous loam about 14 inches thick. The next layer is reddish-brown, calcareous, friable sandy clay loam about 40 inches thick. Below this, extending to a depth of 70 inches, is yellowish-red, calcareous, very friable loam. The underlying material, extending to a depth of 100 inches, is sand and gravel in beds.

Bukreek soils are moderately permeable. They are well drained, runoff is slow, and their available water capacity is high.

Representative profile of Bukreek loam, gravelly substratum, 1 to 3 percent slopes, in a cultivated field, 500 feet east of a point on U.S. Highway 83. This point is 10.8 miles south of Aspermont.

Ap—0 to 6 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak, fine, granular structure; slightly hard, friable; mildly alkaline; abrupt, smooth boundary.

A1—6 to 14 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak to moderate, fine, granular structure; slightly hard, friable; mildly alkaline; clear, smooth boundary.

B21t—14 to 30 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate, coarse, prismatic structure and medium, subangular blocky; hard, friable; few clay films; threads of calcium carbonate; calcareous; moderately alkaline; abrupt, smooth boundary.

B22tca—30 to 54 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak to moderate, fine, subangular blocky structure; hard, friable; 5 percent calcium carbonate concretions; few clay films; calcareous; moderately alkaline; gradual, smooth boundary.

B23t—54 to 70 inches, yellowish-red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak, fine, granular structure; slightly hard, very friable; few clay films and clay tubules; calcareous; moderately alkaline; clear, wavy boundary.

IIC—70 to 100 inches, stratified beds of gravel and fine sand; clay tubules in upper part; calcareous; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. The A horizon ranges from 10 to 18 inches in thickness and from reddish brown to dark brown in color.

The B21t horizon ranges from 10 to 30 inches in thickness, from reddish brown to brown in color, and from sandy clay loam to clay loam in texture. Depth to calcareous material ranges from 12 to 24 inches.

The B22tca horizon is 24 to 45 inches thick and is 2 to 10 percent calcium carbonate. The B22tca horizon is 28 to 48 inches below the surface, and gravel beds are at a depth of 60 to 120 inches (fig. 9).

Bukreek loam, gravelly substratum, 0 to 1 percent slopes (BvA).—This nearly level soil is in broad, smooth areas 100 to 200 acres in size. Slopes are dominantly 0.5 percent.

The surface layer is reddish-brown, noncalcareous loam about 16 inches thick. Below this is a layer of reddish-brown, friable sandy clay loam about 44 inches thick. The upper part is noncalcareous, and the lower part is 5 percent calcium carbonate concretions. The underlying material, extending to a depth of 74 inches, is yellowish-red, calcareous, very friable loam. Sand and gravel beds are at a depth of 74 inches.

Included with this soil in mapping are areas of Hilgrave soils and areas of level Frankirk soils.

This Bukreek loam is used mainly for range, but some small areas are cultivated. The soil blowing and water erosion hazards are slight. Capability unit IIc–3; Mixedland range site; pasture group 7C.

Bukreek loam, gravelly substratum, 1 to 3 percent slopes (BvB).—This gently sloping soil has convex slopes that are dominantly about 2 percent. Soil areas average about 100 acres in size.

This soil has the profile described as representative for the Bukreek series, gravelly substratum.

Included with this soil in mapping are areas of more sloping Hilgrave and less sloping Frankirk soils.

This Bukreek loam is mainly used for range, but some areas are cultivated. The water erosion hazard is mod-

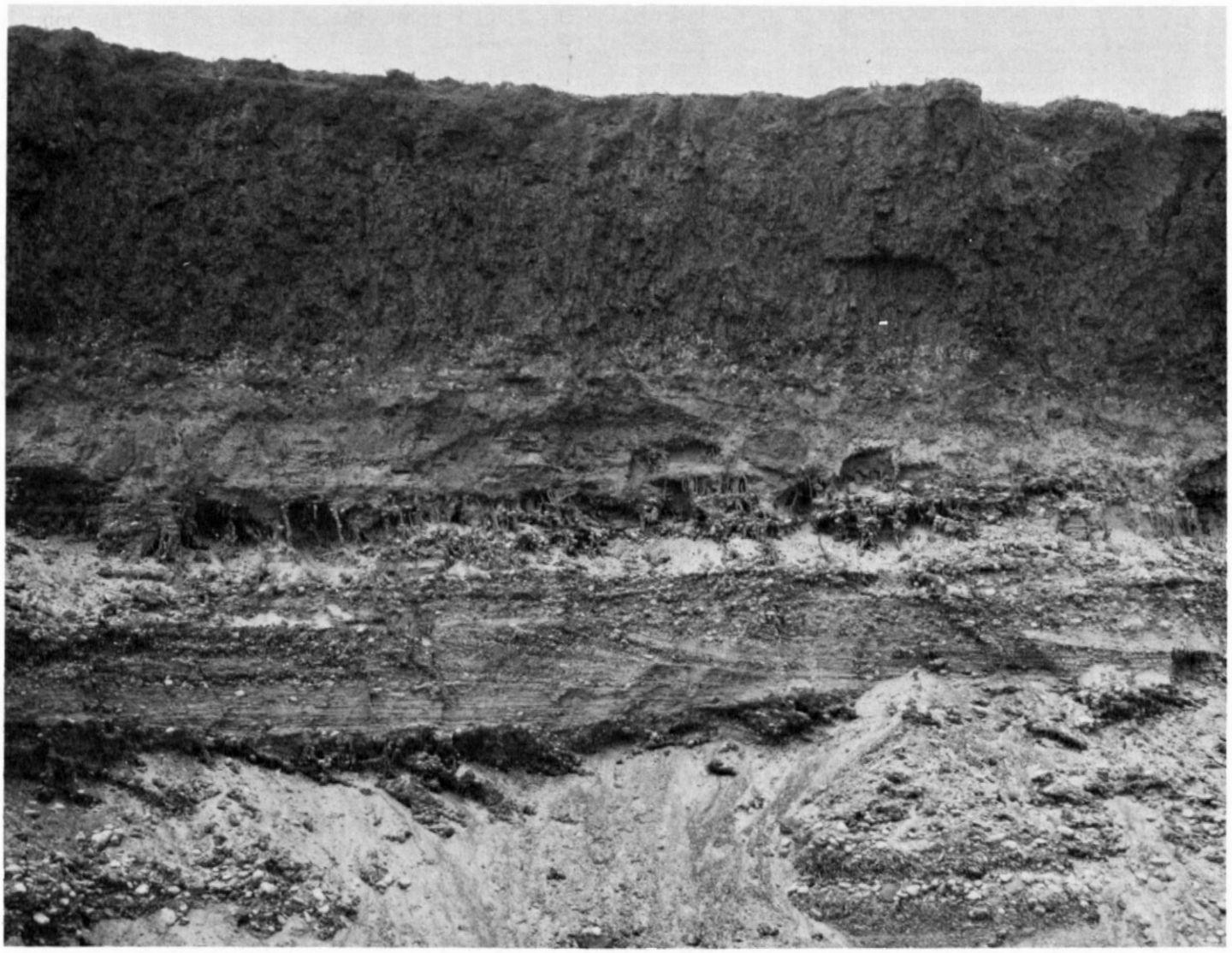

Figure 8.—**Profile of Bukreek loam, gravelly substratum.**

erate, and the soil blowing hazard is slight. Capability unit IIe-4; Mixedland range site; pasture group 7C.

Clairemont Series

The Clairemont series consists of deep, nearly level soils that formed in alluvium. These soils show little alteration since deposition.

In a representative profile, the surface layer is reddish-brown, calcareous silty loam about 8 inches thick. The underlying material, extending to a depth of about 96 inches, is reddish-brown, calcareous silty clay loam.

These soils are moderately permeable, and they are well drained. Runoff is slow, and the available water capacity is high.

Representative profile of Clairemont silt loam, in a level cultivated field, 200 feet east of Farm Road 610. This site is approximately 16.6 miles southwest of Aspermont.

Ap—0 to 8 inches, reddish-brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, friable; calcareous; moderately alkaline; abrupt, smooth bounary.

C—8 to 96 inches, reddish-brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) moist; massive parting to subangular blocky structure; dull faces on peds; hard, friable; faint bedding planes; calcareous; moderately alkaline.

The A horizon ranges from 4 to 14 inches in thickness and from light reddish brown and reddish brown to dark reddish brown in color. The C horizon ranges from reddish brown to dark reddish brown.

Clairemont silt loam (Ca).—This nearly level soil is on flood plains along major streams in areas 50 to 100 acres in size. Slopes are dominantly less than 0.5 percent.

Included with this soil in mapping are narrow bands of Yomont soils that are adjacent to the stream.

Most areas of this Clairemont silt loam are cultivated, and a few areas are in native range. The hazards of soil

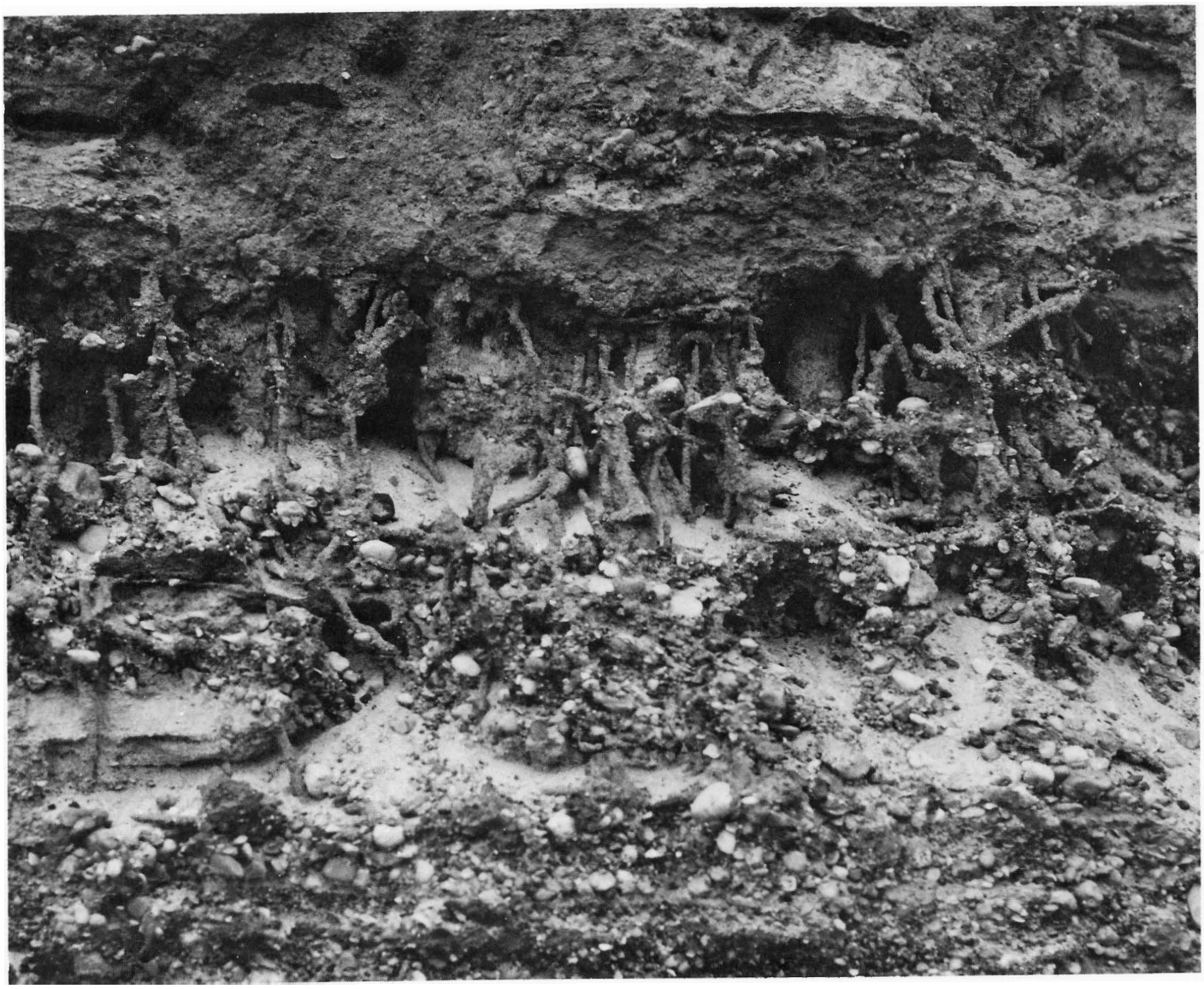

Figure 9.—**Tubules of translocated clay in profile of Bukreek loam, gravelly substratum.**

blowing and water erosion are slight. Crops are damaged by flooding about once in 5 years. Capability unit IIe–3; Bottomland range site; pasture group 1C.

Cobb Series

The Cobb series consists of moderately deep, gently sloping soils on uplands. These soils are underlain by sandstone.

In a representative profile, the surface layer is reddish-brown, slightly acid fine sandy loam about 6 inches thick. The next layer is reddish-brown, slightly acid to neutral sandy clay loam about 30 inches thick. Red, noncalcareous sandstone is at a depth of about 36 inches.

Cobb soils are moderately permeable and well drained. Runoff is slow to medium, and the available water capacity is moderate.

Representative profile of Cobb fine sandy loam, 1 to 3 percent slopes, in range, 100 feet north of a point on a county road that is 11.4 miles south of Old Glory, on Farm Road 1835, then 4 miles east on the county road.

A1—0 to 6 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable; many roots; slightly acid; abrupt, smooth boundary.

B21t—6 to 24 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; compound weak, medium, prismatic structure parting to weak, subangular blocky; hard, friable, slightly sticky; many roots; few thin clay films; slightly acid; clear, smooth boundary.

B22t—24 to 36 inches, reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak, medium, prismatic structure parting to moderate, medium, blocky; very hard, firm, slightly sticky;

common roots; common thin clay films; neutral; abrupt, irregular boundary.
R—36 inches, red (10R 5/6) sandstone; noncalcareous.

The solum ranges from 20 to 48 inches in thickness. The A horizon ranges from 6 to 12 inches in thickness and from brown to reddish brown in color.

The Bt horizon ranges from reddish brown to red in color. The B21t horizon is 8 to 18 inches thick, and the B22t horizon is 6 to 18 inches thick. Where present, the B3ca horizon is red to yellowish red.

Sandstone is at a depth of 20 to 48 inches.

Cobb fine sandy loam, 1 to 3 percent slopes (CbB).—This gently sloping soil is in areas 100 to several thousand acres in size. Slopes comonly are 1.2 percent, although parts of some areas have slopes of less than 1 percent.

Included with this soil in mapping are smooth, flat areas of Miles and Frankirk soils. Also included are convex areas of Cosh and Spade soils on higher ridges.

Most of this Cobb fine sandy loam is used for range, although a few small areas are in crops. This soil is well drained, and runoff is slow to medium. It is subject to moderate soil blowing and water erosion hazards. Capability unit IIIe-4; Sandy Loam range site; pasture group 8C.

Colorado Series

The Colorado series consists of deep, nearly level soils that formed in alluvium.

In a representative profile, the surface layer is brown, calcareous clay loam about 10 inches thick. The underlying material, extending to a depth of 60 inches, is brown, calcareous clay loam. It is very friable and has evident bedding planes.

Colorado soils are moderately permeable and well drained. Runoff is slow, and their available water capacity high.

Representative profile of Colorado soils, in range, 200 feet east of a point on Farm Road 1835. This point is 1.5 miles north of Old Glory.

A1—0 to 10 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable; many roots; calcareous; moderately alkaline; clear, smooth boundary.
C—10 to 60 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; massive; hard, very friable; many roots; bedding planes evident; calcareous; moderately alkaline.

The A1 horizon ranges from 5 to 12 inches in thickness and from brown to reddish brown in color. The C horizon ranges from brown to reddish brown in color.

Colorado soils (Cd).—These soils are on the flood plains of smaller drains and creeks. Some areas have small drains that cut into the flood plains. Slopes range from 0 to 1 percent, but are commonly 0.5 percent.

Included with these soils in mapping are areas of Clairmont and Mangum soils. Also included are side slopes along the creeks and drains.

These Colorado soils are subject to flooding about four times in 5 years and are best suited to range. They are well drained, and their runoff is slow. The soil blowing and water erosion hazards are slight. Capability unit Vw-1; Bottomland range site; pasture group 2A.

Cosh Series

The Cosh series consists of shallow, gently sloping soils on uplands. These soils overlie weakly cemented sandstone.

In a representative profile, the surface layer is reddish-brown, neutral fine sandy loam about 6 inches thick. The next layer is reddish-brown, neutral, friable sandy clay loam about 12 inches thick. Red, weakly cemented sandstone is at a depth of about 18 inches.

Cosh soils are moderately permeable and are well drained. Runoff is medium, and available water capacity is low.

Representative profile of Cosh fine sandy loam, in an area of Cosh and Spade soils, 1 to 3 percent slopes, in a cultivated field, 100 feet south of a point on a county road. This point is 4 miles north of Old Glory, on Farm Road 1835, and 1 mile east on the county road.

Ap—0 to 6 inches, reddish-brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable; few fine siliceous pebbles; neutral; abrupt, smooth boundary.
B2t—6 to 18 inches, reddish-brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; very hard, friable; few thin clay films; neutral; abrupt, smooth boundary.
R—18 inches, red (2.5YR 4/6) weakly cemented sandstone.

The A horizon ranges from 4 to 10 inches in thickness and from reddish brown to brown in color. The B2t horizon ranges from 8 to 15 inches in thickness and from reddish brown to red in color. Sandstone is at a depth of 12 to 20 inches. The sandstone is weakly cemented, but roots do not penetrate it.

Cosh and Spade soils, 1 to 3 percent slopes (CsB).—The soils in this mapping unit are gently sloping and are on convex ridges. Slopes are commonly 2 percent. Soil areas are about 20 to 30 acres in size.

Of the total area of this mapping unit, approximately 55 percent is Cosh fine sandy loam and about 45 percent is Spade fine sandy loam. On about 85 percent of the mapped areas there are both Cosh and Spade soils, and in 15 percent only one or the other. In the areas containing both Cosh and Spade fine sandy loams, the Cosh soil generally is less sloping, and the Spade soil is on convex ridges and is more sloping.

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

The Spade soil has a surface layer of reddish-brown fine sandy loam about 5 inches thick. The next layer is reddish-brown, calcareous, very friable fine sandy loam about 20 inches thick. The next lower layer, about 5 inches thick, is yellowish-red, calcareous loam. The underlying material is red, calcareous, weakly cemented sandstone.

Included in some areas of this mapping unit are areas of Cobb and Latom soils. The Cobb soils are lower and nearly level, and the Latom soils are higher and more sloping .

About half of this mapping unit is cultivated; the other half is in range. The water erosion and soil blowing hazards are moderate. Capability unit IIIe-6; Sandy Loam range site; pasture group 8C.

Cosh and Spade soils, 3 to 5 percent slopes (CsC).—The soils in this mapping unit are gently sloping and

are on convex ridges. Areas range from about 15 to 25 acres in size.

Of the total area of this mapping unit, about 55 percent is Cosh fine sandy loam, and about 45 percent is Spade fine sandy loam. About 90 percent of the area contains both Cosh and Spade soils, and the rest contains either one or the other. In the areas containing both Cosh and Spade fine sandy loams, the Cosh soil generally is in the plane, less sloping areas, and the Spade soil is on ridges and in more convex areas.

This Cosh soil has a surface layer of reddish-brown, very friable, neutral fine sandy loam about 5 inches thick. The next layer is reddish-brown, neutral, friable sandy clay loam about 10 inches thick. The underlying material is red, noncalcareous, weakly cemented sandstone.

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

Included in this mapping unit are small areas of Latom and Cobb soils. The Latom soils are on ridgetops, and the Cobb soils are lower and less sloping.

Most of this mapping unit is in range, although a few small areas are cultivated. The soil blowing and water erosion hazards are moderate. Capability unit IVe–3; Sandy Loam range site; pasture group 8C.

Cottonwood Series

The Cottonwood series consists of very shallow, nearly level and gently sloping soils on uplands. These soils are underlain by gypsum.

In a representative profile, the surface layer is brown, calcareous loam about 8 inches thick. The underlying material, extending to a depth of 40 inches, is nearly white, calcareous, soft gypsum.

Cottonwood soils are moderately permeable and well drained. Runoff is rapid, and the available water capacity is low.

Representative profile of Cottonwood loam, in an area of Acme-Cottonwood complex, in range, 100 feet north of U.S. Highway 380 at a point 3.8 miles northwest of intersection of U.S. Highways 380 and 83 in Aspermont.

A—0 to 8 inches, brown (7.5YR 5/2) loam, brown (7.5YR 4/2) moist; moderate, fine, granular structure; soft, friable; few roots; calcareous; moderately alkaline; abrupt, wavy boundary.

C—8 to 40 inches, white, calcareous, soft gypsum beds.

The A horizon ranges from 3 to 10 inches in thickness and from light gray to brown in color.

Cottonwood-Owens association (Ct).—This mapping unit is made up of broad areas of severely dissected and intermingled, small, narrow benches and scarps 3 to 20 feet high. These soils are so closely associated and occur in such an intermingled pattern that it is not practical to map them separately at the scale used. Slopes range from 0 to 5 percent. Mapped areas range from 100 to 3,000 acres in size.

The delineations are much larger and the composition of these units is more variable than other mapping units in the county. Mapping has been controlled well enough, however, for the anticipated uses of the soils.

Cottonwood soils make up about 45 percent of this mapping unit, Owens soils about 30 percent, and included soils about 25 percent. The Cottonwood soils are in narrow bands along the edge of benches above scarps. The Owens soils are gently sloping and occur between scarps and Cottonwood soils. The red-bed materials making up a part of the association are variable, interbedded gypsum and clayey shale.

The Cottonwood soils have a 6-inch surface layer of grayish-brown, calcareous loam over gypsum.

The Owens soils have an 18-inch surface layer of reddish-brown, calcareous clay that overlies shaly clay.

Included in this mapping unit are areas of Aspermont, Clairemont, Colorado, Nipsum, Tillman, and Vernon soils. Also included is Badland in escarpments or severely eroded areas below scarps. Clairemont and Colorado soils are on the flood plains of drains. Aspermont, Nipsum, Tillman, and Vernon soils are on benches.

This mapping unit is in range. The water erosion hazard is moderate to high, and the soil blowing hazard is slight. Both soils in capability unit VIIs–1; Cottonwood in the Gypland range site; Owens in the Shallow Redland range site; not placed in a pasture group.

Devol Series

The Devol series consists of deep, nearly level and gently sloping soils on uplands. These soils formed in noncalcareous loamy and sandy material.

In a representative profile, the surface layer is yellowish-brown, neutral, loamy fine sand about 18 inches thick. The next layer is very friable fine sandy loam, about 32 inches thick, that is yellowish red in the upper part and reddish yellow in the lower part. The underlying material, extending to a depth of 85 inches, is reddish-yellow loamy fine sand.

Devol soils are moderately rapidly permeable and well drained. Runoff is very slow, and the available water capacity is low.

Representative profile of Devol loamy fine sand, 0 to 3 percent slopes, in range, 100 feet south of a point on a field road. This point is 7.2 miles north of Old Glory, by Farm Road 1835, then 0.6 mile east-northeast on the field road.

A1—0 to 18 inches, yellowish-brown (10YR 5/4) loamy fine sand, dark brown (10YR 4/3) moist; single grain; loose; many roots; neutral; clear, smooth boundary.

B2t—18 to 35 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak, fine, granular structure; slightly hard, very friable; common roots; neutral; gradual, smooth boundary.

B3—35 to 50 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; weak, fine, granular structure; slightly hard, very friable; common roots; mildly alkaline; gradual, smooth boundary.

C—50 to 85 inches, reddish-yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) moist; single grain; loose; mildly alkaline.

The solum ranges from 40 to 58 inches in thickness. The A1 horizon ranges from 14 to 18 inches in thickness and from yellowish brown to brown.

The B2t horizon ranges from 10 to 20 inches in thickness and from reddish brown to yellowish red in color. The B3 horizon is 12 to 20 inches thick and yellowish red to reddish yellow.

The C horizon is yellowish-red to reddish-yellow loamy fine sand to fine sand.

These soils are outside the range of the Devol series in that the A horizon is more yellow in color than is the range for the series. This difference does not alter use, management, or behavior.

Devol loamy fine sand, 0 to 3 percent slopes (DeB).—This soil is nearly level to gently sloping and gently undulating. Slope commonly is 2 percent. Soil areas are 200 to 1,000 acres in size.

Included with this soil in mapping are nearly level Miles soils.

A few areas of this Devol loamy fine sand are cultivated, but most are in range. Areas that were once cultivated have been returned to native grasses. The soil blowing hazard is high, and the water erosion hazard is slight. Areas that are now cultivated or were once cultivated have 3- to 5-feet high sand dunes along field boundaries. Capability unit IVe–6; Sandyland range site; pasture group 9A.

Enterprise Series

The Enterprise series consists of deep, nearly level and gently sloping soils on uplands. These soils formed in calcareous, loamy, wind-deposited material.

In a representative profile, the surface layer is reddish-brown, calcareous very fine sandy loam about 18 inches thick. This layer is very friable and contains a few films of calcium carbonate. The next layer is reddish-brown, calcareous very fine sandy loam about 18 inches thick. The underlying material, extending to a depth of about 64 inches, is yellowish-red, calcareous very fine sandy loam.

Enterprise soils are moderately rapidly permeable and well drained. Runoff is slow to medium, and the available water capacity is high.

Representative profile of Enterprise very fine sandy loam, 1 to 3 percent slopes, in a cultivated field 100 feet north of U.S. Highway 380, at a point 6.9 miles west of the intersection of U.S. Highway 380 and Farm Road 1646.

Ap—0 to 8 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak, fine, granular structure; soft, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—8 to 18 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak, fine, granular structure; soft, very friable; calcareous; moderately alkaline; gradual, smooth boundary.

B2—18 to 36 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak to moderate, fine, granular structure; slightly hard, very friable; common threads and films of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—36 to 64 inches, yellowish-red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

The A horizon ranges from 10 to 36 inches in thickness and from reddish brown to light brown in color. The B horizon ranges from 12 to 36 inches in thickness and from reddish brown to yellowish red in color. The C horizon is yellowish red to reddish brown.

Enterprise very fine sandy loam, 0 to 1 percent slopes (EnA).—This soil is nearly level and has weakly convex slopes.

The surface layer is reddish-brown, calcareous very fine sandy loam about 20 inches thick. The next layer is reddish-brown, calcareous, very friable very fine sandy loam about 24 inches thick. This layer contains a few films and threads of calcium carbonate. The underlying material, extending to a depth of about 64 inches, is yellowish-red, calcareous very fine sandy loam.

Included with this soil in mapping are areas of smooth, flat Tipton soils.

This Enterprise very fine sandy loam is mainly cultivated, although a few areas are in native range. The hazards of soil blowing and water erosion are slight. Capability unit IIe–2; Mixedland range site; pasture group 8C.

Enterprise very fine sandy loam, 1 to 3 percent slopes (EnB).—This soil is gently sloping. Slopes are commonly 2 percent.

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

Included with this soil in mapping are small areas of Tipton and Hardeman soils. The Tipton soils are lower and nearly level, and the Hardeman soils are higher and more sloping.

This Enterprise very fine sandy loam is mainly cultivated, although a few areas are in range. The water erosion hazard is moderate, and the soil blowing hazard is slight. Capability unit IIe–1; Mixedland range site; pasture group 8C.

Enterprise very fine sandy loam, 3 to 5 percent slopes (EnC).—This soil is gently sloping. Slopes are commonly 4 percent.

The surface layer is reddish-brown, calcareous very fine sandy loam about 15 inches thick. The next layer is yellowish-red, calcareous very fine sandy loam about 15 inches thick. This layer is very friable and contains a few films and threads of calcium carbonate. The underlying material, extending to a depth of about 64 inches, is yellowish-red, calcareous very fine sandy loam.

Included with this soil in mapping are areas of Hardeman and Miles soils. The Hardeman soils are higher and more sloping, and the Miles soils are smooth and less sloping.

About half of this Enterprise very fine sandy loam is cultivated, and half is in range. A few cultivated areas are gullied and have lost about 60 percent of the surface layer to water erosion. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Capability unit IIIe–3; Mixedland range site; pasture group 8C.

Frankirk Series

The Frankirk series consists of deep, nearly level and gently sloping soils on uplands. These soils formed in calcareous, loamy alluvium.

In a representative profile, the surface layer is reddish-brown, neutral clay loam about 7 inches thick. The next layer, about 9 inches thick, is neutral, reddish-brown clay loam. Below this is about 19 inches of reddish-brown clay and about 13 inches of red clay loam. The next lower layer is about 16 inches of yellowish-red sandy clay loam that overlies about 21 inches of reddish-yellow

sandy clay loam. The underlying material, extending to a depth of 100 inches, is yellowish-red loam.

Frankirk soils are moderately slowly permeable and well drained. Runoff is slow, and the available water capacity is high.

Representative profile of Frankirk clay loam, 0 to 1 percent slopes, in a cultivated field, 100 feet north of a point on a county road. This point is 0.1 mile north of the Post Office in Old Glory, on U.S. Highway 380, then 2.6 miles east on the county road.

Ap—0 to 7 inches, reddish-brown (5YR 5/3) clay loam, dark reddish brown (5YR 3/3) moist; weak, fine, granular structure; slightly hard, friable; neutral; abrupt, smooth boundary.

B1—7 to 16 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; few thin clay films; neutral; clear, smooth boundary.

B21t—16 to 35 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; weak, coarse, prismatic structure parting to moderate, medium, blocky; hard, firm; few distinct clay films; mildly alkaline; gradual, smooth boundary.

B22t—35 to 48 inches, red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; moderate, medium, subangular blocky structure; hard, friable; few distinct clay films; calcareous; moderately alkaline; diffuse, smooth boundary.

B31t—48 to 64 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate, medium, subangular blocky structure; hard, friable; clay films on some peds; 2 percent calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B32ca—64 to 85 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak, fine, granular structure; hard, friable; 5 percent, by volume, calcium carbonate concretions; calcareous; moderately alkaline; diffuse, smooth boundary.

C—85 to 100 inches, yellowish-red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; massive; hard, friable; calcareous; moderately alkaline.

The solum ranges from 60 to 90 inches in thickness. The A horizon ranges from 5 to 9 inches in thickness and from brown to reddish brown in color. The B1 horizon ranges from 5 to 14 inches in thickness. The B21t horizon is 15 to 24 inches thick and red to reddish brown. The B22t horizon is 8 to 20 inches thick, red to yellowish red, clay to clay loam, and moderately to mildly alkaline.

The B3t horizon is 0 to 18 inches thick, red to yellowish red, and sandy clay loam to clay loam. The B3ca horizon is yellowish red to red in color and sandy clay loam to clay loam in texture.

The C horizon is loam, clay loam, or sandy clay loam.

Frankirk clay loam, 0 to 1 percent slopes (FnA).—This nearly level soil has smooth to slightly convex slopes that are commonly 0.6 percent. Most soil areas are several thousand acres in size.

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

Included with this soil in mapping are Rotan soils in lower, weakly concave areas.

Most of this Frankirk clay loam is cultivated, but a few areas are in native range. The hazards of soil blowing and water erosion are slight. Capability unit IIc–3; Deep Hardland range site; pasture group 7C.

Frankirk clay loam, 1 to 3 percent slopes (FnB).—This gently sloping soil has convex slopes that are commonly 2 percent. Most soil areas are about 75 to 150 acres in size.

The surface layer is reddish-brown, neutral clay loam about 6 inches thick. The next layer, about 8 inches thick, is reddish-brown clay loam. Below this is reddish-brown clay about 18 inches thick and red clay loam about 15 inches thick. The next lower layer is yellowish-red sandy clay loam, about 10 inches thick, that overlies red sandy clay loam about 10 inches thick. The underlying material is yellowish-red sandy clay loam that extends to a depth of 70 inches.

Included with this soil in mapping are areas of Rotan soils that have concave surfaces and Aspermont soils that are more sloping.

About half of this Frankirk clay loam is cultivated, and about half is in range. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Capability unit IIe–1; Deep Hardland range site; pasture group 7C.

Frio Series

The Frio series consists of deep, nearly level soils that formed in alluvium.

The surface layer is reddish-brown, calcareous silty clay loam about 30 inches thick. The underlying material, extending to a depth of about 60 inches, is reddish-brown, calcareous, friable silty clay loam.

Frio soils are moderately slowly permeable and well drained. Runoff is slow, and the available water capacity is high.

Representative profile of Frio silty clay loam, 200 feet south of a point on Texas Highway 6, 5.3 miles southeast of the intersection of Texas Highway 6 and U.S. Highway 380.

Ap—0 to 12 inches, reddish-brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/3) moist; weak to moderate, fine, subangular blocky and granular structure; slightly hard, friable, slightly sticky; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—12 to 30 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate, medium, and fine, subangular blocky and granular structure; hard, firm, sticky; calcareous; moderately alkaline; gradual, smooth boundary.

C—30 to 60 inches, reddish-brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, friable, slightly sticky; calcareous; moderately alkaline; little evidence of stratification.

The A horizon ranges from reddish brown to brown in color. The C horizon ranges from reddish brown to yellowish red in color. Profiles show an irregular decrease of organic matter with increasing depth.

These soils are outside the range defined for the series in that the hue of the A horizon is more red. This does not affect use, management, or behavior of the soils.

Frio silty clay loam (Fo).—This nearly level soil is on the flood plains of the major streams. Slopes range from 0 to 1 percent and commonly are 0.5 percent.

Included with this soil in mapping are areas of Clairemont soils.

Most of this Frio silty clay loam is cultivated, but a few areas are in native range. Soil blowing and water erosion are slight hazards. Some areas are subject to flooding once in 5 years. Capability unit IIc–1; Bottomland range site; pasture group 1C.

Hardeman Series

The Hardeman series consists of deep, sloping and strongly sloping soils on uplands. These soils formed in loamy, wind-deposited material.

In a representative profile, the surface layer is reddish-brown, calcareous, fine sandy loam about 12 inches thick. The next layer is yellowish-red, calcareous fine sandy loam about 18 inches thick. This layer has a few films of calcium carbonate. The underlying material, extending to a depth of about 60 inches, is yellowish-red, calcareous fine sandy loam.

Hardeman soils are moderately rapidly permeable and well drained. Runoff is medium, and available water capacity is moderate.

Representative profile of Hardeman fine sandy loam, 5 to 12 percent slopes, in range, 5.25 miles north on Farm Road 1646 from the intersection of U.S. Highway 380, then 5 miles west on county road, 0.5 mile northwest on field road, and 250 feet west.

A1—0 to 12 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable; calcareous; moderately alkaline; clear, smooth boundary.

B2—12 to 30 inches, yellowish-red (5YR 5/6) fine and sandy loam, yellowish red (5YR 4/6) moist; weak, fine, granular structure; slightly hard, very friable; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—30 to 60 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak, fine, granular structure; slightly hard, very friable; calcareous; moderately alkaline.

The A1 horizon ranges from 8 to 15 inches in thickness. The B horizon ranges from 12 to 24 inches in thickness and from reddish brown to yellowish red in color. The C horizon is yellowish red to reddish brown.

Hardeman fine sandy loam, 5 to 12 percent slopes (HaD).—This sloping to strongly sloping soil commonly has slopes that average 8 percent.

Included with this soil in mapping are small areas of gravel outcrop on ridges and Enterprise and Miles soils that are lower and less sloping.

This Hardeman fine sandy loam is used mainly for range. A few areas are used for crops, even though the steepness makes this soil not well suited to use as cropland. Cultivated areas have dunes 3 to 5 feet high along field boundaries. The hazard of water erosion is high, and the hazard of soil blowing is moderate. Capability unit VIe–4; Sandy Loam range site; not placed in a pasture group.

Hensley Series, Moderately Deep Variant

The Hensley series is made up of nearly level, moderately deep soils on uplands. These soils overlie limestone.

In a representative profile, the surface layer is reddish-brown, neutral loam about 5 inches thick. The next layer is firm clay, about 31 inches thick, that is reddish brown in the upper part and red in the lower part. Hard, bedded limestone is at a depth of about 36 inches.

Hensley soils, moderately deep variant, are slowly permeable and well drained. Runoff is slow, and available water capacity is high.

Representative profile of Hensley loam, moderately deep variant, 0 to 1 percent slopes, in range, 100 feet west of a point on a county road. This point is 1.7 miles north of the Jones-Stonewall County line by Farm Road 1835, then 1.3 miles north and west on the county road.

A1—0 to 5 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak to moderate, fine, granular and subangular blocky structure; hard, friable; many roots; neutral; clear, smooth boundary.

B21t—5 to 20 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; weak, coarse, prismatic structure parting to moderate, medium, blocky; very hard, firm; common roots; common distinct clay films; neutral; clear, smooth boundary.

B22t—20 to 32 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate, medium, blocky structure; very hard, firm; common roots; common distinct clay films; neutral; clear, smooth boundary.

B3—32 to 36 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; weak, medium, blocky structure; very hard, firm; few roots; about 3 percent limestone fragments and concretions of ironstone and calcium carbonate; mildly alkaline; abrupt, wavy boundary.

R—36 to 46 inches, hard, bedded limestone; precipitated calcium carbonate in fractures and between bedding planes.

The A horizon ranges from 4 to 8 inches in thickness and from brown to reddish brown in color. The B21t and B22t horizons range from 14 to 34 inches in thickness and from red to reddish brown in color. The B3 horizon is absent in some profiles. Depth to limestone bedrock is 20 to 40 inches.

Hensley loam, moderately deep variant, 0 to 1 percent slopes (HeA).—This nearly level soil is in plane areas about 200 acres in size. Slopes are commonly 0.5 percent.

Included with this soil in mapping are small areas of Talpa, Tillman, and Yates soils. The Tillman soils are on the lower parts of the landscape, and the Talpa and Yates soils are on the higher, convex ridges.

This Hensley loam is used mainly for range, although a few areas are in crops. The hazards of soil blowing and water erosion are slight. Capability unit IIc–3; Deep Hardland range site; pasture group 7C.

Hilgrave Series

The Hilgrave series consists of moderately deep, gently sloping and sloping soils on uplands. These soils formed in gravel beds.

In a representative profile, the surface layer is reddish-brown, neutral gravelly sandy loam 6 inches thick. The next layer is reddish-brown, friable gravelly sandy clay loam about 12 inches thick. Below this is about 6 inches of reddish-yellow gravelly loamy sand. The underlying material, extending to a depth of 40 inches, is stratified layers of gravel and fine sand.

Hilgrave soils are moderately rapidly permeable and well drained. Runoff is medium to rapid, and available water capacity is low.

Representative profile of Hilgrave gravelly sandy loam, 3 to 8 percent slopes, in range, 500 feet north of a point on U.S. Highway 380. This point is 8 miles west of Swenson.

A1—0 to 6 inches, reddish-brown (5YR 4/4) gravelly sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; soft, very friable; many roots; 50 percent, by volume, waterworn siliceous gravel; neutral; clear, smooth boundary.

B2t—6 to 18 inches, reddish-brown (5YR 4/4) gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; weak, medium, subangular blocky structure; soft, friable; common roots; clay bridging evident between sand grains; 60 percent, by volume, waterworn siliceous gravel; neutral; clear, smooth boundary.

B3ca—18 to 24 inches, reddish-yellow (5YR 7/6) gravelly loamy sand, yellowish red (5YR 5/6) moist; weak granular structure; slightly hard, very friable; few roots; 50 percent by volume, waterworn siliceous gravel; calcium carbonate coatings on pebbles and sand grains; calcareous; moderately alkaline; abrupt, wavy boundary.

C—24 to 40 inches, reddish-yellow (5YR 7/6) stratified layers of gravel and fine sand, reddish yellow (5YR 6/6) moist; single grain; loose; calcareous; moderately alkaline.

The solum ranges from 20 to 50 inches in thickness. The A1 horizon ranges from 5 to 10 inches in thickness and from reddish brown to brown in color. This horizon is 35 to 70 percent gravel.

The Bt horizon is 9 to 25 inches thick and reddish brown to red. The Bca horizon is 4 to 15 inches thick and reddish brown to yellowish red or reddish yellow.

Hilgrave gravelly sandy loam, 3 to 8 percent slopes (HgD).—This gently sloping and sloping soil has convex slopes. Soil areas are 20 to 300 acres in size.

Included with this soil in mapping is a soil similar to Hilgrave gravelly sandy loam except that it is less than 20 inches thick and overlies gravel beds. Another similar soil that has a hard caliche layer at a depth of 16 to 24 inches makes up about 10 percent of the mapped acreage. Hardeman and Miles soils that are lower and less sloping than the Hilgrave soil also are included.

Most of this Hilgrave gravelly sandy loam is in range. A few of the less sloping areas are used for crops. The hazard of soil blowing is moderate, and the hazard of water erosion is moderate to high. Capability unit VIe–4; Gravelly range site; not placed in a pasture group.

Hollister Series

The Hollister series consists of deep, nearly level soils on uplands. These soil formed in clayey shale sediments.

In a representative profile, the surface layer is dark grayish-brown, firm silty clay loam about 7 inches thick. The next layer is very firm clay, about 31 inches thick, that is very dark grayish brown in the upper part and dark grayish brown in the lower part. Below this is about 34 inches of firm, yellowish-red clay. The underlying material is light-gray clayey shale that extends to a depth of 92 inches.

Hollister soils are slowly permeable and well drained. Runoff is slow, and available water capacity is high.

Representative profile of Hollister silty clay loam, 0 to 1 percent slopes, in range, 0.65 mile west of a point on U.S. Highway 83 that is 1.1 miles south of the King-Stonewall County line.

A11—0 to 5 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; many roots; mildly alkaline; clear, smooth boundary.

A12—5 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; many roots; mildly alkaline; abrupt, smooth boundary.

B21t—7 to 24 inches, very dark grayish-brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; weak, coarse, blocky structure parting to moderate to strong, medium, blocky; very hard, very firm, sticky and plastic; common roots; continuous clay films; mildly alkaline; gradual, smooth boundary.

B22t—24 to 38 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, medium, blocky structure; very hard, very firm, sticky and plastic; roots between peds; distinct clay films; few, hard, fine calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B23t—38 to 60 inches, yellowish-red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; few roots between peds; thin clay films; 5 percent gypsum crystals; calcareous; moderately alkaline; diffuse, smooth boundary.

B24tca—60 to 72 inches, yellowish-red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; weak, fine, granular structure; hard, firm, sticky and plastic; few clay films; 5 percent calcium carbonate concretions; 5 percent gypsum crystals; calcareous; moderately alkaline; gradual, smooth boundary.

C—72 to 92 inches, light-gray (5Y 7/1) clayey shale, gray (5Y 5/1) moist; massive; hard, firm, plastic; calcareous; moderately alkaline.

The solum ranges from 60 to 80 inches in thickness. The A horizon ranges from 6 to 10 inches in thickness and from dark grayish brown to brown in color. The B21t and B22t horizons range from 26 to 40 inches in thickness and from very dark grayish brown to brown in color. The B23t and B24tca horizons are 23 to 40 inches thick and yellowish red to reddish brown.

The C horizon is red or gray clayey shale sediment of Permian age.

Hollister silty clay loam, 0 to 1 percent slopes (HoA).—This nearly level soil has slightly concave slopes that are commonly 0.5 percent. Soil areas are 200 to 300 acres in size.

Included with this soil in mapping are small areas of Tillman soil on the higher parts of the landscape.

About half of this Hollister silty clay loam is cultivated, and about half is in range. The soil blowing and water erosion hazards are slight. Capability unit IIc–2; Deep Hardland range site; pasture group 7A.

Latom Series

The Latom series consists of very shallow and shallow, gently sloping and sloping soils on uplands. These soils formed in material weathered from strongly cemented sandstone.

In a representative profile, the surface layer is brown, calcareous loam about 8 inches thick. This layer overlies strongly cemented sandstone that extends to a depth of more than 14 inches.

Latom soils are slowly permeable and moderately well drained. Runoff is slow, and available water capacity is low .

Representative profile of Latom loam, in an area of Latom-Rock outcrop complex, in range, 200 feet south of a point on a county road. This point is 4.5 miles north of Aspermont, on Farm Road 1263, then 12.1 miles north and east on the county road.

A1—0 to 8 inches, brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable; few films and threads of

calcium carbonate in lower 4 inches; calcareous; moderately alkaline; abrupt, smooth boundary.
R—8 to 14 inches, red and gray strongly cemented sandstone; thin coating of calcium carbonate in crevices.

The A horizon ranges from 4 to 20 inches in thickness, from reddish brown to brown in color, and from loam to fine sandy loam in texture.

Latom-Rock outcrop complex (Lc).—The soils and land type in this mapping unit are gently sloping to steep. They are so closely associated and occur in such intermingled patterns that it is not practical to map them separately at the scale used. This mapping unit is about 70 percent Latom, about 20 percent Rock outcrop, and about 10 percent inclusions of less extensive soils.

The gently sloping to sloping Latom soils have convex slopes. The Rock outcrop is on steep escarpments and gently sloping, severely eroded areas below the scarps. It is made up of outcrops of sandstone and severely eroded areas below the sandstone.

Included in this mapping unit are small areas of Cosh and Owens soils in larger, smoother areas.

This mapping unit is suitable for limited grazing and wildlife. It is in range. Some areas of this unit are severely eroded. The soil blowing hazard is slight, and the water erosion hazard is moderate to high. Capability unit VIIs–1; Very Shallow range site; not placed in a pasture group.

Likes Series

The Likes series consists of deep, gently sloping to sloping and gently undulating soils on uplands. These soils formed in calcareous, wind-deposited sands.

In a representative profile, the surface layer is light reddish-brown, calcareous fine sand about 8 inches thick. The underlying material, extending to a depth of about 64 inches, is reddish-yellow, calcareous fine sand.

Likes soils are moderately rapidly permeable and excessively drained. Runoff is slow, and available water capacity is low.

Representative profile of Likes fine sand, in range, 0.2 mile north of U.S. Highway 380 at a point 6.7 miles west of the intersection of U.S. Highway 380 and Farm Road 1646.

A1—0 to 8 inches, light reddish-brown (5YR 6/4) fine sand, reddish brown (5YR 5/4) moist; single grain; loose; calcareous; moderately alkaline; clear boundary.
C—8 to 64 inches, reddish-yellow (5YR 7/6) fine sand, reddish yellow (5YR 6/6) moist; single grain; loose; calcareous; moderately alkaline.

The A horizon ranges from 5 to 10 inches in thickness, from reddish brown to yellowish brown in color, and from neutral to moderately alkaline in reaction. The C horizon ranges from reddish yellow to yellow in color and from mildly to moderately alkaline in reaction.

Likes fine sand (Lk).—This gently sloping and sloping soil is sandy and is on gently undulating uplands. Slopes are 3 to 8 percent.

Included with this soil in mapping are areas of Lincoln soils on the flood plains of the rivers.

Almost all of this Likes fine sand is in range. The hazard of soil blowing is high, and the hazard of water erosion is slight. Capability unit VIIe–1; Deep Sand range site; not placed in a pasture group.

Lincoln Series

The Lincoln series consists of deep, nearly level soils that formed in alluvium.

In a representative profile, the surface layer is reddish-yellow, loose, calcareous loamy fine sand about 10 inches thick. The next layer, extending to a depth of about 64 inches, is reddish-yellow, calcareous fine sand that contains thin layers of silt loam.

Lincoln soils are rapidly permeable and somewhat excessively drained. Runoff is slow, and the available water capacity is low.

Representative profile of Lincoln soils, 6.5 miles west of Swenson, Tex., on U.S. Highway 380, on the north side of the bridge over the Salt Fork of the Brazos River.

A1—0 to 10 inches, reddish-yellow (5YR 6/6) loamy fine sand; yellowish red (5YR 5/6) moist; single grain; loose; stratification not altered; calcareous; moderately alkaline; clear, smooth boundary.
C—10 to 64 inches, reddish-yellow (7.5YR 8/6) fine sand, reddish yellow (7.5YR 7/6) moist; single grain; stratification not altered; thin strata (less than 3 inches thick) of reddish-brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; calcareous; moderately alkaline.

The A horizon ranges from 6 to 15 inches in thickness, from light reddish brown to reddish yellow in color, and from loamy fine sand to fine sand in texture. Textures of silt loam, silty clay loam, and fine sandy loam in layers 3 to 10 inches thick are in some profiles. The C horizon ranges from pink to reddish yellow in color.

Lincoln soils (Ln).—These nearly level soils occupy the flood plains of rivers (fig. 10). They have water tables at a depth of 5 to 8 feet.

Included with these soils in mapping are small areas of Yomont and Likes soils. The Likes soils are on higher ridges, and the Yomont soils are in narrow bands adjacent to soils on uplands.

These Lincoln soils are flooded about twice in 5 years and are used for range. The hazard of soil blowing is high. Capability unit Vw–2; Sandy Bottomland range site; pasture group 3A.

Mangum Series

The Mangum series consists of deep, nearly level soils that formed in recent clayey alluvium.

In a representative profile, the surface layer is 7 inches of reddish-brown, calcareous silty clay loam. The underlying material is reddish-brown, massive, calcareous clay that extends to a depth of 60 inches.

Mangum soils are very slowly permeable and crack when dry. They are moderately well drained. Runoff is slow, and available water capacity is high.

Representative profile of Mangum silty clay loam, in range, 300 feet west of a point on U.S. Highway 83 that is 2 miles south of Aspermont.

A1—0 to 7 inches, reddish-brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate, fine, blocky structure; hard, firm, slightly sticky; many roots; calcareous; moderately alkaline; clear, smooth boundary.
C1—7 to 30 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; massive; very hard, very firm, sticky and plastic; common roots; few pressure faces on sides of peds; films and threads of calcium carbonate in lower half; cracks 1 to

Figure 10.—Area of Lincoln soils.

1.5 centimeters wide extend from top to bottom of horizon; calcareous; moderately alkaline; clear, smooth boundary.

C2—30 to 60 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; hard, firm, sticky and plastic; few roots; calcium carbonate films; few fine and medium calcium carbonate concretions; few gypsum crystals in lower part; few bedding planes; calcareous; moderately alkaline.

The A1 horizon ranges from 4 to 10 inches in thickness and from reddish brown to brown in color. The C horizon contains few to common films and threads of calcium carbonate.

Mangum silty clay loam (Ma).—This soil is on the broad, shallow flood plains bordering smaller drainageways of the county. Slopes are mainly less than 1 percent. The drainageways are narrow and meandering.

Included with this soil in mapping are Colorado soils and areas of Tillman soils on higher uplands.

This Mangum silty clay loam is mostly in range, but a few areas are used for crops. This soil is subject to flooding about four times in 5 years. The hazards of soil blowing and water erosion are slight. Capability unit Vw-1; Bottomland range site; pasture group 1A.

Miles Series

The Miles series is made up of deep, nearly level to sloping soils that formed in ancient loamy alluvial outwash.

In a representative profile, the surface layer is about 8 inches of reddish-brown, neutral fine sandy loam. The next layer, extending to a depth of about 50 inches, is reddish-brown, friable sandy clay loam. This layer is neutral in the upper part and mildly alkaline in the lower part. Beneath this is a layer of yellowish-red, calcareous sandy clay loam about 10 inches thick. It is underlain by reddish-yellow, calcareous sandy clay loam that extends to a depth of 85 inches.

Miles soils are moderately permeable and well drained. Runoff is slow to moderate, and available water capacity is high.

Representative profile of Miles fine sandy loam, 1 to 3 percent slopes, in a cultivated field, 150 feet south of a point on U.S. Highway 380 that is 8.9 miles west of Swenson.

Ap—0 to 8 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak, fine, granular structure; soft, very friable; neutral; abrupt, smooth boundary.

B1t—8 to 12 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak, medium, subangular blocky structure; hard, friable; few thin clay films; neutral; gradual, smooth boundary.

B21t—12 to 32 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; compound weak, coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; very hard, friable; few thin clay films on peds; mildly alkaline; gradual, smooth boundary.

B22t—32 to 50 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; compound coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; very hard,

friable; few clay films; mildly alkaline; gradual, smooth boundary.

B23t—50 to 60 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky structure; hard, friable; few thin clay films; few threads and soft lumps of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—60 to 75 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak, fine, granular structure; slightly hard, friable; 5 percent, by volume, whitish, friable to slightly cemented calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

C—75 to 85 inches, reddish-yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; massive; friable; few soft concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to more than 70 inches in thickness. The A horizon ranges from 7 to 14 inches in thickness, from brown to reddish brown in color, and from fine sandy loam to loamy fine sand in texture.

The B1t horizon ranges from 0 to 8 inches in thickness. The B21t and B22t horizons are 30 to 50 inches thick and reddish brown to red.

The B23t and B3ca horizons are 20 to 35 inches thick and yellowish red to red. The upper part of the Bt horizon is neutral, and the lower part is mildly to moderately alkaline. The B3ca horizon ranges from prominent to scarcely evident or absent. The C horizon is reddish yellow to red.

Miles fine sandy loam, 0 to 1 percent slopes (MnA).—This nearly level soil has smooth to slightly convex slopes that are dominantly 0.5 percent. Most soil areas average several hundred acres in size.

The surface layer is reddish-brown fine sandy loam about 10 inches thick. The next layer is reddish-brown, noncalcareous sandy clay loam about 40 inches thick. The underlying material is yellowish-red, calcareous sandy clay loam.

Included in some mapped areas of this soil are areas of Altus and Tipton soils in slightly concave positions.

This Miles fine sandy loam is mainly cultivated, but a few areas are in native range. Runoff on this soil is slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. A few cultivated fields have dunes 1 to 2 feet high along field boundaries. Capability unit IIIe–4; Sandy Loam range site; pasture group 8C.

Miles fine sandy loam, 1 to 3 percent slopes (MnB).—This gently sloping soil has convex slopes that are dominantly 2 percent. Most soil areas average several hundred acres in size.

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

Included with this soil in mapping are areas of Miles fine sandy loam that have slopes of less than 1 percent and some that have slopes of more than 3 percent.

This Miles fine sandy loam is mostly cultivated, but a few areas are in range. Runoff is slow. The hazard of soil blowing is moderate, and the hazard of water erosion is slight. In some cultivated fields dunes 1 to 3 feet high are along their boundaries. Capability unit IIIe–4; Sandy Loam range site; pasture group 8C.

Miles fine sandy loam, 3 to 5 percent slopes (MnC).—This gently sloping soil has convex slopes that are dominantly about 4.5 percent. Most soil areas are about 50 to 100 acres in size.

The surface layer is reddish-brown fine sandy loam about 8 inches thick. The next layer is reddish-brown, noncalcareous sandy clay loam about 30 inches thick. Beneath this is a layer of yellowish-red, noncalcareous sandy clay loam about 20 inches thick. The underlying material is reddish-yellow, calcareous sandy clay loam.

Included with this soil in mapping are areas of Hardeman and Hilgrave soils. Also included are areas of Miles fine sandy loam that have less than 3 percent slope and some areas having slope of more than 5 percent.

About half of this Miles fine sandy loam, 3 to 5 percent slopes, is cultivated, and about half is in range. Runoff is medium. This soil is subject to moderate hazards of soil blowing and water erosion. Some areas have a few gullies about 12 inches deep, and some cultivated fields have dunes that are 1 to 2 feet high along their boundaries. Capability unit IVe–2; Sandy Loam range site; pasture group 8C.

Miles fine sandy loam, 5 to 8 percent slopes (MnD).—This soil has convex slopes that are dominantly about 6 percent. It is on ridges and on the side slopes of drainageways in areas generally less than 70 acres in size.

The surface layer is reddish-brown, noncalcareous fine sandy loam about 7 inches thick. The next layer is reddish-brown, noncalcareous sandy clay loam about 30 inches thick. Beneath this is a layer of yellowish-red, noncalcareous sandy clay loam about 20 inches thick. The underlying material is reddish-yellow, calcareous sandy clay loam.

Included with this soil in mapping are areas of Hilgrave soils at higher elevations.

This Miles fine sandy loam is used mainly for range, but a few areas are cultivated. Cultivated areas have gullies 1 to 3 feet deep about 150 feet apart. The hazard of water erosion is high, and the hazard of soil blowing is moderate. Runoff is medium. Capability unit VIe–4; Sandy Loam range site; not placed in a pasture group.

Miles loamy fine sand, 0 to 3 percent slopes (MlB).—This nearly level to gently sloping soil has convex to gently undulating slopes that are dominantly 1.5 percent. Areas are 200 to 400 acres in size.

The surface layer is brown, noncalcareous loamy fine sand about 14 inches thick. The next layer is reddish-brown, noncalcareous sandy clay loam about 30 inches thick. Below this is yellowish-red, noncalcareous sandy clay loam about 24 inches thick. The underlying material is reddish-yellow, calcareous sandy clay loam.

Included with some mapped areas of this soil are Springer and Devol soils at higher elevations and Miles fine sandy loam in lower, smoother areas. Also included are a few small areas of Miles loamy fine sand that have slopes of more than 3 percent.

Most of this Miles loamy fine sand is cultivated, but a few areas are in range. Most cultivated fields have dunes 3 feet high along their boundaries. The hazard of water erosion is slight, and the hazard of soil blowing is severe. Capability unit IVe–4; Sandyland range site; pasture group 9A.

Miles loamy fine sand, 3 to 5 percent slopes (MlC).—This gently sloping or gently undulating soil has convex slopes that are commonly 4 percent. Areas are about 50 acres in size.

The surface layer is brown, noncalcareous loamy fine sand about 14 inches thick. The next layer is reddish-brown, noncalcareous sandy clay loam about 32 inches

thick. Beneath this is a layer of yellowish-red, noncalcareous sandy clay loam about 20 inches thick. The underlying material is reddish-yellow calcareous sandy clay loam.

Included with this soil in mapping are small areas of Devol, Nobscot, and Springer soils at higher elevations. Small areas of Miles loamy fine sand that have slopes of less than 3 percent also are included.

Nearly all of this Miles loamy fine sand is in range. The hazards of soil blowing and water erosion are high. Capability unit VIe–5; Sandyland range site; pasture group 9A.

Nipsum Series

The Nipsum series consists of deep, gently sloping soils on uplands. These soils formed in calcareous, clayey materials.

In a representative profile, the surface layer is brown, calcareous clay about 30 inches thick. The next layer is reddish-brown, calcareous clay about 18 inches thick. The underlying material, extending to a depth of about 60 inches, is reddish-brown, calcareous clay.

Nipsum soils are slowly permeable and well drained. Runoff is medium, and available water capacity is high.

Representative profile of Nipsum clay, 1 to 3 percent slopes, in range, 200 feet north of a point on a private ranch road. This point is 3.6 miles south of Aspermont, by U.S. Highway 83, then 4.5 miles east on a county road, and 1.2 miles north and west on the private road.

A11—0 to 10 inches, brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate, fine, subangular blocky structure and weak, fine, granular; hard, friable; calcareous; moderately alkaline; clear, smooth boundary.

A12—10 to 30 inches, brown (7.5YR 5/2) clay, dark brown (7.5YR 3/3) moist; moderate, fine and medium, subangular blocky structure; hard, firm; common roots; many very fine pores; common worm casts; few calcium carbonate films and threads; calcareous; moderately alkaline; gradual, smooth boundary.

Bca—30 to 48 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; weak, fine, subangular blocky structure; hard, firm; about 3 percent, by volume, calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C—48 to 60 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; hard, firm; calcareous; moderately alkaline.

The solum ranges from 40 to more than 60 inches in thickness. The A horizon ranges from 20 to 35 inches in thickness and from dark brown to reddish brown in color.

The Bca horizon ranges from 8 to 20 inches in thickness and from reddish brown to brown in color. The calcium carbonate content of this horizon is 1 to 10 percent. The C horizon is yellowish red to reddish brown.

Nipsum clay, 1 to 3 percent slopes (NcB).—This gently sloping soil is on smooth, convex foot slopes. Slopes are dominantly 1.8 percent. Areas range from 200 to 400 acres in size.

Mapped with this soil are Frio soils on the flood plains of small drains and Rotan soils that are nearly level. Aspermont and Quanah soils at higher elevations also are included. Also included are small areas of Nipsum clay that have slopes of more than 3 percent.

This Nipsum clay is mostly in range. A few areas are cultivated. This soil is subject to slight hazards of soil blowing and moderate hazards of water erosion. Capability unit IIe–1; Valley range site; pasture group 7A.

Nobscot Series

The Nobscot series consists of deep, nearly level to gently undulating soils on uplands. These soils formed in unconsolidated, sandy, wind-deposited material.

In a representative profile, the surface layer is about 32 inches of slightly acid fine sand that is brown in the upper part and very pale brown in the lower part. The next layer is yellowish-red, slightly acid, friable fine sandy loam about 16 inches thick. The underlying material, extending to a depth of about 90 inches, is yellow, slightly acid loamy sand and fine sand that contains thin bands of fine sandy loam.

Nobscot soils are moderately rapidly permeable and well drained. Runoff is very slow, and available water capacity is low.

Representative profile of Nobscot fine sand, in an area of the Nobscot association, 6.9 miles north of Swanson, by Farm Road 1646, then 2 miles east and 1 mile north on a ranch road, and west into range 500 feet.

A1—0 to 9 inches, brown (10YR 5/3) fine sand, brown (10YR 4/3) moist; single grain; loose; slightly acid; clear, smooth boundary.

A2—9 to 32 inches, very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) moist; single grain; loose; slightly acid; clear, smooth boundary.

B2t—32 to 48 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; massive; hard, friable; few thin clay films; slightly acid; diffuse, smooth boundary.

C—48 to 90 inches, yellow (10YR 8/6) loamy sand and fine sand that contains thin bands of fine sandy loam, yellow (10YR 7/6) moist; slightly acid.

The A1 horizon ranges from grayish brown to pale brown and light brown. The combined thickness of the A1 and A2 horizons ranges from 24 to 40 inches. The A2 horizon ranges from very pale brown to reddish yellow.

The Bt horizon is 8 to 36 inches thick and yellowish red to reddish yellow. The C horizon is yellow to light-red loamy fine sand to fine sand.

Nobscot association (Ns).—This mapping unit is nearly level to gently undulating and hummocky. Most of it is in three large delineations. Slopes range from 0 to 5 percent.

Nobscot fine sand makes up 80 percent of this mapping unit. Twenty percent of the unit is a soil similar to Nobscot soil but it has a thicker fine sand surface layer and a sandy clay loam lower layer.

The soils in this mapping unit occupy similar topographic positions and cannot be distinguished by observation of the surface alone because they have the same kinds and amounts of vegetation. The areas are much larger, and their composition more variable, than for other mapping units in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

Included in this mapping unit are areas of Miles and Springer soils in lower, nearly level positions.

Nearly all of the acreage of this mapping unit is in range, but a few areas are cultivated. The hazard of water erosion is slight, and the hazard of soil blowing is high. Some areas that were cultivated are now in native grasses. Capability unit VIe–1; Deep Sand range site; pasture group 9A.

Obaro Series

The Obaro series consists of moderately deep and deep, gently sloping soils on uplands. These soils formed in calcareous, loamy and weakly cemented sandstone red beds.

In a representative profile, the surface layer is reddish-brown, calcareous very fine sandy loam about 10 inches thick. The next layer is calcareous, friable loam, about 24 inches thick, that is reddish brown in the upper part and yellowish red in the lower part. Red, weakly cemented silt and sandstone is at a depth of about 34 inches.

Obaro soils are moderately permeable and well drained. Runoff is medium, and available water capacity is moderate.

Representative profile of Obaro very fine sandy loam, 3 to 5 percent slopes, in a cultivated field, 14.6 miles southwest of Aspermont, by Farm Road 610, then 1.7 miles east on a county road, and 0.2 mile south on a field road, and 300 feet west to the site.

Ap—0 to 10 inches, reddish-brown (5YR 5/3) very fine sandy loam, reddish brown (5YR 4/3) moist; weak, fine, granular structure; slightly hard, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

B2—10 to 22 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak to moderate, fine, granular structure; hard, friable, slightly sticky; few films and threads of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B3ca—22 to 34 inches, yellowish-red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak, fine, granular structure; hard, friable; 13 percent calcium carbonate concretions; calcareous; moderately alkaline; diffuse, smooth boundary.

C—34 to 48 inches, red (2.5YR 4/6) weakly cemented, calcareous silt and sandstone, dark red (2.5YR 3/6) moist.

The A horizon ranges from 5 to 12 inches in thickness and from reddish brown to dark reddish brown in color. The B2 horizon ranges from 8 to 20 inches in thickness and from reddish brown to reddish yellow in color. The B3ca horizon is 4 to 14 inches thick and red to yellowish red. This horizon is 18 to 38 inches below the surface. The C horizon is 20 to 48 inches below the surface.

Obaro very fine sandy loam, 1 to 3 percent slopes (OaB).—This gently sloping soil has convex slopes that are commonly 2 percent. Soil areas are 50 to 100 acres in size.

The surface layer is reddish-brown very fine sandy loam about 12 inches thick. The next layer is reddish-brown loam about 20 inches thick. The underlying material, extending to a depth of 46 inches, is yellowish-red loam.

Included with this soil in mapping are areas of Paducah soils in smooth, somewhat lower areas.

Most of this Obaro very fine sandy loam is cultivated. The hazards of water erosion and soil blowing are slight. Capability unit IIIe–2; Mixedland range site; pasture group 8C.

Obaro very fine sandy loam, 3 to 5 percent slopes (OaC).—This gently sloping soil is in areas 30 to several hundred acres in size. Slopes are commonly 4 percent.

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

Included with this soil in mapping are small areas of less sloping Paducah soils as well as Woodward and Quinlan soils on the more sloping ridgetops. Also included are small areas of Obaro very fine sandy loam that have slopes of less than 3 percent.

About 50 percent of this Obaro very fine sandy loam, 3 to 5 percent slopes, is cultivated; the rest is in range. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Capability unit IVe–1; Mixedland range site; pasture group 8C.

Owens Series

The Owens series consists of shallow, gently sloping to strongly sloping soils on uplands. These soils formed in shaly clay sediments.

In a representative profile, the surface layer is about 16 inches of brown, calcareous clay. The underlying material, extending to a depth of 30 inches, is red and gray shaly clay.

Owen soils are very slowly permeable and well drained. Runoff is rapid, and available water capacity is medium.

Representative profile of Owens clay, in an area of Owens-Badland association, in range, 1 mile west of Farm Road 1835, from a point that is 4.5 miles north of Old Glory.

A1—0 to 4 inches, brown (7.5YR 5/4) clay, brown (7.5YR 4/4) moist; moderate, fine, subangular blocky structure; very hard, very firm; many roots; calcareous; moderately alkaline; gradual, smooth boundary.

Bca—4 to 16 inches, brown (7.5YR 5/4) clay, brown (7.5YR 4/4) moist; moderate, medium, subangular blocky and blocky structure; very hard, very firm; common roots; few films and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—16 to 30 inches, red and gray interbedded layers of shaly clay; massive; calcareous; moderately alkaline.

The A horizon ranges from 4 to 8 inches in thickness and from brown to reddish brown in color. The B horizon ranges from 8 to 14 inches in thickness and from brown to reddish brown in color. In about 30 percent of the areas as much as 20 percent of the profile consists of particles of shaly clay. The C horizon is 12 to 20 inches below the surface and is red, reddish-brown, gray, or olive shaly clay.

Owens-Badland association (Ob).—This mapping unit is made up of sloping to strongly sloping soils on uplands (fig. 11). These uplands are dissected by numerous small drainageways. The components of this mapping unit are so closely associated and occur in such intermingled patterns that it is not practical to map them separately at the scale used. The delineations are much larger and the composition of these mapping units is more variable than in other mapping units in the county. Mapping has been controlled well enough, however, for the anticipated uses of the soils. Areas of this mapping unit are irregularly shaped and ranged from 20 to several thousand acres in size.

In a representative area the Owens soils cover 45 percent of this mapping unit, Badland is in 40 percent, and inclusions of less extensive soils are in 15 percent. The Owens soils are gently sloping to strong sloping and are on benches. Slopes are commonly about 6 percent. The Owens soil has the profile described as representative for the Owens series.

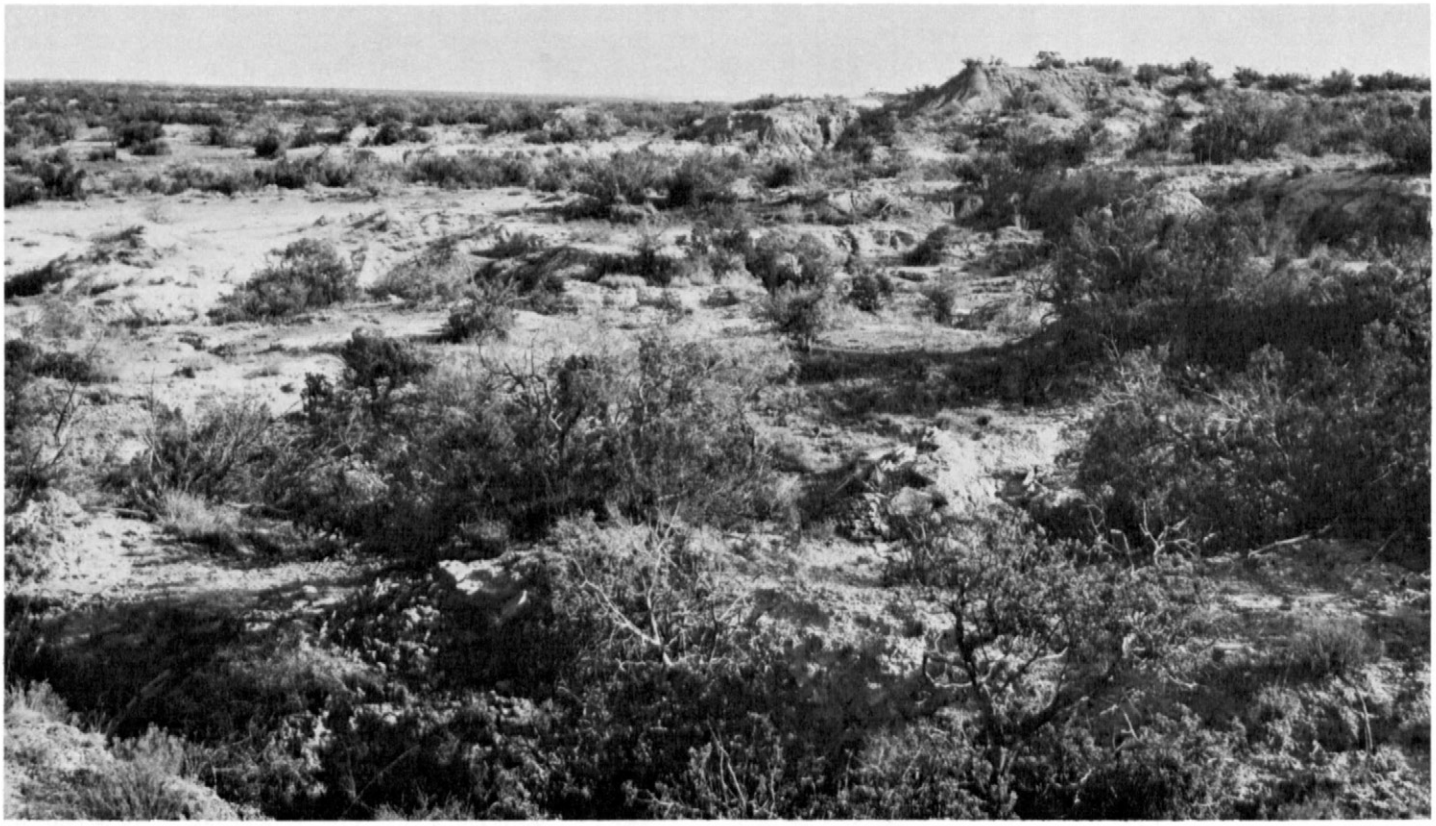

Figure 11.—Area of the mapping unit Owens-Badland association.

The Badland areas are on escarpments and smoother, severely eroded areas below escarpments. They are nearly barren outcrops of shaly and clayey red-bed materials.

Included in some mapped areas of this unit are small areas of Vernon and Cottonwood soils. The Vernon soils are on the larger, smoother benches, and the Cottonwood soils are in narrow bands above scarps. Also included are Treadway soils along drains and in valleys.

This mapping unit is in range. It is not suited to use as cropland. The hazard of soil blowing is slight, and the hazard of water erosion is high. Both soils in capability unit VIIs–1; Owens part in Shallow Redland range site; Badland part in Rough Breaks range site; not placed in a pasture group.

Paducah Series

The Paducah series consists of deep, nearly level to gently sloping soils on uplands. These soils formed in calcareous, loamy and sandy red-bed material of Permian age.

In a representative profile, the surface layer is reddish-brown, neutral very fine sandy loam about 9 inches thick. The next layer is sandy clay loam, about 39 inches thick, that is reddish brown in the upper part and red in the lower part. It is underlain by light-red loam about 20 inches thick. Red, calcareous, weakly consolidated sandstone is at a depth of about 68 inches.

Paducah soils are moderately permeable and well drained. Runoff is slow to medium, and their available water capacity is high.

Representative profile of Paducah very fine sandy loam, 1 to 3 percent slopes, in a cultivated field, 100 feet south of a point on a county road. This point is 14.6 miles southwest of Aspermont, by Farm Road 610, and 0.4 mile east on the county road.

Ap—0 to 9 inches, reddish-brown (5YR 4/4) very fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable; neutral; abrupt, smooth boundary.

B2t—9 to 30 inches, reddish-brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; moderate, medium and fine, subangular blocky structure; very hard, firm; few distinct clay films; neutral; gradual, smooth boundary.

B3—30 to 48 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; weak, medium, subangular blocky structure and fine, granular; hard, friable, slightly sticky; calcareous in the lower 6 inches; mildly alkaline; gradual, smooth boundary.

C1ca—48 to 68 inches, light-red (2.5YR 6/6) loam, red (2.5YR 4/6) moist; hard, friable, slightly sticky; 8 percent films, threads, and fine concretions of calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

C2—68 to 75 inches, red (2.5YR 5/6), sandy, weakly consolidated red-bed material of Permian age.

The solum ranges from 40 to 72 inches in thickness. The A horizon ranges from 6 to 12 inches in thickness and from reddish brown to brown in color.

The B2t horizon ranges from 10 to 30 inches in thickness and from reddish brown to red in color. The B3 horizon is 10 to 20 inches thick, red to yellowish red, and loam to sandy clay loam.

The depth to carbonates is 30 to 60 inches. The Cca horizon is red to yellowish red.

These soils are outside the range of the Paducah series in that the secondary carbonates are at slightly greater depths than those described for the Paducah soils. They are like Paducah, however, in use, management, and behavior.

Paducah very fine sandy loam, 0 to 1 percent slopes (PdA).—This nearly level soil has slightly convex slopes that are commonly 0.5 percent. Soil areas average about 100 acres in size.

The surface layer is reddish-brown, neutral very fine sandy loam about 10 inches thick. The next lower layer is sandy clay loam, about 42 inches thick, that is reddish brown in the upper part and red in the lower part. The underlying material is red, weakly consolidated red-bed material.

Included with this soil in mapping are small areas of St. Paul soils on smooth flats along narrow drains. Small areas of Paducah soils that have slopes of more than 1 percent also are included.

This Paducah very fine sandy loam is mainly cultivated. Runoff is slow, and the hazards of soil blowing and water erosion are slight. Capability unit IIe–2; Mixedland range site; pasture group 8C.

Paducah very fine sandy loam, 1 to 3 percent slopes (PdB).—This gently sloping soil is in areas commonly several hundred acres in size. Slopes dominantly are 2.5 percent.

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

Included with this soil in mapping are small areas of St. Paul soils on smooth flats along narrow drains and areas of Obaro soils. Also included are small areas of Paducah soils that have slopes of less than 1 percent and some that have slopes of more than 3 percent.

Most of this Paducah very fine sandy loam is cultivated. Runoff is slow to medium. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Capability unit IIe–1; Mixedland range site; pasture group 8C.

Paducah very fine sandy loam, 3 to 5 percent slopes (PdC).—This soil has gently convex slopes and is on crests and the sides of ridges. Slopes are commonly 4 percent.

The surface layer is reddish-brown, neutral very fine sandy loam about 7 inches thick. The next layer is sandy clay loam, about 36 inches thick, that is reddish brown in the upper part and red in the lower part. The underlying material is red, calcareous, weakly consolidated red-bed material.

Included with this soil in mapping are Obaro soils in higher areas and Paducah soils that have slopes of less than 3 percent.

About 50 percent of this Paducah very fine sandy loam is cultivated; the rest is in range. Some cultivated areas have a few gullies. The hazard of soil blowing is slight, and the hazard of water erosion is moderate. Capability unit IIIe–3; Mixedland range site; pasture group 8C.

Quanah Series

The Quanah series is made up of deep, gently sloping soils on uplands. These soils formed in silty red-bed materials.

In a representative profile, the surface layer is reddish-brown, calcareous silt loam about 12 inches thick. The next layer is calcareous silt loam, about 24 inches thick, that is reddish brown in the upper part and reddish yellow in the lower part. The lower part of this layer is 20 percent calcium carbonate. The underlying material, extending to a depth of 60 inches, is red, calcareous silt loam.

Quanah soils are moderately slowly permeable and well drained. Runoff is medium, and available water capacity is high.

Representative profile of Quanah silt loam, 1 to 3 percent slopes, in range, across Farm Road 610 from Johnson Chapel, which is 6.9 miles southwest of Aspermont, by Farm Road 610.

A1—0 to 12 inches, reddish-brown (5YR 4/3) silt loam, dark reddish brown (5YR 3/3) moist; weak, fine, granular structure; slightly hard, friable; many roots; few worm casts; calcareous; moderate alkaline; clear, smooth boundary.

B2—12 to 22 inches, reddish-brown (2.5YR 5/4) silt loam, reddish brown (2.5YR 4/4) moist; moderate, medium and fine, granular and subangular blocky structure; hard, friable; many roots; few worm casts; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—22 to 36 inches, reddish-yellow (5YR 7/6) silt loam, yellowish red (5YR 5/6) moist; weak, medium, subangular blocky structure; hard, friable; common roots; common films, threads, and concretions of calcium carbonate; 20 percent, by volume, calcium carbonate; calcareous; moderately alkaline; diffuse, smooth boundary.

C—36 to 60 inches, red (2.5YR 5/6) silt loam, red (2.5YR 4/6) moist; massive; hard; silty red-bed sediments; few soft masses of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon ranges from 10 to 12 inches in thickness and from reddish brown to brown in color. The B2 horizon ranges from 7 to 15 inches in thickness. The B3ca horizon is 10 to 20 inches thick and red to yellowish red. The C horizon is 27 to 40 inches below the surface.

These soils are outside the range of the Quanah series in that they are redder. This difference does not alter use, management, or behavior.

Quanah silt loam, 1 to 3 percent slopes (QhB).—This gently sloping soil is in irregular areas mostly less than 50 acres in size. Slopes are plane to weakly convex and commonly 1.5 percent.

Mapped with this soil are less extensive areas of St. Paul and Paducah soils in lower, less sloping areas.

About half this Quanah silt loam is cultivated, and half is in range. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Capability unit IIIe–5; Deep Hardland range site; pasture group 7C.

Quinlan Series

The Quinlan series consists of shallow, strongly sloping and moderately steep soils on uplands. These soils formed in sandy red beds of Permian age.

In a representative profile, the surface layer is red, calcareous, very fine sandy loam about 8 inches thick. The next layer is red, calcareous, very friable very fine sandy loam about 8 inches thick. The underlying material, extending to a depth of 30 inches, is red, calcareous, weakly cemented packsands and silts.

Quinlan soils are moderately rapidly permeable and well drained. Runoff is rapid, and available water capacity is low.

Representative profile of Quinlan very fine sandy loam in an area of Woodward-Quinlan complex, rolling, in range, 14.6 miles southwest of intersection of Farm Roads 610 and 2211 in Aspermont, then 2.7 miles west on county road and 0.8 mile west on private road, and 100 feet north of road.

A1—0 to 8 inches, red (2.5YR 4/6) very fine sandy loam, dark red (2.5YR 3/6) moist; weak, fine, granular structure; slightly hard, very friable; many roots; calcareous; moderately alkaline; gradual, wavy boundary.

B2—8 to 16 inches, red (2.5YR 5/6) very fine sandy loam, red (2.5YR 4/6) moist; weak, fine, granular structure; slightly hard, very friable; common roots; few films and threads of calcium carbonate; particles of soft sandstone; calcareous; moderately alkaline; gradual, wavy boundary.

C—16 to 30 inches, red (2.5YR 5/6) and gray (5Y 6/1) weakly cemented packsands and silts of Permian age, red (2.5YR 4/6) moist.

The A horizon ranges from 4 to 10 inches in thickness and from reddish brown to red in color. The B horizon ranges from 2 to 10 inches in thickness and from red to yellowish red in color. The C horizon is 10 to 20 inches below the surface.

Quinlan-Rough broken land complex (Qr).—This mapping unit consists of large, geologically eroded gullies within which are complex patterns of smooth benches and escarpments (fig. 12).

Quinlan soils make up about 50 percent of this mapping unit, Rough broken land 30 percent, and included less extensive soils 20 percent.

The Quinlan soils are in the smooth benches that are commonly 50 feet wide and 500 feet long. Slope of these benches ranges from 8 to 15 percent. The Quinlan soils have a surface layer of reddish-brown, calcareous very fine sandy loam about 8 inches thick. The next layer is yellowish-red, calcareous very fine sandy loam about 10 inches thick. The underlying material is red, calcareous, weakly cemented sandstone.

The Rough broken land on the steep escarpments has slopes ranging from 20 to 45 percent. These escarpments are interbedded layers of sandy and silty red beds interbedded with gypsum.

Included in mapping are less extensive areas of Cottonwood soils in narrow bands along benches above escarpments and Woodward soils along the smoother benches. Also included are Yomont soils in narrow bands on flood plains of the drainageways.

All of this mapping unit is in range. The hazard of water erosion is high, and the hazard of soil blowing is slight. Both soils in capability unit VIIs–2; Quinlan in Mixedland range site; Rough broken land in Rough Breaks range site; not placed in a pasture group.

Figure 12.—Area of the Quinlan-Rough broken land complex showing Quinlan soil in smooth areas and Rough broken land on escarpments.

Randall Series

The Randall series consists of deep, nearly level soils on the floors of playa basins. These soils formed under periodically wet conditions in calcareous and alkaline, moderately fine to fine-textured materials.

In a representative profile, the surface layer is dark-gray clay about 25 inches thick. The next layer is gray, calcareous, very firm clay about 23 inches thick. The underlying material, extending to a depth of 62 inches, is white, calcareous silt loam.

Randall soils crack when dry. They are very slowly permeable and somewhat poorly drained. Their available water capacity is high.

Representative profile of Randall clay, in range, 100 feet east of a point on Farm Road 1835. This point is 3 miles north of the Jones-Stonewall County line.

A11—0 to 12 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak, medium and coarse, blocky structure; extremely hard, very firm, very sticky and plastic; shiny pressure faces on peds; neutral; diffuse, wavy boundary.

A12—12 to 25 inches, dark-gray (2.5Y 4/1) clay, very dark gray (2.5Y 3/1) moist; weak, coarse, prismatic structure parting to moderate, coarse, blocky; extremely hard, very firm, very sticky and plastic; pressure faces on peds; calcareous; moderately alkaline; gradual, wavy boundary.

AC—25 to 48 inches, gray (5Y 5/1) clay, dark gray (5Y 4/1) moist; moderate, coarse, blocky structure; wedge-shaped parallelepipeds have long axis tilted 30 degrees from the horizontal; extremely hard, very firm, very sticky and plastic; few, strongly cemented, black iron-manganese concretions; calcareous; moderately alkaline; clear, wavy boundary.

C—48 to 62 inches, white (5Y 8/2) silt loam, light gray (5Y 7/2) moist; massive; slightly hard, friable; calcareous; moderately alkaline.

The A horizon ranges from 12 to 25 inches in thickness and from dark gray to very dark gray in color. Depth to calcareous material ranges from 10 to 20 inches. The AC horizon is 15 to 35 inches thick and gray to dark gray. The C horizon is 40 to more than 60 inches below the surface.

Randall clay (Ra).—This soil is in playas that are rounded or oval in shape. The three areas of Randall clay in the county range from 15 to 90 acres in size. Slopes are less than 0.5 percent.

This soil is used for range. Water collects on it after rains. The hazards of water erosion and soil blowing are slight. Capability unit VIw–1; not placed in a pasture group. Included with surrounding range site.

Rock Outcrop

Rock outcrop consists of nearly barren outcrops of sandstone. These outcrops are on escarpments and in severely eroded areas below the scarps. Slopes are 3 to 40 percent. Runoff on these areas is rapid.

Rock outcrop has no value as cropland and supports such sparse vegetation that it has little value as range. Areas of Rock outcrop are mapped only in a complex with Latom soils.

Rotan Series

The Rotan series consists of deep, nearly level soils on uplands. These soils formed in ancient alluvial outwash.

In a represenative profile, the surface layer is dark grayish-brown clay loam about 8 inches thick. The next layer is firm clay, about 40 inches thick, that is dark grayish brown in the upper part and dark brown in the lower part. Below this is about 22 inches of reddish-yellow clay. The underlying material, extending to a depth of 80 inches, is yellowish-red clay loam.

Rotan soils are moderately slowly permeable and well drained. Runoff is very slow, and available water capacity is high.

Representative profile of Rotan clay loam, 0 to 1 percent slopes, in a cultivated field, 200 feet north of a point on a county road. This point is 4 miles north of Old Glory, by Farm Road 1835, then 0.3 mile east on the county road.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; slightly hard, friable, slightly sticky; mildly alkaline; abrupt, smooth boundary.

B21t—8 to 16 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky and blocky structure; hard, friable, slightly sticky; few thin clay films; mildly alkaline; clear, wavy boundary.

B22t—16 to 26 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate, medium and fine, blocky structure; very hard, firm, sticky; few distinct clay films; calcareous; moderately alkaline; gradual, wavy boundary.

B23t—26 to 36 inches, dark-brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate, fine, blocky structure; very hard, firm, sticky; few distinct clay films; few fine calcium carbonate concretions; calcareous; moderately alkaline; gradual, wavy boundary.

B24t—36 to 48 inches, dark-brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) moist; moderate, fine, subangular blocky structure; hard, friable, slightly sticky; few thin clay films; 3 percent calcium carbonate concretions; calcareous; moderately alkaline; gradual, wavy boundary.

B25tca—48 to 70 inches, reddish-yellow (5YR 7/6) clay, yellowish red (5YR 5/6) moist; moderate, fine, subangular blocky structure; hard, friable, sticky; few thin clay films; 20 percent calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B3—70 to 80 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate, fine, subangular blocky structure; hard, friable, slightly sticky; 5 percent, by volume, soft calcium carbonate concretions; calcareous; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. The A horizon ranges from 6 to 10 inches in thickness and from grayish brown to dark brown in color. The B21t, B22t, and B23t horizons range from 21 to 36 inches in thickness and from dark brown to dark grayish brown in color.

The B24t horizon is 8 to 20 inches thick and dark brown to dark grayish brown. The B25tca and B3 horizons are reddish yellow and yellowish red to pink. Calcium carbonate content of the B25tca is 15 to 45 percent. Secondary carbonates are 8 to 24 inches below the surface. The calcic horizon is 35 to 60 inches below the surface.

Rotan clay loam, 0 to 1 percent slopes (RnA).—This nearly level soil is in broad areas several hundred to a thousand acres in size. Slopes are smooth to weakly concave.

Included with this soil in mapping are areas of Frankirk soils that are higher and more sloping and areas of

Rotan clay loam that have slopes of more than 1 percent but less than 1.5 percent.

Most of this Rotan clay loam, 0 to 1 percent slopes, is cultivated, although a few areas are in range. The hazards of water erosion and soil blowing are slight. Capability unit IIc–3; Deep Hardland range site; pasture group 7C.

Rough Broken Land

Rough broken land (Ro) is a miscellaneous land type in steep areas along escarpments and in broken and gullied areas (fig. 13).

Deeply incised drainageways have cut into these areas, which range from 5 acres to several hundred in size. Slopes range from 20 to 45 percent.

Among mapped areas of this land type are limestone caps that overlie calcareous white sand, sandstone, conglomerate, siltstone, shaly clay, hard gypsum rock, and dolomite. Capability unit VIIs–1; Rough Breaks range site; not placed in a pasture group.

Rowena Series

The Rowena series consists of moderately deep, nearly level soils on uplands. These soils formed in calcareous, old alluvium.

In a representative profile, the surface layer is dark grayish-brown, calcareous clay loam about 8 inches thick. The next layer is dark-brown, calcareous, firm clay about 31 inches thick. The underlying material, extending to a depth of 60 inches, is reddish-yellow, calcareous clay loam.

Rowena soils crack when dry. They are moderately slowly permeable and well drained. Runoff is slow, and available water capacity is high.

Representative profile of Rowena clay loam, 0 to 1 percent slopes, in a cultivated field, which is about 13 miles south of Old Glory on Farm Road 1835, then 1 mile east of Farm Road 1835, and 650 feet north of the Jones-Stonewall County line.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky and granular structure; hard, friable; calcareous; moderately alkaline; abrupt, smooth boundary.

B21—8 to 19 inches, dark-brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate, medium and fine, subangular blocky structure; hard, firm; shiny pressure faces on peds; calcareous; moderately alkaline; gradual, wavy boundary.

B22—19 to 39 inches, dark-brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate, medium and fine, subangular blocky structure; hard, firm; shiny pressure faces on peds; calcareous; moderately alkaline; clear, wavy boundary.

C1ca—39 to 49 inches, reddish-yellow (5YR 7/6) clay loam, reddish yellow (5YR 6/6) moist; massive; hard, friable; 33 percent calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

C2—49 to 60 inches, reddish-yellow (5YR 7/6) clay loam, reddish yellow (5YR 6/6) moist; massive; hard, friable; 17 percent calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 6 to 10 inches in thickness and from very dark grayish brown to brown in color. The B2 horizon ranges from 20 to 34 inches in thickness and from very dark grayish brown to reddish brown in color.

The solum, or depth to the C1ca horizon, is 30 to 40 inches. The C horizon is reddish yellow to light brown. The C1ca horizon is 15 to 40 percent calcium carbonate and has 5 percent more calcium carbonate than the C2 horizon.

Figure 13.—**Double Mountain in Stonewall County. Material on mountains such as this is mapped as Rough broken land.**

Rowena clay loam, 0 to 1 percent slopes (RwA).—This nearly level soil is within areas that are commonly several hundred acres in size. Slopes are dominantly less than 0.5 percent.

Almost all of this Rowena clay loam is cultivated, although a few areas are in range. The hazards of water erosion and soil blowing are slight. Capability unit IIc–3; Deep Hardland range site; pasture group 7C.

Spade Series

The Spade series consists of moderately deep, gently sloping soils on uplands. These soils formed in material weathered from calcareous sandstone and conglomerate.

In a representative profile, the surface layer is reddish-brown, calcareous fine sandy loam about 5 inches thick. The next layer is reddish-brown, calcareous fine sandy loam about 17 inches thick. Below this is yellowish-red, calcareous, friable loam about 8 inches thick. This layer is about 25 percent calcium carbonate. Calcareous, weakly cemented sandstone and conglomerate are at a depth of about 30 inches.

Spade soils are moderately rapidly permeable and well drained. Runoff is medium, and available water capacity is low. In Stonewall County, these soils are mapped only in an undifferentiated group with Cosh soils.

Representative profile of Spade fine sandy loam, in an area of Cosh and Spade soils, 3 to 5 percent slopes, in a cultivated field, 100 feet north of a point on a county road that is 4 miles north of Old Glory, by Farm Road 1835, and 1.4 miles east on the county road.

Ap—0 to 5 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

B21—5 to 22 inches, reddish-brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B22ca—22 to 30 inches, yellowish-red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak, fine, granular structure; hard, friable; 25 percent calcium carbonate concretions; calcareous; moderately alkaline; abrupt, irregular boundary.

R—30 to 40 inches, red (2.5YR 5/6), weakly cemented sandstone and conglomerate, red (2.5YR 4/6) moist; calcareous; moderately alkaline.

The A horizon ranges from 4 to 10 inches in thickness and from reddish brown to brown in color. The B21 horizon ranges from 12 to 20 inches in thickness and from reddish brown to light reddish brown in color. The B22ca horizon is 5 to 30 percent visible calcium carbonate and 2 to 8 inches thick. Sandstone is 20 to 40 inches below the surface.

Springer Series

The Springer series consists of deep, nearly level, gently sloping, and gently undulating soils on uplands. These soils formed in wind-deposited materials.

In a representative profile, the surface layer is yellowish-brown, neutral loamy fine sand about 18 inches thick. The next layer is very friable fine sandy loam about 42 inches thick. It is reddish brown in the upper part and reddish yellow in the lower part. The next lower layer is about 15 inches of reddish-brown fine sandy loam. Below this, and extending to a depth of about 90 inches, is yellowish-red fine sandy loam.

Springer soils are moderately rapidly permeable and well drained. Runoff is slow, and available water capacity is low.

Representative profile of Springer loamy fine sand, 0 to 3 percent slopes, 100 feet east of a point on a county road that is 5.3 miles west of Swenson, Tex., by U.S. Highway 380, then 2 miles north on the county road.

A1—0 to 18 inches, yellowish-brown (10YR 5/4) loamy fine sand, dark brown (10YR 3/3) moist; single grain; loose; many roots; neutral; clear, smooth boundary.

B2t—18 to 38 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak, fine, granular structure; slightly hard, very friable; common roots; few thin clay films; neutral; clear, smooth boundary.

B3—38 to 60 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak, fine, granular structure; soft, very friable; common roots; mildly alkaline; gradual, smooth boundary.

B'2t—60 to 75 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak, fine, granular structure; slightly hard, very friable; few thin clay films; mildly alkaline; gradual, smooth boundary.

B'3—75 to 90 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak, fine, granular structure; slightly hard, very friable; few thin clay films; mildly alkaline.

The solum ranges from 60 to more than 80 inches in thickness. The A horizon ranges from 12 to 20 inches in thickness and from reddish brown to yellowish brown in color. The B2t horizon ranges from 12 to 20 inches in thickness and from reddish brown to red in color. The B3 horizon is 12 to 24 inches thick and yellowish red to reddish yellow. The B'2t horizon is 6 to 20 inches thick and red to reddish brown. The B'3 horizon is yellowish red to red.

Springer loamy fine sand, 0 to 3 percent slopes (SgB).—This nearly level, gently sloping and gently undulating soil is on smooth areas. Slopes are commonly 2 percent.

Included with this soil in mapping are areas of Miles loamy fine sand in lower positions and areas of the Nobscot association in higher and more sloping positions. Small areas of Springer loamy fine sand that have slopes of more than 3 percent also are included.

A few areas of this Springer loamy fine sand, 0 to 3 percent slopes, are cultivated, but most are in range. Many areas that were once cultivated are now in native grasses. A few cultivated fields have dunes 3 to 5 feet high along their boundaries. These soils are subject to a high hazard of soil blowing and a slight hazard of water erosion. Capability unit IVe–6; Sandyland range site; pasture group 9A.

St. Paul Series

The St. Paul series consists of deep, nearly level soils on uplands. These soils formed in calcareous alluvial materials.

In a representative profile, the surface layer is brown silt loam about 8 inches thick. Beneath this is a layer of firm clay loam, about 28 inches thick, that is dark brown in the upper part and brown in the lower part. The next lower layer is friable, very pale brown clay loam about 6

inches thick. The underlying material, extending to a depth of 80 inches, is clay loam that is mottled red in the upper part and yellowish red in the lower part.

St. Paul soils are moderately slowly permeable and well drained. Runoff is slow, and available water capacity is high.

Representative profile of St. Paul silt loam, 0 to 1 percent slopes, 14.6 miles southwest of Aspermont, by Farm Road 610, then 1 mile west on a county road, 0.4 mile north on a private road, and 100 feet east of the road.

A1—0 to 8 inches, brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; moderate, medium, granular structure; slightly hard, friable; many roots; mildly alkaline; clear, smooth boundary.

B21t—8 to 24 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate, medium, blocky structure; very hard, firm, slightly sticky; many roots; few thin clay films; mildly alkaline; gradual, smooth boundary.

B22t—24 to 36 inches, brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; moderate, medium, blocky structure; very hard, firm, slightly sticky; common roots; thin continuous clay films; generally noncalcareous but contains calcareous spots; mildly alkaline; gradual, smooth boundary.

B3—36 to 42 inches, very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; moderate, medium and fine, subangular blocky structure; hard, friable; common roots; calcareous; moderately alkaline; diffuse, smooth boundary.

C1ca—42 to 60 inches, mottled red (2.5YR 4/6) and pinkish-gray (5YR 7/2) clay loam; 5 percent calcium carbonate concretions; calcareous; moderately alkaline; diffuse, smooth boundary.

C2—60 to 80 inches, yellowish-red (5YR 5/6) and gray clay loam; calcareous; moderately alkaline.

The solum ranges from 40 to 56 inches in thickness. The A horizon ranges from 7 to 14 inches in thickness and from brown to dark brown in color. The B21t horizon ranges from 10 to 20 inches in thickness and from brown to dark brown in color. The B22t horizon is 8 to 20 inches thick and brown to reddish brown. The B3 horizon is 6 to 15 inches thick and yellowish red to very pale brown. The C horizon is red to yellowish red.

St. Paul silt loam, 0 to 1 percent slopes (SpA).—This soil is in broad upland areas that are mostly flat to slightly concave. Slopes commonly are 0.5 percent. Most areas are several hundred acres in size.

Included with this soil in mapping are small areas of Acme and Cottonwood soils along drains. Also included are areas of Paducah soils on low, convex ridges.

Much of this St. Paul silt loam is in range. About 40 percent is cultivated. The hazards of soil blowing and water erosion are slight. Capability unit IIe–2; Deep Hardland range site; pasture group 8C.

Talpa Series

The Talpa series consists of very shallow to shallow, gently sloping soils on uplands. These soils are underlain by limestone that is coated with calcium carbonate on the upper side and in the partings.

In a representative profile, the surface layer is 8 inches of grayish-brown, calcareous clay loam containing 10 percent limestone fragments. This is underlain by hard limestone.

Talpa soils are moderately permeable and well drained. Runoff is rapid, and available water capacity is low.

Representative profile of Talpa clay loam, in an area of Talpa-Yates complex, 4.5 miles north on Farm Road 1263 from its intersection with U.S. Highway 83 in Aspermont, then 1 mile east on a county road, 0.7 mile east and 1.4 miles southeast on a private road, and 450 feet south in range.

A1—0 to 8 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky and granular structure; slightly hard, friable, slightly sticky; 10 percent, by volume, fine hard limestone fragments; calcareous; moderately alkaline; abrupt, irregular boundary.

R—8 to 10 inches, hard limestone; coating of reprecipitated calcium carbonate 1 inch thick on the upper surface.

The A horizon ranges from 5 to 14 inches in thickness and from grayish brown to dark grayish brown in color. The content of limestone fragments ranges from 5 to 20 percent and increases with depth.

Talpa-Yates complex (Tq).—This mapping unit is made up of gently sloping soils in areas several thousand acres in size. The soils in this mapping unit are so closely associated and occur in such an intermingled pattern that it is not practical to map them separately at the scale used.

This mapping unit is made up of 59 percent Talpa, 15 percent Yates, and 26 percent included soils that are mostly similar to Talpa and Yates soils in their behavior. The Talpa soils are on ridges and have convex slopes of 1.5 to 5 percent. The Yates soils are less sloping than the Talpa.

Included in this mapping unit are areas of Hensley loam, moderately deep variant, and Tillman soils, which are lower and nearly level. A few areas of Cottonwood, Owens, and Vernon soils also are included.

Because of the shallowness of the major soils, and the size and shape of the included minor soils, this mapping unit is in range, the use for which it seems most suitable. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Capability unit VIIs–1; Very Shallow range site; not placed in a pasture group.

Tillman Series

The Tillman series consists of deep, nearly level to gently sloping soils on uplands. These soils formed in shaly clay materials of Permian age.

In a representative profile, the surface layer is reddish-brown, calcareous clay loam about 7 inches thick. The next layer is calcareous clay, about 39 inches thick, that is reddish brown in the upper part and red in the lower part. Below this is about 19 inches of weak-red and gray clay. The underlying material, extending to a depth of 90 inches, is weak-red and gray, compact shaly clay.

Tillman soils are slowly permeable and well drained. Runoff is slow to medium, and available water capacity is high.

Representative profile of Tillman clay loam, 1 to 3 percent slopes, in a cultivated field, 100 feet east of a point on a county road 0.2 mile south of U.S. Highway 380, and 2.25 miles east on U.S. Highway 380 from its intersection with U.S. Highway 83 in Aspermont.

Ap—0 to 7 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate, medium,

granular structure; very hard, friable; calcareous; moderately alkaline; abrupt, smooth boundary.

B1t—7 to 13 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate, medium, subangular blocky structure; hard, firm; few thin clay films; calcareous; moderately alkaline; clear, smooth boundary.

B21t—13 to 20 inches, reddish-brown (5YR 4/3) clay, dark reddish-brown (5YR 3/4) moist; moderate, medium, blocky structure; extremely hard, very firm; distinct clay films; calcareous; moderately alkaline; gradual, smooth boundary.

B22t—20 to 30 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate, medium, blocky structure; extremely hard, very firm; distinct clay films; calcareous; moderately alkaline; gradual, smooth boundary.

B23t—30 to 36 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate, medium, subangular blocky structure; very hard, firm; thin clay films; calcareous; moderately alkaline; diffuse, wavy boundary.

B24tca—36 to 46 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate, medium, subangular blocky structure; very hard, firm; thin clay films; 5 percent calcium carbonate concretions; calcareous; moderately alkaline; diffuse, wavy boundary.

B3—46 to 65 inches, weak-red (10YR 4/4) and gray (5Y 6/1) clay, dark red (10YR 3/6) and gray (5Y 5/1) moist; moderate, medium, subangular blocky structure; very hard, firm; 25 percent flakes and particles of compact clayey red beds; calcareous; moderately alkaline; diffuse, wavy boundary.

C—65 to 90 inches, weak-red (10R 4/4) and gray (5Y 6/1) shaly clay, dark red (10R 3/6) and gray (5Y 5/1) moist; blocky structure but compact; extremely hard, very firm; noncalcareous.

The solum ranges from 60 to more than 80 inches in thickness. The A horizon ranges from 5 to 11 inches in thickness, from reddish brown to brown in color, and from mildly to moderately alkaline in reaction.

The B21t, B22t, and B23t horizons range from 20 to 30 inches in thickness. The B24tca horizon is 8 to 15 inches thick, is red to yellowish red, and is 1 to 10 percent calcium carbonate. The B3 horizon is 10 to 20 inches thick.

Tillman clay loam, 0 to 1 percent slopes (TcA).—This nearly level soil has slightly convex slopes that are commonly 0.5 percent. Areas are several hundred to more than one thousand acres in size.

The surface layer is brown, calcareous clay loam about 8 inches thick. Beneath this is a layer of calcareous clay, about 50 inches thick, that is reddish brown in the upper part and red in the lower part. The underlying material, extending to a depth of 90 inches, is weak-red clay in the upper part and shaly clay in the lower part.

Included with this soil in mapping are areas of Hollister soils that have concave surfaces and areas of Tillman clay loam that have slopes of more than 1 percent.

About 50 percent of this Tillman clay loam, 0 to 1 percent slopes, is cultivated, and 50 percent is in range. The hazards of water erosion and soil blowing are slight. Runoff is slow. Capability unit IIs–1; Deep Hardland range site; pasture group 7A.

Tillman clay loam, 1 to 3 percent slopes (TcB).—This gently sloping soil is in areas 50 to several thousand acres in size. Slopes are convex and commonly 2 percent.

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

Included with this soil in mapping are small areas of Vernon and Aspermont soils that have more convex slopes.

About 40 percent of this Tillman clay loam is cultivated, and the rest is in range. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Runoff is medium. Capability unit IIIe–1; Deep Hardland range site; pasture group 7A.

Tipton Series

The Tipton series consists of deep, nearly level soils on uplands. These soils formed in calcareous, old alluvial materials.

In a representative profile, the surface layer is dark-brown, neutral loam about 9 inches thick. Beneath this is a layer of friable, noncalcareous clay loam, about 29 inches thick, that is dark brown in the upper part and reddish brown in the lower part. The next layer, about 26 inches thick, is yellowish-red clay loam. The underlying material, extending to a depth of 90 inches, is reddish-yellow loam.

Tipton soils are moderately permeable and well drained. Runoff is slow, and the available water capacity is high.

Representative profile of Tipton loam, 0 to 1 percent slopes, 18.4 miles southwest of Aspermont, on Farm Road 610, and 100 feet south of the road in a cultivated field.

Ap—0 to 9 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak, fine, granular structure; slightly hard, friable; neutral; abrupt, smooth boundary.

B1t—9 to 15 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate, medium, subangular blocky and granular structure; hard, friable, slightly sticky; few thin clay films; neutral; clear, smooth boundary.

B2t—15 to 38 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; weak, coarse, prismatic and moderate, medium, subangular blocky structure; hard, friable, slightly sticky; thin clay films; mildly alkaline; gradual, smooth boundary.

B3—38 to 64 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak, fine, granular structure; hard, friable, slightly sticky; calcareous; moderately alkaline; gradual, smooth boundary.

Cca—64 to 90 inches, reddish-yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; calcareous; moderately alkaline.

The solum ranges from 44 to more than 72 inches in thickness. The A horizon ranges from 9 to 15 inches in thickness and from brown to dark brown in color.

The B1t horizon ranges from 4 to 10 inches in thickness and from brown to dark brown in color. The B2t horizon is 14 to 28 inches thick and brown to reddish brown. The B3 horizon is 20 to 30 inches thick and yellowish red to reddish brown. The Cca horizon is pinkish gray to reddish yellow.

Tipton loam, 0 to 1 percent slopes (TpA).—This soil is on broad, smooth terraces along rivers. Soil areas are flat to slightly concave, and slopes are dominantly 0 to 0.5 percent.

Included with this soil in mapping is a soil similar to Tipton, except that it is calcareous to the surface. Other inclusions are areas of Miles and Enterprise soils on low, convex ridges.

This Tipton loam is mainly cultivated, although a few areas are in native range. The hazards of soil blowing and water erosion are slight. Capability unit IIc–1; Mixedland range site; pasture group 8C.

Treadway Series

The Treadway series consists of shallow and moderately deep, nearly level and gently sloping soils on uplands. These soils formed on alluvial fans below outcrops of Permian red beds in calcareous, clayey alluvium.

In a representative profile, the surface layer is reddish-brown, calcareous, firm silty clay loam about 6 inches thick. The next layer is reddish-brown, calcareous, very firm clay about 18 inches thick. The underlying material, extending to a depth of 70 inches, is reddish-brown calcareous clay.

Treadway soils crack when dry. They are very slowly permeable and well drained. Runoff is very rapid, and their available water capacity is high.

Representative profile of Treadway silty clay loam, in an area of Treadway soils, in range, 100 feet north of a point on Farm Road 2211 that is 0.9 mile west of Aspermont.

A1—0 to 6 inches, reddish-brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; platy surface 2 inches thick; moderate, medium and fine, blocky structure; hard, firm, slightly sticky and plastic; common roots; calcareous; moderately alkaline; gradual, smooth boundary.

B2—6 to 24 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; massive to weak, coarse, blocky structure; very hard, very firm, sticky; few roots; partly weathered clayey and silty red bed; common lime films and threads; silt films between peds; calcareous; gradual, smooth boundary.

C—24 to 70 inches, reddish-brown (2.5 4/4) clay, dark reddish brown (2.5YR 3/4) moist; massive; very hard, very firm, slightly sticky and plastic; partly weathered red-bed clay; calcareous; moderately alkaline.

The solum ranges from 15 to 36 inches in thickness. The A1 horizon ranges from 5 to 7 inches in thickness and from clay loam to silty clay in texture. The B2 horizon ranges from 5 to 28 inches in thickness and from weak red to brown in color. The C horizon is red to reddish brown.

Treadway soils (Tr).—These nearly level and gently sloping soils are on alluvial fans below outcrops of Permian red beds. Slopes are commonly about 1 percent, but they range from 0 to 2 percent.

Included with these soils in mapping are areas of Badland and Tillman and Mangum soils. The Badlands are severely eroded. Mangum soils are on the flood plains of drainageways, and Tillman soils are on lower, nearly level areas.

These Treadway soils are in range. The hazard of water erosion is high, and the hazard of soil blowing is slight. Capability unit VIs–1; Clay Flat range site; not placed in a pasture group.

Vernon Series

The Vernon series consists of moderately deep, gently sloping soils on uplands. These soils formed in shaly clays of Permian age.

In a representative profile, the surface layer is reddish-brown, calcareous clay loam about 7 inches thick. The next layer is reddish-brown, calcareous, firm clay about 13 inches thick. Beneath this is 10 inches of red, calcareous, firm clay. The underlying material, extending to a depth of 48 inches, is red shaly clay.

Vernon soils are very slowly permeable and well drained. Runoff is rapid, and available water capacity is high.

Representative profile of Vernon clay loam, 1 to 3 percent slopes, in range, 100 feet north of a point on a county road. This point is 0.5 mile west of U.S. Highway 83 and 2.5 miles south of Aspermont.

A1—0 to 7 inches, reddish-brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate, fine, subangular blocky structure; hard, friable, slightly sticky and plastic; many roots; many very fine pores; few worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B2—7 to 20 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; weak, blocky and moderate, medium, subangular blocky structure; hard, firm, slightly sticky and plastic; common roots; few films and threads of calcium carbonate on ped surfaces; few worm casts; common very fine pores; few, hard, calcium carbonate concretions in lower part; calcareous; moderately alkaline; clear, smooth boundary.

B3ca—20 to 30 inches, red (2.5YR 4/6) clay, dark reddish brown (2.5YR 3/4) moist; weak, subangular blocky structure; hard, firm, sticky and plastic; few roots; few hard calcium carbonate concretions; calcareous; moderately alkaline; diffuse, smooth boundary.

C—30 to 48 inches, red (10R 5/6) shaly clay, dark red (10R 3/6) moist; red-bed clays and shales; few, very fine, hard calcium carbonate concretions in vertical crevices in upper part; generally noncalcareous but calcareous in cracks and crevices.

The solum ranges from 20 to 36 inches in thickness. The A1 horizon ranges from 5 to 10 inches in thickness and from reddish brown to brown in color. The B horizon is 10 to 24 inches thick and red to yellowish red. It is from 0 to 5 percent calcium carbonate concretions.

Vernon clay loam, 1 to 3 percent slopes (VeB).—This soil is on low ridges. Slopes are weakly convex and commonly 2 percent.

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

Included with this soil in mapping are areas of Aspermont, Owens, and Tillman soils. Some spots are underlain with limestone. The areas of Tillman soil are lower and less sloping, and those of the Owens soil are higher and more sloping.

This Vernon clay loam is mainly used for range, but a few areas are cultivated. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Capability unit IVe–5; Shallow Redland range site; pasture group 7A.

Vernon clay loam, 3 to 5 percent slopes (VeC).—This soil is on ridges and side slopes. Slopes are convex and commonly 3.5 percent.

The surface layer is reddish-brown, calcareous clay loam about 6 inches thick. The next layer is reddish-brown, calcareous clay about 20 inches thick. The underlying material, extending to a depth of 45 inches, is red shaly clay.

Included with this soil in mapping are areas of Aspermont, Owens, and Tillman soils. Also included are small areas that are underlain by limestone. The included areas of Owens soils are higher and more sloping, and those of the Tillman soils are lower and less sloping.

This Vernon clay loam is best suited to range. It is subject to a severe hazard of water erosion and a slight

hazard of soil blowing. Capability unit IVe–7; Shallow Redland range site; pasture group 7A.

Woodward Series

The Woodward series is made up of moderately deep and deep, sloping, strongly sloping, and rolling soils on uplands. These soils formed in material weathered from weakly cemented sandstone.

In a representative profile, the surface layer is reddish-brown, calcareous very fine sandy loam about 9 inches thick. The next layer is calcareous, friable very fine sandy loam, about 25 inches thick, that is reddish brown in the upper part and red in the lower part. The lower part is about 5 percent calcium carbonate concretions. Calcareous, weakly cemented sandstone is at a depth of about 34 inches.

Woodward soils are moderately permeable and well drained. Runoff is medium, and available water capacity is moderate.

Representative profile of Woodward very fine sandy loam, in an area of the Woodward-Quinlan complex, rolling, in range, 14.6 miles southwest of the intersection of Farm Roads 610 and 2211 in Aspermont, then 2.7 miles west on county road and 0.8 mile west on private road, and 300 feet south of road.

A1—0 to 9 inches, reddish-brown (5YR 4/4) very fine sandy loam, dark reddish brown (5YR 3/4) moist; weak, fine, granular structure; slightly hard, very friable; many roots; calcareous; moderately alkaline; gradual, smooth boundary.

B2—9 to 24 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak, fine, granular structure; slightly hard, friable; many roots; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—24 to 34 inches, red (2.5YR 5/6) very fine sandy loam, red (2.5YR 4/6) moist; weak, fine, granular structure; slightly hard, friable; common roots; 5 percent calcium carbonate concretions; calcareous; moderately alkaline; gradual, wavy boundary.

C—34 to 50 inches, red (2.5YR 5/6) weakly cemented sandstone and silty red-bed materials, red (2.5YR 4/6) moist; calcareous; moderately alkaline.

The solum ranges from 20 to 48 inches in thickness. The A1 horizon ranges from 7 to 12 inches in thickness. The B2 horizon is 7 to 30 inches thick and reddish brown to light red. The B3ca horizon is 8 to 10 inches thick and light red to reddish brown.

Woodward-Quinlan complex, rolling (WoD).—This mapping unit is made up of sloping, strongly sloping, and rolling soils on convex ridges. Soil areas are 30 to 4,000 acres in size. Slopes range from 5 to 12 percent.

Woodward soils cover 50 percent of this unit, Quinlan soils 42 percent, and other included soils 8 percent.

The Woodward soils have slopes of less than 9 percent. They have the profile described as representative for the Woodward series. The Quinlan soils have slopes of more than 9 percent. They have the profile described as representative for the Quinlan series.

Included in some areas of this mapping unit are Cottonwood, Obaro, and Paducah soils. The Cottonwood soils are in higher areas, and the Obaro and Paducah soils are lower and less sloping.

Almost all of this mapping unit is used for range. Some areas that were once cultivated have been returned to rangeland. These areas have gullies 1 to 3 feet deep, and from 3 to 4 inches of the surface layer has been removed. The hazard of soil blowing is slight, and the hazard of water erosion is high. Capability unit VIe–3; Mixedland range site; not placed in a pasture group.

Yates Series

The Yates series consists of very shallow, gently sloping soils on uplands. These soils formed in material weathered from limestone.

In a representative profile, the surface layer is reddish-brown, noncalcareous clay loam, about 6 inches thick, that is 45 percent limestone fragments. The underlying material is hard limestone.

Yates soils are moderately permeable and well drained. Runoff is medium, and the available water capacity is low. In Stonewall County, Yates soils are mapped only in a complex with the Talpa soils.

Representative profile of Yates clay loam, in an area of the Talpa-Yates complex, 4.5 miles north of the intersection of Farm Road 1263 and U.S. Highway 83 in Aspermont, then 1 mile east on county road, 2.3 miles east and southeast on private road, and 400 feet south in range.

A1—0 to 6 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist, chroma of 4 when crushed; moderate, fine, subangular blocky structure; slightly hard, friable; 45 percent limestone fragments; mildly alkaline; abrupt, irregular boundary.

R—6 to 10 inches, hard limestone that has coatings of reprecipitated calcium carbonate.

The A horizon ranges from 4 to 10 inches in thickness. It is 35 to 50 percent limestone fragments that are as much as 20 inches across the long axis.

Yomont Series

The Yomont series consists of deep, nearly level and gently sloping soils that formed in recent deposits of alluvium.

In a representative profile, the surface layer is reddish-brown, calcareous very fine sandy loam about 9 inches thick. The underlying material, extending to a depth of 60 inches, is light reddish-brown, calcareous very fine sandy loam.

Yomont soils are moderately rapidly permeable and well drained. Runoff is slow, and available water capacity is high.

Representative profile of Yomont very fine sandy loam, in a cultivated field, 300 feet southwest of the south end of the bridge over Double Mountain Fork of the Brazos River on Texas Highway 6. This bridge is 4.6 miles southeast of the intersection of Texas Highway 6 and U.S. Highway 380.

Ap—0 to 9 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak, fine and medium, granular structure; slightly hard, very friable; calcareous and moderately alkaline; abrupt, smooth boundary.

C—9 to 60 inches, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 5/4) moist; structureless; slightly hard, very friable; bedding planes

evident; thin strata of loamy very fine sand and silt loam, and occasional silty clay loam strata less than 0.5 inch thick; calcareous; moderately alkaline.

The A horizon ranges from 7 to 12 inches in thickness and from reddish brown to light reddish brown in color. The C horizon ranges from light reddish brown to yellowish red in color and is very fine sandy loam with thin bedding planes of loamy very fine sand, silty clay loam, and silt loam.

Yomont very fine sandy loam (Ym).—This nearly level soil is on alluvial flats along the major streams of the county. Slopes range from 0 to 1 percent. This soil floods once in 5 years.

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

Included with this soil in mapping are areas of Clairemont and Lincoln soils.

Most of this Yomont very fine sandy loam is cultivated, but a few areas are in range. The hazards of soil blowing and water erosion are slight. Capability unit IIe–3; Bottomland range site; pasture group 2A.

Yomont very fine sandy loam, frequently flooded (Yn).—This nearly level soil is on flood plains and is flooded annually. Slopes range from 0 to 1 percent.

The surface layer is reddish-brown, calcareous very fine sandy loam about 8 inches thick. The next layer, extending to a depth of 60 inches, is very fine sandy loam that is stratified with thin layers of silty clay loam.

Included with this soil in mapping are areas of Obaro, Paducah, Quinlan, and Woodward soils on uplands.

Because of the flood hazard, this Yomont very fine sandy loam is best suited to range. The hazards of soil blowing and water erosion are slight. Capability unit Vw–1; Bottomland range site; pasture group 2A.

Yomont-Quinlan complex (Yo).—This mapping unit is made up of U-shaped gullies (fig. 14). In a representative area, the Yomont soils cover 55 percent of this complex, Quinlan soils about 30 percent, and Rough broken land 15 percent. Yomont soils occupy the lower parts of the landscape and have slopes of 0 to 2 percent. The Quinlan soils are on the sides of the gullies. Slopes range from 10 to 15 percent, and a few vertical breaks occur.

The Yomont soils have a surface layer of light reddish-brown fine sandy loam about 7 inches thick. The next layer is reddish-brown, calcareous, stratified very fine sandy loam and silt loam that extend to a depth of 60 inches.

The Quinlan soils have a surface layer of red, calcareous very fine sandy loam about 8 inches thick. The next layer is red, calcareous very fine sandy loam about 10 inches thick. This layer has few films and threads of calcium carbonate. The underlying material is red, calcareous, weakly cemented packsand.

Included in this mapping unit are areas of Obaro, Paducah, and Woodward soils in areas higher than the Quinlan soils.

This mapping unit is too steep and too frequently flooded for cultivation. It is used mainly for range. The

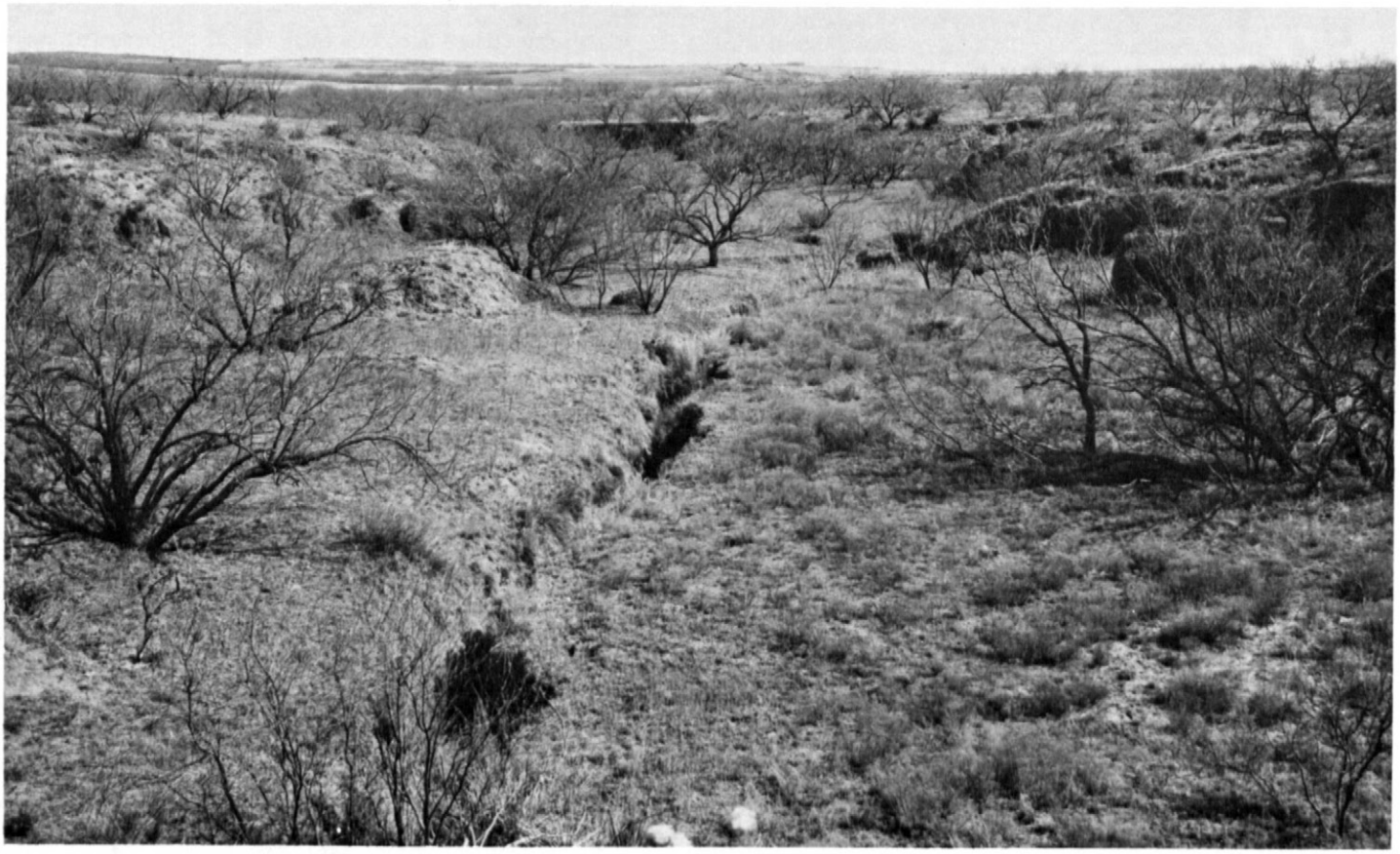

Figure 14.—Area of Yomont-Quinlan complex.

soils in this unit are subject to a slight hazard of soil blowing and a slight to high hazard of water erosion. The Yomont soils flood about twice a year. Capability unit Vw–1; Mixedland range site; not placed in a pasture group.

Use and Management of the Soils

This section concerns the use and management of the soils of the county for cropland, pasture, range, wildlife, engineering purposes, and recreation.

The general conservation management principles for soils by capability units are discussed first in this section. The system of land capability classification used by the Soil Conservation Service is briefly described. A description of high level conservation management of cropland is given. Yield predictions for major crops are provided in table 2, p. 43.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The grouping is 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. This grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not consider 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 or engineering.

In the capability system, all kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. (No Class I soils in Stonewall County.)

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (No Class VIII soils in Stonewall County.)

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 IIIe–4 or IIIe–6. 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 paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units are described and suggestions for the use and management of the soils are given.

The capability unit designations for all the soils in the county can be found in the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT IIe–1

This unit consists of deep, gently sloping soils on uplands. These soils are loamy and slowly to moderately rapidly permeable. Their available water capacity is high, and runoff is slow and medium.

The main crops are cotton, wheat, and grain sorghum. Control of water erosion and maintenance of tilth are necessary to keep these soils productive.

A cropping system that includes small grain, grain sorghum, or other crops that leave large amounts of residue is well suited to this soil. Crop residue kept on the

surface helps to maintain tilth and to control soil blowing. Terraces and contour farming help to control water erosion. Diversion terraces and grassed waterways are needed in some places for protection against runoff from higher lying areas.

CAPABILITY UNIT IIe-2

This unit is made up of deep, nearly level, loamy soils. These soils are moderately rapidly to moderately slowly permeable. Their available water capacity is high, and runoff is slow.

Cotton, wheat, and sorghum are the main crops grown. Maintaining tilth and controlling soil blowing are important to sustained production on these soils.

A cropping system that includes wheat, sorghum, or other crops that produce large amounts of residue is needed. Crop residues kept on the surface help maintain tilth and control soil blowing. Diversion terraces or grassed waterways are needed in some places to protect the soils against runoff from adjacent areas.

CAPABILITY UNIT IIe-3

This unit consists of deep, nearly level soils on the flood plains of major streams of the county. These loamy soils are moderately to moderately rapidly permeable. Their available water capacity is high, and runoff is slow.

Cotton and grain sorghum are the main crops grown, along with small areas of wheat. Controlling soil blowing and maintaining tilth are important for sustained yields on these soils.

A suitable cropping system is one that includes grain sorghum or other crops that produce a large amount of residue. Crop residue kept on or near the surface helps to control soil blowing and to maintain good tilth. In some areas diversion terraces are needed to protect the soils against runoff from higher areas.

CAPABILITY UNIT IIe-4

This unit consists of deep, gently sloping soils on uplands. These loamy soils are moderately permeable. Their available water capacity is high, and runoff is slow.

Cotton, wheat, and grain sorghum are the main crops grown. The control of water erosion and the maintenance of tilth are important to sustained yields.

A cropping system that includes wheat, grain sorghum, or other crops that yield a large amount of residue is well suited to these soils. Crop residue kept on the surface helps to control erosion and to maintain tilth. Terraces and contour farming help to control erosion. Diversion terraces and grassed waterways are needed in some areas to protect the soil against runoff from adjacent areas.

CAPABILITY UNIT IIe-5

Altus fine sandy loam, 0 to 1 percent slopes, is the only soil in this unit. This soil is moderately permeable, and the available water capacity is high. Runoff is slow.

Cotton, wheat, and sorghum are the main crops grown. Maintaining tilth and controlling soil blowing are important to the sustained productivity of this soil.

A cropping system that includes wheat, sorghum, or other crops that produce large amounts of crop residue is well suited to this soil. Crop residue kept on the surface helps maintain tilth and control soil blowing. In some areas diversion terraces and grassed waterways are needed to control water from adjacent areas.

CAPABILITY UNIT IIs-1

Tillman clay loam, 0 to 1 percent slopes, is the only soil in this unit. This soil is slowly permeable. The available water capacity is high, and runoff is slow.

Wheat is the main crop, and cotton and grain sorghum also are grown. Maintaining good tilth and conserving moisture help keep this soil productive. When dry this soil produces cracks that take in water rapidly; when wet the cracks close, and water moves through the soil slowly.

A suitable cropping system is one that includes wheat, grain sorghum, or other crops that produce a large amount of crop residue. This residue kept on the surface helps to maintain good tilth (fig. 15). Terraces help conserve moisture. In some areas, diversion terraces and grassed waterways are needed to protect this soil against runoff from adjacent areas.

CAPABILITY UNIT IIc-1

This unit consists of deep soils that are nearly level. These soils are moderately to moderately slowly permeable, and they have a high available water capability. Runoff is slow.

Cotton, wheat, and grain sorghum are the main crops grown. Maintenance of tilth and control of soil blowing are important considerations where these soils are cultivated.

A suitable cropping system includes wheat, grain sorghum, or other crops that produce a large amount of residue. The residue adds organic matter to the soils and helps maintain good tilth and control soil blowing. In some places, diversion terraces are needed to protect these soils against runoff from higher lying areas.

CAPABILITY UNIT IIc-2

Hollister silty clay loam, 0 to 1 percent slopes is the only soil in this capability unit. This soil is deep and has slow permeability and runoff. The available water capacity is high.

Cotton, grain sorghum, and wheat are the main crops grown. Maintaining good tilth and controlling soil blowing are important to sustained productivity on this soil.

A suitable cropping system includes grain sorghum or other crops that produce large amounts of crop residue. Crop residue left on the surface of the soil helps maintain tilth and control soil blowing. Diversion terraces are needed in some areas to protect against runoff.

CAPABILITY UNIT IIc-3

This unit consists of moderately deep and deep, nearly level soils on uplands. These soils are loamy and are slowly to moderately permeable. Their available water capacity is high, and runoff is slow and very slow.

Cotton, grain sorghum, and wheat are the main crops grown. Controlling soil blowing and maintaining tilth are important in keeping these soils productive.

A cropping system that includes grain sorghum, wheat, or other crops that produce a large amount of residue is needed. Crop residue kept on the surface helps to control soil blowing, adds to the organic matter in the soil, and

Figure 15.—**Wheat residue left on the surface of Tillman clay loam, 0 to 1 percent slopes.**

helps to maintain good tilth. In some areas diversion terraces and grassed waterways are needed to protect the soil against runoff from adjacent higher areas.

CAPABILITY UNIT IIIe–1

Tillman clay loam, 1 to 3 percent slopes, is the only soil in this unit. This soil is slowly permeable. The available water capacity is high, and runoff is slow.

The main crops grown are wheat, cotton, and grain sorghum. Controlling water erosion and maintaining tilth are important for sustained yields on this soil. When dry, this soil cracks; then water enters the dry soil rapidly through the cracks. As soon as the soil is wet, the cracks close, and movement of water into the soil is slow.

A cropping system that includes wheat, grain sorghum, or other crops that produce a large amount of residue is needed. Residue kept on the surface helps to control water erosion and to maintain tilth. Terraces also help to control water erosion. Diversion terraces and grassed waterways are needed in some areas to protect the soil against runoff from adjacent higher areas.

CAPABILITY UNIT IIIe–2

Obaro very fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. This soil is moderately permeable, and the available water capacity is moderate. Runoff is medium.

Cotton, wheat, and sorghum are the main crops grown. Maintaining tilth and controlling soil blowing are important to the sustained productivity of this soil.

A cropping system that includes small grain, sorghum, or other crops that produce large amounts of residue is well suited to this soil. Crop residues kept on the surface help to maintain tilth and to control soil blowing. Terraces and contour tillage help to control water erosion and reduce runoff. Diversion terraces and grassed waterways are needed in some places for protection against runoff from other areas.

CAPABILITY UNIT IIIe–3

This unit consists of deep, gently sloping soils on uplands. These loamy soils are moderately to moderately rapidly permeable. Their available water capacity is high, and runoff is medium.

The main crops are cotton and grain sorghum, and a small acreage of wheat is also grown. Control of water erosion and maintenance of tilth are necessary for sustained yields.

A cropping system that includes grain sorghum, wheat, or other crops that produce a large amount of residue is suitable. Residue kept on the surface protects the soils from erosion and helps maintain tilth. Terraces and contour tillage further help reduce water erosion. Diversion terraces and grassed waterways are needed in some areas to protect the soils against erosion caused by runoff.

CAPABILITY UNIT IIIe–4

This unit is made up of moderately deep and deep, nearly level and gently sloping soils. These soils are moderately permeable, and their available water capacity is moderate and high. Runoff is slow and medium.

Cotton and grain sorghum are the main crops. A small acreage of wheat also is grown. Controlling soil blowing and water erosion are important for sustained yields.

A cropping system that includes grain sorghum, or other crops that produce a large amount of residue, is well suited. Residue kept on the surface helps to control soil blowing and water erosion. In some of the more sloping areas, terraces are needed to control water erosion. Diversion terraces and grassed waterways are needed to protect the soil where water from adjacent areas causes erosion.

CAPABILITY UNIT IIIe–5

The loamy soils in this unit are moderately deep and deep and gently sloping. They are moderately and moderately slowly permeable. Their available water capacity is high, and runoff is medium.

These soils are used for crops and range. The main crops are wheat, grain sorghum, and cotton. Controlling water erosion and maintaining tilth are important where these soils are tilled.

A cropping system that includes wheat, grain sorghum, or other crops that produce a large amount of residue is needed. This crop residue kept on the surface helps to control erosion and to maintain tilth. Contour tillage and terraces also are needed to control water erosion in cultivated areas. To protect the soil against runoff from adjacent, higher areas, diversion terraces and grassed waterways are needed.

CAPABILITY UNIT IIIe–6

The shallow to moderately deep Cosh and Spade soils, 1 to 3 percent slopes, are the only soils in this unit. These soils are loamy and are moderately to moderately rapidly permeable. Their available water capacity is low, and runoff is medium.

Wheat and grain sorghum are the main crops, and cotton is grown in some areas. The control of soil blowing and water erosion is important to sustained productivity of these soils.

A cropping system that includes grain sorghum, wheat, or other crops that produce a large amount of residue is suitable. Residue kept on the surface helps to control soil blowing and water erosion. Terraces and contour tillage further help control water erosion. Grassed waterways and diversion terraces are needed to protect some areas against runoff from adjacent areas.

CAPABILITY UNIT IVe–1

The moderately permeable soils of this unit are very shallow to deep and nearly level to gently sloping. Their available water capacity is low to high, and the runoff is slow to rapid.

Wheat and grain sorghum are the main crops grown. Controlling water erosion and maintaining good tilth are important to sustained yields on these soils.

A cropping system that provides large amounts of crop residue is needed. This crop residue kept on the soil surface helps to control erosion and to maintain good tilth. Terraces and contour farming also are needed to help control water erosion. In some areas diversion terraces and grassed waterways are necessary to protect against runoff from adjacent areas.

CAPABILITY UNIT IVe–2

Miles fine sandy loam, 3 to 5 percent slopes, is the only soil in this unit. It is moderately permeable and has a high available water capacity. Runoff is medium.

Cotton, grain, and forage soghum are the main crops grown. Controlling soil blowing and water erosion are important to sustained use of this soil.

Crops that provide a continuous cover of vegetation, or crops that produce a large amount of residue, are needed. Crop residue kept on the surface helps to control soil blowing and water erosion. Terraces and contour farming also are needed to control water erosion. Diversion terraces and grassed waterways protect areas against runoff from adjacent higher areas.

CAPABILITY UNIT IVe–3

This unit consists only of Cosh and Spade soils, 3 to 5 percent slopes. These soils are moderately permeable, and their available water capacity is low. Runoff is medium.

Wheat and forage sorghum are the main crops grown. The control of soil blowing and water erosion are important for sustained use of these soils.

A cropping system that provides a continuous cover of vegetation, or that provides large amounts of residue, is suitable. Residue kept on the surface helps to control erosion and soil blowing. Terraces and contour farming also are needed to control water erosion. Diversion terraces and grassed waterways protect areas subject to runoff.

CAPABILITY UNIT IVe–4

Miles loamy fine sand, 0 to 3 percent slopes, is the only soil in this unit. It is moderately permeable, and its available water capacity is high. Runoff is slow.

The main crops grown are cotton, peanuts, and sorghum. Controlling soil blowing and maintaining tilth are important to sustained yields on this soil.

Crops that provide a continuous cover of vegetation, or crops that produce a large amount of residue, are needed. Residue kept on the surface helps to control soil blowing and to maintain tilth (fig. 16).

Figure 16.—**Miles loamy fine sand protected from soil blowing by sorghum stubble.**

CAPABILITY UNIT IVe–5

Vernon clay loam, 1 to 3 percent slopes, is the only soil in this unit. This soil is very slowly permeable. The available water capacity is high, and runoff is rapid.

Wheat and sorghum are the main crops. Controlling water erosion and maintaining tilth are necessary for sustained yields.

Crops that provide a continuous cover of vegetation, or crops that produce a large amount of residue, are needed on this soil. Residue kept on the surface helps to control erosion and to maintain tilth. Terraces and contour tillage are needed to control water erosion. Some areas require diversion terraces and grassed waterways for protection against runoff from adjacent areas.

CAPABILITY UNIT IVe–6

This unit consists of deep, nearly level to gently sloping and gently undulating soils on uplands. These sandy soils are moderately rapidly permeable. Their available water capacity is low, and runoff is slow and very slow.

The main crop grown is sorghum. Crops that provide a continuous cover of vegetation, or that produce a large amount of residue, are suitable for these soils. Residue kept on the surface helps to control soil blowing and to maintain tilth.

CAPABILITY UNIT IVe–7

Vernon clay loam, 3 to 5 percent slopes, is the only soil in this unit. This soil is moderately deep and very slowly permeable. Its available water capacity is high, and runoff is rapid.

Nearly all of this unit is in range. Permanent vegetation is needed to protect the soil from water erosion.

CAPABILITY UNIT Vw–1

This unit consists of deep, nearly level and gently sloping soils on flood plains. These soils are moderately rapidly permeable to very slowly permeable. They are subject to flooding, which can leave them scoured or covered with a deposition of new soil material. Their available water capacity is high, and runoff is slow.

These soils are used mainly for range. Because of the hazard of flooding, these soils are not suited to cultivation.

CAPABILITY UNIT Vw–2

Lincoln soils are the only soils in this unit. These sandy soils are on flood plains. They are deep, nearly level, and rapidly permeable. Their available water capacity is low, and runoff is slow.

These soils are subject to flooding and to the scouring and deposition of new soil material that results from it. The hazard of soil blowing also is high. The water table is at 5 to 8 feet from the surface.

Nearly all of this unit is in range. Because of the hazards of soil blowing and flooding, it is best suited to range.

CAPABILITY UNIT VIe–1

The Nobscot association makes up this unit. These soils are deep and nearly level to gently undulating. They are moderately rapidly permeable. Their available water capacity is low, and runoff is very slow.

Nearly all of this unit is in range. Permanent vegetation is needed to protect against soil blowing.

CAPABILITY UNIT VIe-2

Aspermont silty clay loam, 5 to 12 percent slopes, is the only soil in this unit. This is a moderately deep to deep, moderately permeable soil on uplands. The available water capacity is high, and runoff is rapid.

All of this unit is in range. Permanent vegetation is needed to protect this soil from water erosion.

CAPABILITY UNIT VIe-3

The Woodward-Quinlan complex, rolling, makes up this unit. These loamy soils are shallow to deep and sloping to strongly sloping. They are moderately to moderately rapidly permeable. They are subject to a high hazard of water erosion. Their available water capacity is moderate to low, and runoff is medium to rapid.

Nearly all of this unit is in range. Permanent vegetation is needed to protect these soils against water erosion.

CAPABILITY UNIT VIe-4

This unit consists of moderately deep and deep, gently sloping to strongly sloping soils on uplands. These soils have a loamy or gravelly and loamy surface layer and are moderately to moderately rapidly permeable. Their available water capacity is high to low, and runoff is medium to rapid.

Nearly all of this unit is in range. Permanent vegetation is needed to protect these soils from soil blowing and water erosion.

CAPABILITY UNIT VIe-5

Miles loamy fine sand, 3 to 5 percent slopes, is the only soil in this unit. This soil is moderately permeable. Its available water capacity is high, and runoff is medium.

Most of this unit is in range. Permanent vegetation is needed to protect this soil against soil blowing and water erosion.

CAPABILITY UNIT VIw-1

Randall clay, the only soil in this unit, is a very slowly permeable soil in the basins of playas. This soil is somewhat poorly drained, deep, and nearly level.

All of this soil is in range. A good cover of growing plants is needed to help control soil blowing, surface crusting, and puddling.

CAPABILITY UNIT VIs-1

Treadway soils are the only soils in this unit. These loamy soils are shallow to moderately deep and nearly level to gently sloping. They are slowly permeable. Their available water capacity is high, and runoff is rapid.

This unit is best suited for use as range. The soils are droughty, and native vegetation is sparse. A good cover of vegetation helps to control water erosion.

CAPABILITY UNIT VIIe-1

Likes fine sand is the only soil in this unit. This deep soil is gently sloping to sloping and gently undulating. It is moderately rapidly permeable. Its available water capacity is low, and runoff is slow.

All of this unit is in range. Permanent vegetation is needed for protection against soil blowing.

CAPABILITY UNIT VIIs-1

This unit is made up of shallow and very shallow, loamy to clayey soils. These are moderately to very slowly permeable soils on uplands. Their available water capacity is moderate to low, and runoff is slow to rapid.

All of this unit is in range. A good cover of growing plants is needed to help control water erosion.

CAPABILITY UNIT VIIs-2

The Quinlan-Rough broken land complex makes up this unit. Areas of this mapping unit are shallow, are strongly sloping to moderately steep, and are on uplands. They are loamy and moderately rapidly permeable. Their available water capacity is low, and runoff is rapid.

All of this capability unit is used for range. A good cover of growing plants is needed to control water erosion.

Predicted Yields

Crop yields in Stonewall County depend on how well the soils have been managed. Consistent high yields can be obtained if the soils are used within their capabilities and are managed according to their needs. Such yields are generally an indication that the soils have been improved and are being kept in good tilth.

Table 2 gives, for each soil in the county considered suitable for crops, predicted average yields per acre under a high level of management. In Stonewall County, these predictions are for cotton, grain, sorghum, and wheat grown on dryland soils. The predictions are based on experiments over a period of 10 to 20 years, on records of experiment stations, and on information obtained from farmers and others familiar with the soils.

A high level of management for soils in this county consists of:

1. Managing crop residue in a way that effectively controls erosion and protects the soil.
2. Using a cropping sequence that maintains an adequate supply of organic material.
3. Conserving rainwater.
4. Maintaining fertility by the timely application of fertilizer and by growing soil-improving crops.
5. Controlling insects, diseases, and weeds.
6. Keeping tillage to a minimum and tilling only when the moisture content is such that compaction is minimized.
7. Planting improved crop varieties.
8. Using terraces and other mechanical aids and effectively maintaining them.

Use of the Soils for Pasture

Pastures are important in Stonewall County because they provide supplemental grazing. An improved pasture or meadow is one in which introduced grasses are used for obtaining high yields of forage. Some of the important grasses used in improved pastures are bermudagrass, blue panicum, johnsongrass, and weeping lovegrass.

A well-managed pasture requires rotation grazing, a proper stocking rate, weed control, fertilization, and an adequate supply of water.

TABLE 2.—*Predicted average acre yield of principal crops under a high level of management*

[Only the soils suitable for field crops are listed in this table. Absence of data indicates that the crop generally is not grown on the soil named]

Soil	Cotton (lint)	Grain sorghum	Wheat	Soil	Cotton (lint)	Grain sorghum	Wheat
	Lb	*Lb*	*Bu*		*Lb*	*Lb*	*Bu*
Acme-Cottonwood complex		1,000	10	Miles fine sandy loam, 0 to 1 percent slopes	325	1,800	20
Altus fine sandy loam, 0 to 1 percent slopes	350	2,500	22	Miles fine sandy loam, 1 to 3 percent slopes	300	1,700	20
Aspermont silty clay loam, 1 to 3 percent slopes	225	1,200	15	Miles fine sandy loam, 3 to 5 percent slopes	250	1,250	15
Aspermont silty clay loam, 3 to 5 percent slopes	150	1,150	15	Miles loamy fine sand, 0 to 3 percent slopes	250	1,500	15
Bukreek loam, 0 to 1 percent slopes	300	1,750	20	Obaro very fine sandy loam, 1 to 3 percent slopes	200	1,500	15
Bukreek loam, 1 to 3 percent slopes	250	1,500	15	Obaro very fine sandy loam, 3 to 5 percent slopes	150	1,250	15
Bukreek loam, gravelly substratum, 0 to 1 percent slopes	300	1,750	20	Paducah very fine sandy loam, 0 to 1 percent slopes	275	1,800	20
Bukreek loam, gravelly substratum, 1 to 3 percent slopes	250	1,500	15	Paducah very fine sandy loam, 1 to 3 percent slopes	200	1,700	20
Clairemont silt loam	400	2,500	25	Paducah very fine sandy loam, 3 to 5 percent slopes	200	1,500	15
Cobb fine sandy loam, 1 to 3 percent slopes	200	1,500	18	Quanah silt loam, 1 to 3 percent slopes	175	1,000	15
Cosh and Spade soils, 1 to 3 percent slopes	150	1,000	10	Rotan clay loam, 0 to 1 percent slopes	300	2,000	25
Cosh and Spade soils, 3 to 5 percent slopes	120	800	10	Rowena clay loam, 0 to 1 percent slopes	250	2,000	25
Devol loamy fine sand, 0 to 3 percent slopes	200	1,500	15	Springer loamy fine sand, 0 to 3 percent slopes	175	1,200	10
Enterprise very fine sandy loam, 0 to 1 percent slopes	350	2,000	20	St. Paul silt loam, 0 to 1 percent slopes	300	2,000	20
Enterprise very fine sandy loam, 1 to 3 percent slopes	275	2,000	20	Tillman clay loam, 0 to 1 percent slopes	250	1,800	25
Enterprise very fine sandy loam, 3 to 5 percent slopes	250	1,500	20	Tillman clay loam, 1 to 3 percent slopes	200	1,450	20
Frankirk clay loam, 0 to 1 percent slopes	250	1,750	25	Tipton loam, 0 to 1 percent slopes	400	2,500	25
Frankirk clay loam, 1 to 3 percent slopes	225	1,700	20	Vernon clay loam, 1 to 3 percent slopes	100	700	15
Frio silty clay loam	400	3,500	30	Yomont very fine sandy loam	350	2,250	25
Hensley loam, moderately deep variant, 0 to 1 percent slopes		1,500	25				
Hollister silty clay loam, 0 to 1 percent slopes	250	2,000	20				

Pasture suitability groups

The soils in Stonewall County have been placed in pasture 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.

The pasture groups in Stonewall County are identified by a number and a capital letter. The pasture group in which each soil that is suited to use as pasture has been placed is listed in the "Guide to Mapping Units" at the back of this survey. Not all mapping units are placed in pasture groups, because some of them are better suited to range than to pasture.

PASTURE GROUP 1A

Mangum silty clay loam, the only soil in this group, is a nearly level soil on bottom lands. It is subject to overflow an average of four times in 5 years. This soil is very slowly permeable and has a high available water capacity. It is best suited to johnsongrass, blue panicum, and similar grasses.

PASTURE GROUP 1C

This group consists of deep, loamy, nearly level soils on bottom lands. These soils are subject to overflow once in 5 years. They are moderately slowly permeable and moderately permeable. Their available water capacity is high. This group is best suited to johnsongrass and similar grasses.

PASTURE GROUP 2A

This group consists of deep, loamy, nearly level soils on bottom lands. These soils are subject to overflow, washing, and deposition of new soil material. They are moderately and moderately rapidly permeable, and they have a high available water capacity. These soils are best suited to bermudagrass, johnsongrass, and similar grasses.

PASTURE GROUP 3A

Lincoln soils are the only soils in this group. These deep, sandy soils are nearly level and are on bottom lands. They overflow twice in 5 years. Their permeability is rapid, and their available water capacity is low. Grass is hard to establish because of the loose seedbed, blowing sand, and competition from weeds. These soils are best suited to bermudagrass and similar grasses.

PASTURE GROUP 7A

This pasture group consists of moderately deep and deep, clayey and loamy soils on uplands. These nearly level and gently sloping soils are very slowly to slowly permeable. Their available water capacity is high.

These soils are wet or droughty according to the season. If they are grazed when wet, they are subject to puddling or compaction of the surface. Seedbed preparation is difficult. These soils are suited to blue panicum, johnsongrass, and similar grasses.

PASTURE GROUP 7C

This group consists of deep to moderately deep, loamy soils on uplands. These soils are nearly level and gently sloping. Their permeability is moderate to slow, and the available water capacity is high. These soils are best suited to blue panicum, johnsongrass, and similar grasses.

PASTURE GROUP 8C

This pasture group consists of shallow to deep, loamy soils that are nearly level to gently sloping and are on uplands. These soils are moderately rapidly to moderately slowly permeable, and their available water capacity is low to high. Quick surface drying and some crusting make it difficult to establish grasses. These soils are best suited to blue panicum, johnsongrass, and other such grasses.

PASTURE GROUP 9A

This group consists of deep, sandy, nearly level and gently sloping soils on uplands. These soils are moderately to moderately rapidly permeable, and their available water capacity is low to high. Grass is difficult to establish because of loose seedbed, blowing soil, crusting, and competition from grass-type weeds that are difficult to control. These soils are best suited to grasses such as weeping lovegrass and johnsongrass.

PASTURE GROUP 13A

This pasture group consists of the Acme-Cottonwood complex. These loamy, very shallow and shallow soils are nearly level and are on uplands. They are moderately permeable, and their available water capacity is low. The droughty nature of these soils makes grass establishment difficult. These soils are best suited to blue panicum, johnsongrass, and similar grasses.

Range Management [2]

Ranching and livestock farming are the most important agricultural enterprises in Stonewall County. Native grassland covers some 460,000 acres, or 78 percent of the county. The 85 ranching units in the county range from 500 to 20,000 acres in size.

About 62 percent of the cropland in this county is used to grow winter feed for a balanced year-round cattle operation. Small grain, hybrid forage sorghum, and hay are used to supplement the range.

Most ranches are cow-calf operations, though stocker steers make up a significant percentage of many herds. The number of steers wintered is determined by the amount of feed produced during the summer growing season. Winter feeding is heavy. Stock are fed from December through March. Calves are often sold on a contract requiring delivery late in the spring or early in the summer.

Vegetation ranges from short grass on the hardlands to tall grass on the sandy areas. Many kinds of woody plants grow on the steeper slopes of the rough breaks and along the bottom lands.

The native grasslands have been heavily grazed for many years. As a result, a large percentage of the more desirable types of grasses and forbs have been grazed out, and less desirable grasses, weeds, and brush have invaded. In many places, the sandylands produce an abundance of shin oak and less palatable dropseeds instead of the taller, more robust grasses. The tighter soils have been invaded by mesquite, and the shallow soils by noxious weeds.

A close look at these sites, however, reveals remnants of the original grasses and desirable adapted plants. Generally these plants will increase if the grassland is given proper care and treatment.

Range sites and condition classes

A range site is a distinctive kind of range. It differs from other range sites in having an ability to produce a significantly different kind or proportion of plants or a capacity to produce different total annual yield. In appraising range, differences great enough to require some variation in management, such as a different rate of stocking, are considered significant, and sufficient for establishing a range site.

Differences in kinds, proportion, and production of plants on a site are caused by differences in environmental factors, such as soil, topography, and climate. Thus, a range site can be identified by knowing the kinds of soil and their capacity to produce a distinctive potential plant community.

The most productive combination of forage plants on a range site is generally the potential, or climax, vegetation. *Range condition* is the present state of the vegetation on a range site in relation to the potential plant cover for that site. This condition is expressed as a percentage, which indicates degree of departure from the potential plant community. Range is in excellent condition if more than 75 percent of the existing plants are the original, or climax, plants; in good condition if 50 to 75 percent are climax plants; in fair condition if 25 to 50 percent are climax plants; and in poor condition if less than 25 percent are climax plants.

For most range sites, and most range livestock operations, the higher the range condition class, the greater is the quality and amount of available forage. Decline in range condition frequently is related to grazing or similar disturbance of the potential plant community.

Livestock tend to graze the most palatable and nutritious plants first; and consequently, these plants are destroyed or damaged first. These plants first affected by grazing are called decreasers. Other plants also are affected as grazing continues, and these are called in-

[2] By JOE B. NORRIS, range conservationist, Soil Conservation Service.

creasers and invaders. Following are definitions of all three kinds of range plants.

Decreaser plants are kinds of plants in the potential plant community that decrease in relative abundance when the community is subject to continued moderately heavy to heavy grazing. Most of these kinds of plants are palatable and decrease from excessive use. The total of all such kinds is counted in determining range condition class.

Increasers are kinds of plants present in the potential plant community that normally increase in relative abundance when the community is subjected to continued moderately heavy to heavy grazing use. Some increasers having moderately high palatability may initially increase, and then decrease as grazing pressure continues. Others of low grazing preference may continue to increase either in actual plant numbers or in relative proportions. Only the percentages of increaser plants normally expected to occur in the potential plant community are counted in determining range condition.

Invader plants are not members of the potential plant community for the site. They invade the community as a result of various kinds of disturbance. They may be annuals or perennials, grasses, weeds, or woody plants. Some have relatively high grazing value, but many have no grazing value. Invader plants are not counted in determining range condition class.

Descriptions of range sites

Fourteen range sites have been identified and described in Stonewall County. They are discussed in the following pages.

BOTTOMLAND RANGE SITE

This range site is on lowlands along major draws, small drains, and intermittent streams. The soils are deep, nearly level, and loamy. They are moderately rapidly to very slowly permeable. The runoff from higher lying areas can result in brief flooding. Any damage to vegetation is commonly caused by sediment rather than wetness.

This site is capable of producing an abundance of mid and tall grasses when in good to excellent condition. Grass remains green longer than on other sites because it receives extra water as runoff. Elm, hackberry, cottonwood, and similar trees are scattered along the banks of the major streams.

Livestock prefer this site, and if overgrazing is permitted for long periods, the site deteriorates rapidly. Tall grasses are the first to be eliminated under heavy grazing. Then the mid grases are replaced by perennial weeds, numerous annuals, and heavy stands of brush. Under continued grazing pressure, all grazeable forage eventually is eliminated.

The climax vegetation varies from place to place, depending on the origin of the alluvial deposits. About 70 percent of the climax vegetation consists of sand bluestem, indiangrass, switchgrass, Canada wildrye, false switchgrass, and side-oats grama. The remaining 30 percent is mainly western wheatgrass, vine-mesquite, silver bluestem, blue grama, and buffalograss.

If the climax grasses are not maintained, the site is invaded by noxious plants that grow from seed washed in from outlying areas. These invaders ordinarily are the annuals common in cultivated fields; for example, sunflower, cocklebur, buffalo-bur, hairy caltrop, common broomweed, crotons, thistles, and sandbur. Other common invaders are mesquite, sand dropseed, three-awn, windmillgrasses, Texas grama, and hairy tridens. Inland saltgrass and salt cedar grow in saline areas.

Overgrazing also allows mesquite and other brush to invade. Mesquite and brush can be controlled effectively by saturating the base of each plant with oil or a combination of oil and chemical herbicide. Dozing is often used on the more open stands. Rootplowing of dense stands of brush also is a common practice.

This site responds to range seeding where flooding is not a problem. The extra water received on the site makes seeding less hazardous than on upland sites.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 3,600 pounds in wet years to 2,000 pounds in dry years. About two-thirds of this yield is suitable forage for cattle.

CLAY FLAT RANGE SITE

Treadway soils are the only soils in this range site. These nearly level to gently sloping soils are on broad uplands. They are shallow to moderately deep, loamy soils that are very slowly permeable.

Among the important grasses in the potential plant community are blue grama, white tridens, and vine-mesquite. As the site deteriorates, tobosagrass and buffalograss dominate. In still poorer range condition, mesquite, pricklypear, cholla cactus, and annual weeds invade.

Since most of the annual production is tobosagrass, livestock grazing is limited to the spring of the year. 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. About half of this yield is suitable forage for cattle.

DEEP HARDLAND RANGE SITE

The site consists of mostly smooth, nearly level to gently sloping soils on uplands. It is readily accessible to cattle. It is a favorite grazing site and receives heavy grazing pressure.

The soils of this site are shallow to deep. They are loamy and moderately to slowly permeable. Their available water capacity ranges from low to high. In many places, the intake of moisture is reduced by surface crusting and by a compacted layer caused by trampling.

The potential plant community on this site is made up of blue grama, Arizona cottontop, western wheatgrass, side-oats grama, vine-mesquite, and feather bluestem. Other important grasses are buffalograss, tobosagrass, and sand dropseed.

Continuous overgrazing results in an immediate thinning of blue grama, followed by a thickening of buffalograss. Further deterioration of the range results in invasion of perennial three-awn, hairy tridens, broom snakeweed, and mesquite.

In poorer condition classes and during years in which there is a wet spring, invading annuals grow on the normally bare spots. The most common of these are Texas filaree, evax, various plantains, bladderpod, plains greenthread, bitterweed, common broomweed, and little barley. The common invading perennial forbs on this site are western ragweed, silverleaf nightshade, and Dakota verbena.

Growing plants are necessary to reduce surface crusting and to control erosion. Once the range is in poor condition, recovery is very slow because desirable kinds of seed plants are lacking, because the soil is crusted, and because a heavy growth of mesquite has invaded. Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 2,300 pounds in wet years to 1,500 pounds in dry years. Approximately 85 percent of this yield is forage for livestock and wildlife.

DEEP SAND RANGE SITE

This site consists of nearly level to sloping and gently undulating soils on uplands. These soils are deep, moderately rapidly permeable, and sandy. Their available water capacity is low.

The vegetation is predominantly tall grass with lesser amounts of mid grasses. Grasses that make up about 70 percent of the original plant community are sand bluestem, little bluestem, and giant dropseed. Other important grasses making up the remaining 30 percent are feathery bluestem, sand dropseed, and perennial three-awns. Woody plants, such as Havard oak, also grow on this site.

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. About two-thirds of this yield is suitable forage for livestock and wildlife.

GRAVELLY RANGE SITE

Hilgrave gravelly sandy loam, 3 to 8 percent slopes, is the only soil in this range site. This soil is gently sloping to sloping and is on hills and knolls. It is moderately deep, gravelly and loamy, and moderately rapidly permeable. The gravel is interspersed throughout the profile.

The gravel gives this soil a good relationship of plants, soil, moisture, and air that ecourages growth of many kinds of plants. The total growth of vegetation, however, is sparse.

Among grasses that form about 70 percent of the potential plant community are side-oats grama, blue grama, little bluestem, and Arizona cottontop. Other important grasses are sand bluestem, indiangrass, and switchgrass. These grow on the more favored spots. This range site also produces hairy grama, buffalograss, silver bluestem, Texas wintergrass, and small amounts of shin oak. Invaders are Texas grama, sand muhly, hairy tridens, fall witchgrass, agarito, redberry juniper, catclaw, pricklypear, and numerous annual weeds. Mesquite invades the deeper soils that are associated with this site in some places.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 1,800 pounds in wet years to 1,100 pounds in dry years. About 60 percent of this yield is suitable forage for livestock and wildlife.

GYPLAND RANGE SITE

The Cottonwood part of the Cottonwood-Owens association is the only soil in this range site. This soil is loamy, very shallow, and nearly level to gently sloping. It is moderately permeable, and its available water capacity is low.

The gypsum in this soil is below the surface in solid strata, on the surface as blisters of friable particles, or in platy crystalline form. The climax vegetation is directly affected by the gypsum. Except in areas of almost pure gypsum, this site has a mid and tall grass appearance. Characteristic grasses are side-oats grama, little bluestem, and sand bluestem. In places where the gypsum content is high, vegetation is sparse and side-oats grama and hairy grama are dominant. Other important grasses on this site are blue grama, indiangrass, switchgrass, vine-mesquite, plains bristlegrass, and Arizona cottontop.

Other plants on this site are buffalograss, slim or rough tridens, reverchon panicum, black grama, silver bluestem, sand dropseed, and perennial three-awn. Dotted gayfeather and blackfeather dalea also are characteristic of the site.

The principal invaders are mesquite, redberry juniper, yucca, catclaw, false-broomweed, Texas grama, hairy tridens, and numerous annual weeds.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 1,100 pounds in wet years to 500 pounds in dry years. About two-thirds of this yield is forage for livestock and wildlife.

MIXEDLAND RANGE SITE

This site is made up of nearly level to moderately steep, shallow to deep loamy soils. These soils are moderately rapidly permeable, and their available water capacity is low to high.

About 70 percent of the vegetation is climax grasses. Blue grama is dominant. Other climax grasses are little bluestem, Arizona cottontop, plains bristlegrass, side-oats grama, Canada wildrye, switchgrass, and western wheatgrass. Approximately 30 percent of the vegetation consists of buffalograss, hairy grama, sand dropseed, silver bluestem, and along drains, meadow dropseed.

Any deterioration in the vegetation results in an immediate thinning of side-oats grama, Arizona cottontop, and plains bristlegrass. Blue grama is the next prominent grass to become sparse. If continuously overgrazed, the range soon consists almost entirely of buffalograss and many invading forbs.

The chief invading grasses are red grama, Texas grama, sixweeks grama, tumble windmillgrass, hooded windmillgrass, gummy lovegrass, little barley, tumblegrass, and hairy tridens. Woody invaders are mesquite, pricklypear, tasajillo, small soapweed, and juniper.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 2,400 pounds in wet years to 1,600 pounds in dry years. About 75 per-

cent of this vegetation is suitable forage for livestock and wildlife.

ROUGH BREAKS RANGE SITE

The topography of this site ranges from steep to gently sloping. It is gently sloping in the dissected, gullied areas that have been carved in erosive, loamy soils.

The grasses that grow on the slopes where this range site is in good to excellent condition are side-oats grama, little bluestem, and blue grama. Switchgrass, sand bluestem, indiangrass, and Canada wildrye grow in places that receive more moisture or retain more of the moisture received. Other grasses that make up some 30 percent of the total original vegetation are hairy grama, perennial three-awns, black grama, slim tridens, and sand dropseed. Woody plants that grow on the slopes are redberry juniper, feather dalea, skunkbush, and catclaw acacia. Invader plants on this site are Texas grama, hairy tridens, sand muhly, and numerous annual weeds.

Even where this site is in excellent condition, plant cover is generally sparse. Under prolonged heavy use, all of these steep slopes lose their protective cover of vegetation, and erosion accelerates.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 900 pounds in wet years to 500 pounds in dry years. Only about 50 percent or less of this yield is forage for livestock; the rest is not accessible. Wildlife makes better use of the vegetation on the steeper slopes.

SANDY BOTTOMLAND RANGE SITE

Lincoln soils are the only soils in this range site. These soils are deep, nearly level, sandy soils along streambeds. They are rapidly permeable, and their available water capacity is low. They are subject to flooding and deposition. If unprotected by plant cover, the soils are subject to scouring and gullying.

The vegetation on this site is mid and tall grasses. Indiangrass, switchgrass, and sand bluestem are dominant on the site in its original condition. Other important grasses are side-oats grama, little bluestem, Canada wildrye, Texas bluegrass, and big sandreed. About 70 percent of the total original vegetation was made up of these plants. A few woody plants, such as sand plum, cottonwood, willow trees, sand sagebrush, and skunkbush, also grew under climax conditions.

Any site deterioration caused by overgrazing results in a rapid increase of such grasses as vine-mesquite, three-awns, sand dropseed, and blue grama. Inland saltgrass and alkali sacaton are the main grasses that grow in the saline spots.

Continued overgrazing results in an invasion of gummy lovegrass, annual three-awns, tumble lovegrass, low growing paspalums, and numerous annual weeds. Other woody invaders are yucca, groundsels, and salt cedar.

Where this site is in excellent condition, the potential per acre yield of air-dry herbage ranges from 3,500 pounds in wet years to 2,200 pounds in dry years. About three-fourths of this yield is suitable for livestock and wildlife forage.

SANDYLAND RANGE SITE

The deep sandy soils of this site have a topography that ranges from smooth and nearly level to sloping and gently undulating. The available water capacity of these soils is low to high.

About 75 percent of the plant community on this site consists of climax grasses such as side-oats grama, sand bluestem, indiangrass, and little bluestem. Approximately 25 percent of the plants are silver bluestem, sand dropseed, hairy grama, hooded windmillgrass, fall witchgrass, and perennial three-awn. On some of the soils, a few woody plants such as Havard oak are a part of the climax vegetation. In many areas, this oak is so dense that there is little grazing.

Any deterioration in this site results in an increase of yucca, shin oak, and annual weeds. Invading grasses are annual three-awn, fringed signalgrass, tumble windmillgrass, gummy lovegrass, red lovegrass, and tumble lovegrass. The invading weeds are tumble ringwing, annual wildbuckwheat, prairie sunflower, woollywhite, beebalm, pricklepoppy, Riddell groundsel, and stillingia.

A few years of care, after control of brush where necessary, enable this site to regain good to excellent condition if a seed source is available. When response is slow, overseeding by the best known methods speeds recovery.

Where in excellent condition, the potential acre yield of air-dry herbage ranges from 3,000 pounds in wet years to 1,800 pounds in dry years. About two-thirds of this yield is suitable forage for livestock and wildlife.

SANDY LOAM RANGE SITE

This site is made up of shallow to deep, nearly level to strongly sloping soils. These loamy soils are on uplands. They are moderately permeable to moderately rapidly permeable, and their available water capacity is low to high.

The climax grasses that make up about 70 percent of the potential plant community are side-oats grama, Arizona cottontop, and plains bristlegrass. Other important grasses making up 30 percent of the vegetation are buffalograss, blue grama, black grama, sand dropseed, perennial three-awn, and hooded windmillgrass.

Many areas of this site are treated for the invasion of brush. Both mechanical and chemical methods are used. The resting of pastures after treatment allows grass to recover.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 2,500 pounds in wet years to 1,800 pounds in dry years. About two-thirds of this yield is forage for livestock and wildlife.

SHALLOW REDLAND RANGE SITE

This site is made up of shallow to deep, gently sloping to strongly sloping soils. These clayey and loamy soils

are very slowly to moderately permeable, and their available water capacity is moderate to high.

The potential plant community consists of side-oats grama, blue grama, vine-mesquite, little bluestem, sand bluestem, and indiangrass.

Forbs in the climax vegetation are groundplum milkvetch, dalea, prairie-clover, scurfpea, heath aster, Engelmanndaisy, dotted gayfeather, penstemon, sagewort, and gaura. Desert shrubs, such as acacia, mimosa, vine ephedra, agarito, and skunkbush sumac grow in a few places.

Other important grasses are hairy grama, silver bluestem, buffalograss, perennial three-awn, and tobosagrass.

The main woody invaders are mesquite, grassland croton, pricklypear, and lotebush. Common invading perennial grasses are hairy tridens, sand dropseed, Texas grama, red grama, and tumblegrass. Invading forbs are broom snakeweed, wavyleaf thistle, plains actinea, gray goldaster, rock daisy, threadleaf groundsel, and Texas stillingia. Other common invading forbs are common broomweed, bitterweed actinea, oneseed croton, Texas filaree, evax, plantain, plains greenthread, and bladderpod.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 1,600 pounds in wet years to 900 pounds in dry years. About 80 percent of this yield is suitable forage for livestock and wildlife.

VALLEY RANGE SITE

Nipsum clay, 1 to 3 percent slopes, is the only soil on this site. This clayey soil is deep and gently sloping. It is moderately permeable; it receives extra water from runoff; and its available water capacity is high.

The climax vegetation consists of white tridens, vine-mesquite, side-oats grama, western wheatgrass, cane bluestem, blue grama, buffalograss, and tobosagrass. This vegetation under continuous heavy grazing may deteriorate to mesquite and annual weeds.

The site responds favorably to rest, or rotational grazing, particularly where it is started before all the more desirable grasses are grazed out.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 2,500 pounds in wet years to 1,800 pounds in dry years. About 90 percent of this yield is suitable forage for cattle.

VERY SHALLOW RANGE SITE

This site consists of shallow to very shallow loamy soils that are gently sloping and sloping. These soils are moderately to slowly permeable, and their available water capacity is low.

Although this site is generally in a higher condition class than adjacent sites, actual grass density is normally sparse.

The potential plant community consists of blue grama, feather bluestem, black grama, sand bluestem, indiangrass, little bluestem, plains bristlegrass, hairy grama, buffalograss, sand dropseed, perennial three-awn, slim tridens, and rough tridens.

Among the invaders that come onto this site under heavy grazing pressure are hairy tridens, Texas grama, red grama, tumblegrass, mesquite, catclaw acacia, pricklypear, broom snakeweed, and annual weeds.

Where this site is in excellent condition, the potential acre yield of air-dry herbage ranges from 1,700 pounds in wet years to 700 pounds in dry years. About 60 percent of the yield is suitable livestock forage.

Use of Soils for Wildlife [3]

Wildlife resources are an important source of recreation and income in many areas of Stonewall County. Quail, dove, rabbit, and deer are the main game birds and animals in the county. Fishing in Stonewall County is limited to farm ponds. Ponds are generally stocked with large-mouth bass, sunfish, and channel catfish.

Interpretations for wildlife management are discussed in this section. The soils of the county are rated for wildlife habitat and kinds of wildlife in table 3, and these ratings are explained in the following subsections.

Soil interpretations for wildlife habitat

Successful management of wildlife requires that food, cover, and water be available in a suitable combination. Absence or inadequate distribution of any one of these basic essentials can limit or eliminate a particular kind of wildlife from a site. Soil information provides a valuable tool in creating, improving, or maintaing suitable food, cover, and water for wildlife.

Most wildlife habitats are managed by planting suitable vegetation or by manipulating existing vegetation to increase desired plants. In addition, water areas can be created or natural ones improved as wildlife habitats.

The influence of a soil on the growth of plants is known for many kinds of plants, and can be inferred for others from a knowledge of the characteristics and behavior of the soil. Soil interpretations for wildlife habitat aid in selecting the more suitable sites for various kinds of management. They indicate the level of management intensity needed to achieve desired results. They also show why it may not be generally feasible to manage a particular area for a given kind of wildlife.

These interpretations are valuable for 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: (1) thickness of soil useful to crops, (2) texture of the surface soil, (3) available water capacity, (4) wetness, (5) stoniness or rockiness of the surface, (6) flood hazard, and (7) slope.

The soil areas shown on the soil survey maps are rated for wildlife without regard to size, shape, or positional relationship with adjoining areas. Certain influences on habitats, such as elevation and aspect, must be appraised at the site.

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[3] By JAMES HENSON, biologist, Soil Conservation Service.

In table 3 the soils of Stonewall 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: well suited, suited, poorly suited, and unsuited.

Wildlife habitat elements: The six habitat elements rated in table 3 are defined and exemplified as follows:

Grain and seed crops are agricultural grains, or seed-producing annuals, that are 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 can be established by planting and that furnish food and cover for wildlife. Examples are bahiagrass, ryegrass, fescue, and panicgrasses. Legumes include clovers, annual lespedezas, bush lespedezas, and similar plants.

Wild herbaceous 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 acacia, cherry grape, honeysuckle, greenbrier, autumn-olive, and multiflora rose.

Wetland food and cover plants are annual and perennial, wild herbaceous plants in moist to wet sites, exclusive of submerged or floating aquatics, that produce food or cover that is extensively used by wetland wildlife. Examples are smartweed, wild millet, bulrush, spike sedge, rushes, burreeds, wild rice cutgrass, sourdock, cattails, and sedges.

Shallow water developments are low dikes and water-control structures established to create habitat principally for waterfowl. They can be designed to be drained, planted, and flooded or as permanent impoundments to grow submerged aquatics. Both fresh and brackish water are included.

Suitability ratings of soils for wildlife: The following definitions are given for habitat suitability ratings used in table 3.

Well suited indicates that habitats generally 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.

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.

Unsuited indicates that the soil limitation is so extreme that it is impractical, if not impossible, to manage the designated habitat element. Unsatisfactory results are probable (for short-term usage, soils rated as "poorly suited" may provide easy establishment and temporary values).

Kinds of wildlife: The three general kinds of wildlife (rated in table 3) are defined as follows:

Openland wildlife is the birds and mammals that normally frequent cropland, pastures, and areas that are overgrown with grasses, herbs, and shrubby growth. Examples of this kind of wildlife are bobwhite and scaled quail, dove, cottontail rabbits, jackrabbits, coyotes, meadow larks, and lark sparrows.

Brushland wildlife is birds and mammals that normally frequent areas having a cover of hardwood trees and shrubs. Examples of brushland wildlife are deer, turkey, squirrel, raccoon, javelina, badger, skunk, opposum, and bobcat.

Wetland wildlife is birds and mammals that normally frequent such areas as ponds, streams, ditches, marshes, and swamps. Examples of this kind of wildlife are duck, geese, rail, shorebirds, and snipe.

Engineering Uses of the Soils [4]

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. Soil materials are used in the construction of roads, airports, pipelines, buildings, building foundations, water storage facilities, erosion control structures, drainage systems, and sewage disposal systems.

Among the soil properties most important in engineering are permeability, consolidation, shear strength, density, shrink-swell potential, water holding capacity, grain-size distribution, plasticity, and reaction.

Information concerning these and related soil properties are furnished in tables 4, 5, and 6. The estimates and interpretations of soil properties in these tables can be used in—

1. Planning of agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, 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.

[4] By Robert Gray, area engineer, Soil Conservation Service.

TABLE 3.—*Use of soils*

Soil series and map symbols	Wildlife habitat elements			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood trees and shrubs
Acme: Ac	Suited	Well suited	Suited	Suited
For Cottonwood part, see Cottonwood series.				
Altus: AlA	Well suited	Well suited	Well suited	Unsuited
Aspermont: AsB, AsC, AsD	Suited	Well suited	Suited	Unsuited
Badland	Unsuited	Unsuited	Unsuited	Unsuited
Mapped only in an undifferentiated unit with Owens series.				
Bukreek: BuA, BuB	Well suited	Well suited	Suited	Poorly suited
Bukreek, gravelly substratum: BvA, BvB	Well suited	Well suited	Suited	Poorly suited
Clairemont: Ca	Well suited	Well suited	Well suited	Suited
Cobb: CbB	Suited	Well suited	Well suited	Suited
Colorado: Cd	Suited	Suited	Well suited	Suited
Cosh: CsB, CsC	Poorly suited	Poorly suited	Suited	Suited
For Spade part, see Spade series.				
Cottonwood: Ct	Poorly suited	Poorly suited	Suited	Poorly suited
For Owens part, see Owens series.				
Devol: DeB	Suited	Well suited	Well suited	Poorly suited
Enterprise: EnA, EnB, EnC	Well suited	Suited	Well suited	Unsuited
Frankirk: FnA, FnB	Well suited	Suited	Well suited	Poorly suited
Frio: Fo	Well suited	Suited	Well suited	Suited
Hardeman: HaD	Suited	Well suited	Well suited	Unsuited
Hensley, moderately deep variant: HeA	Suited	Well suited	Well suited	Poorly suited
Hilgrave: HgD	Suited	Suited	Well suited	Unsuited
Hollister: HoA	Well suited	Suited	Well suited	Poorly suited
Latom: Lc	Unsuited	Poorly suited	Poorly suited	Poorly suited
For Rock outcrop part, see Rock outcrop.				
Likes: Lk	Poorly suited	Suited	Suited	Poorly suited
Lincoln: Ln	Poorly suited	Suited	Suited	Unsuited
Mangum: Ma	Suited	Suited	Well suited	Suited
Miles: MlB, MlC, MnA, MnB, MnC, MnD	Suited	Well suited	Well suited	Poorly suited
Nipsum: NcB	Well suited	Suited	Well suited	Unsuited
Nobscot: Ns	Poorly suited	Suited	Suited	Suited
Obaro: OaB, OaC	Suited	Well suited	Well suited	Unsuited
Owens: Ob	Poorly suited	Suited	Suited	Unsuited
For Badland part, see Badland.				
Paducah: PdA, PdB, PdC	Well suited	Suited	Well suited	Unsuited
Quanah: QhB	Well suited	Suited	Well suited	Unsuited
Quinlan: Qr	Poorly suited	Suited	Well suited	Unsuited
For Rough broken land part, see Rough broken land.				
Randall: Ra	Suited	Suited	Suited	Unsuited
Rock outcrop	Unsuited	Unsuited	Unsuited	Unsuited
Mapped only in a complex with Latom series.				
Rotan: RnA	Well suited	Suited	Well suited	Poorly suited
Rough broken land: Ro	Unsuited	Poorly suited	Poorly suited	Suited
Rowena: RwA	Well suited	Suited	Well suited	Poorly suited
Spade	Suited	Well suited	Well suited	Unsuited
Mapped only in an undifferentiated unit with Cosh series.				
Springer: SgB	Well suited	Suited	Well suited	Poorly suited
St. Paul: SpA	Well suited	Suited	Well suited	Poorly suited
Talpa: Ta	Poorly suited	Suited	Suited	Suited
For Yates part, see Yates series.				
Tillman: TcA, TcB	Well suited	Suited	Well suited	Unsuited
Tipton: TpA	Well suited	Well suited	Well suited	Poorly suited
Treadway: Tr	Poorly suited	Poorly suited	Poorly suited	Unsuited
Vernon: VeB, VeC	Suited	Suited	Well suited	Unsuited
Woodward: WoD	Suited	Suited	Well suited	Unsuited
For Quinlan part, see the Quinlan series.				
Yates	Poorly suited	Suited	Suited	Poorly suited
Mapped only with Talpa soils.				
Yomont: Ym, Yn, Yo	Well suited	Suited	Well suited	Poorly suited
For Quinlan part, see Quinlan series.				

for wildlife

Wildlife habitat elements—Continued		Kinds of wildlife		
Wetland food and cover plants	Shallow water developments	Openland wildlife	Brushland wildlife	Wetland wildlife
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Unsuited	Unsuited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Poorly suited	Suited	Unsuited.
Unsuited	Unsuited	Suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Suited	Suited	Unsuited.
Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
Suited	Well suited	Poorly suited	Poorly suited	Well suited.
Unsuited	Unsuited	Unsuited	Unsuited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Poorly suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.
Unsuited	Unsuited	Poorly suited	Unsuited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Unsuited	Unsuited	Suited	Suited	Unsuited.
Unsuited	Unsuited	Well suited	Suited	Unsuited.

TABLE 4.—*Engineering*

[Absence of an entry in a column indicates properties were not rated. An asterisk in the first column indicates that at least one mapping and for this reason it is necessary to follow carefully the instructions for referring to other series that

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
		Inches	*Inches*			
*Acme: Ac For Cottonwood part, see Cottonwood series.	C	10–20	0–18 18–56	Clay loam Soft gypsum.	CL	A–6
Altus: AlA	B	>60	0–10 10–64	Fine sandy loam Sandy clay loam	SM or ML SC or CL	A–2 or A–4 A–4 or A–6
Aspermont: AsB, AsC, AsD	B	>60	0–60	Silty clay loam	CL	A–7–6 or A–6
Badland. Mapped only in undifferentiated unit with the Owens series; properties too variable to rate.						
Bukreek: BuA, BuB	B	>60	0–8 8–40 40–74	Loam Clay loam Loam	ML–CL CL ML–CL, CL	A–4 A–6 A–4 or A–6
Bukreek, gravelly substratum: BvA, BvB.	B	>60	0–14 14–54 54–70 70–100	Loam Sandy clay loam Loam Gravel and fine sand	ML–CL CL CL, ML–CL GM	A–4 A–6 A–4, A–6 A–2
Clairemont: Ca	B	>60	0–8 8–96	Silt loam Silty clay loam	CL ML–CL	A–6 A–6
Cobb: CbB	B	20–48	0–6 6–36 36	Fine sandy loam Sandy clay loam Sandstone.	SM SC or CL	A–4 A–6
Colorado: Cd	B	>60	0–60	Clay loam	ML–CL	A–4 or A–6
*Cosh: CsB, CsC For Spade part, see Spade series.	C	12–20	0–6 6–18 18	Fine sandy loam Sandy clay loam Weakly cemented sandstone.	SM SC or CL	A–4 A–6
*Cottonwood: Ct For Owens part, see Owens series.	C	3–10	0–8 8–40	Loam Soft gypsum.	ML or CL	A–4
Devol: DeB	B	>60	0–18 18–50 50–85	Loamy fine sand Fine sandy loam Loamy fine sand	SM SM, ML SM	A–4 or A–2–4 A–2–4, A–4 A–2–4 or A–4
Enterprise: EnA, EnB, EnC	B	>60	0–64	Very fine sandy loam	ML or ML–CL	A–4
Frankirk: FnA, FnB	C	>60	0–16 16–35 35–48 48–85 85–100	Clay loam Clay Clay loam Sandy clay loam Loam	CL CL CL CL CL	A–6 A–6 A–6 A–6 A–6
Frio: Fo	B	>60	0–60	Silty clay loam	CL	A–6 or A–7–6
Hardeman: HaD	B	>60	0–60	Fine sandy loam	SM–SC or ML–CL	A–4
Hensley: HeA	C	20–40	0–5 5–36 36–46	Loam Clay Hard bedded limestone.	CL or SM or SC CL	A–6 or A–7–6 A–7
Hilgrave: HgD	B	>60	0–6 6–24 24–40	Gravelly sandy loam Gravelly sandy clay loam Gravel and fine sand	SM SM or GC GW or GM	A–2–4 A–1 A–3

properties of the soils

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, 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	80–95	60–75	0. 63–2. 0	0. 14–0. 18	7. 9–8. 4	Low.
100	100	90–100	30–60	0. 63–2. 0	0. 09–0. 13	6. 6–7. 3	Low.
100	100	90–100	40–60	0. 63–2. 0	0. 12–0. 16	6. 6–8. 4	Low.
100	98–100	95–98	75–90	0. 63–2. 0	0. 16–0. 20	7. 9–8. 4	Moderate.
100	100	95–100	65–75	0. 63–2. 0	0. 12–0. 16	6. 6–7. 3	Low.
100	100	95–100	75–85	0. 63–2. 0	0. 13–0. 17	7. 4–8. 4	Low.
85–90	80–90	80–90	55–80	0. 63–2. 0	0. 12–0. 16	7. 9–8. 4	Low.
100	100	95–100	65–75	0. 63–2. 0	0. 12–0. 16	7. 4–7. 8	Low.
100	100	95–100	75–85	0. 63–2. 0	0. 13–0. 17	7. 9–8. 4	Low.
85–95	80–90	80–90	55–65	0. 63–2. 0	0. 12–0. 16	7. 9–8. 4	Low.
50–70	40–60	20–30	0–5	6. 30–20. 0	0. 01–0. 05	7. 9–8. 4	Low.
100	100	100	85–98	0. 63–2. 0	0. 10–0. 18	7. 9–8. 4	Low.
100	100	100	85–98	0. 63–2. 0	0. 17–0. 19	7. 9–8. 4	Low.
100	98–100	70–85	38–50	2. 0–6. 3	0. 10–0. 13	6. 1–6. 5	Low.
95–98	90–99	90–98	45–55	0. 63–2. 0	0. 12–0. 15	6. 1–7. 3	Low.
100	100	80–95	60–75	0. 63–2. 0	0. 14–0. 18	7. 9–8. 4	Low.
95–100	90–100	70–85	35–50	2. 0–6. 3	0. 10–0. 13	6. 6–7. 3	Low.
90–98	90–98	90–98	45–55	0. 63–2. 0	0. 12–0. 15	6. 6–7. 3	Low.
100	100	90–100	65–75	0. 63–2. 0	0. 11–0. 14	7. 9–8. 4	Low.
100	100	50–75	30–50	2. 0–6. 3	0. 06–0. 09	6. 6–7. 3	Low.
100	100	70–85	30–60	2. 0–6. 3	0. 09–0. 13	6. 6–7. 8	Low.
100	100	50–75	30–50	2. 0–6. 3	0. 06–0. 09	7. 4–7. 8	Low.
100	100	95–99	80–90	2. 0–6. 3	0. 18–0. 20	7. 9–8. 4	Low.
100	100	100	60–65	0. 63–2. 0	0. 15–0. 18	6. 6–7. 3	Low.
100	100	100	70–80	0. 2–0. 63	0. 14–0. 17	7. 4–7. 8	Moderate.
100	100	100	60–65	0. 63–2. 0	0. 15–0. 18	7. 9–8. 4	Low.
100	100	100	55–75	0. 63–2. 0	0. 15–0. 18	7. 9–8. 4	Low.
100	100	85–95	55–65	0. 63–2. 0	0. 15–0. 20	7. 9–8. 4	Low.
95–100	95–100	75–100	70–95	0. 2–0. 63	0. 15–0. 20	7. 9–8. 4	Moderate.
95–98	90–95	85–90	40–65	2. 0–6. 3	0. 10–0. 13	7. 9–8. 4	Low.
93–99	90–98	85–95	35–65	2. 0–6. 3	0. 14–0. 18	6. 6–7. 3	Low.
90–95	85–95	80–90	60–75	0. 06–0. 2	0. 15–0. 19	6. 6–7. 8	Moderate.
75–90	65–85	35–45	5–10	6. 3–2. 0	0. 07–0. 10	6. 6–7. 3	Low.
25–40	15–30	10–25	8–12	2. 0–6. 3	0. 10–0. 12	6. 6–8. 4	Low.
65–80	35–45	10–25	5–10	6. 3–20. 0	0. 07–0. 10	7. 9–8. 4	Low.

TABLE 4.—*Engineering*

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
		Inches	*Inches*			
Hollister: HoA	D	>60	0–7	Silty clay loam	CL, ML	A–6 or A–7–6
			7–72	Clay	CH	A–7–6
			72–92	Clayey shale	CL or CH	A–7–6
Latom: Lc	D	4–20	0–8	Loam	SM or SM–SC	A–2–4
			8–14	Strongly cemented sandstone.		
Rock outcrop part too variable to rate.						
Likes: Lk	A	>60	0–64	Fine sand	SM or SM–SC	A–2–4
Lincoln: Ln	A	>60	0–10	Loamy fine sand	SM	A–4
			10–64	Fine sand	SM	A–2
Mangum: Ma	D	>60	0–7	Silty clay loam	MH–CH	A–7–6
			7–60	Clay	CH or CL	A–7–6
Miles: MlB, MlC, MnA, MnB, MnC, MnD.	B	>60	0–8	Fine sandy loam	SM	A–2–4 or A–4
			8–50	Sandy clay loam	SC or CL	A–6
			50–85	Sandy clay loam	SC or SM–SC	A–2–4 or A–6
Nipsum: NcB	C	>60	0–60	Clay	CL	A–6 or A–7–6
Nobscot: Ns	A	>60	0–32	Fine sand	SM or SP	A–3
			32–48	Fine sandy loam	SM or ML	A–2 or A–4
			48–90	Loamy sand	SM	A–3
Obaro: OaB, OaC	B	20–48	0–10	Very fine sandy loam	ML or CL	A–4
			10–34	Loam	CL, ML–CL	A–4 or A–6
			34–48	Weakly cemented silt or sandstone.	ML–CL	A–4
*Owens: Ob	D	12–20	0–16	Clay	CL or CH	A–7–6
			16–30	Shaly clay	CL or CH	A–6 or A–7–6
Badland part of Ob too variable to rate.						
Paducah: PdA, PdB, PdC	B	36–72	0–9	Very fine sandy loam	ML–CL	A–4
			9–48	Sandy clay loam	ML–CL	A–4
			48–68	Loam	ML, ML–CL	A–4
			68–75	Weakly consolidated sandy red-bed materials.		
Quanah: QhB	B	>60	0–60	Silt loam	ML or CL	A–4 or A–6
*Quinlan: Qr	C	10–20	0–16	Very fine sandy loam	ML, CL	A–4
			16–30	Weakly cemented packsands and silts.		
For Rough broken land part, see Rough broken land.						
Randall: Ra	D	>60	0–48	Clay	CH or CL	A–7–6 or A–6
			48–62	Silt loam	CL	A–6
Rock outcrop. Properties too variable to rate.						
Rotan: RnA	C	>60	0–8	Clay loam	CL	A–4 or A–6
			8–70	Clay	CL	A–7–6
			70–80	Clay loam	CL	A–6 or A–7–6
Rough broken land: Ro. Properties too variable to rate.						
Rowena: RwA	D	>60	0–8	Clay loam	CL	A–6 or A–7
			8–39	Clay	CH or CL	A–7
			39–60	Clay loam	CL	A–6 or A–7
Spade	B	20–40	0–22	Fine sandy loam	SM	A–4 or A–2–
			22–30	Loam	SM or CL	A–4
Mapped only with Cosh series.			30–40	Weakly cemented sandstone.		

properties of the soils—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*	
100	100	100	95–99	0. 06–0. 2	0. 14–0. 18	7. 4–7. 8	Moderate.
100	98–100	95–98	90–98	0. 06–0. 2	0. 15–0. 17	7. 4–8. 4	High.
100	100	95–99	90–98	0. 06–0. 2	0. 12–0. 16	7. 9–8. 4	High.
95–100	90–95	85–95	25–35	0. 63–2. 0	0. 10–0. 14	7. 9–8. 4	Low.
95–98	95–97	70–90	14–30	2. 0–6. 3	0. 04–0. 08	6. 6–8. 4	Low.
100	100	50–75	36–50	6. 3–20. 0	0. 06–0. 09	7. 9–8. 4	Low.
100	90–100	65–80	15–35	6. 3–20. 0	0. 04–0. 06	7. 9–8. 4	Low.
100	100	100	95–100	<0. 06	0. 15–0. 19	7. 9–8. 4	High.
100	100	100	90–100	<0. 06	0. 14–0. 18	7. 9–8. 4	High.
95–100	94–100	87–95	25–45	2. 0–6. 3	0. 11–0. 14	6. 6–7. 3	Low.
98–100	98–100	90–97	36–60	0. 63–2. 0	0. 13–0. 17	6. 6–7. 8	Low.
90–100	90–95	82–92	30–50	0. 63–2. 0	0. 12–0. 16	7. 4–8. 4	Low.
98–100	95–100	95–100	80–95	0. 06–0. 2	0. 13–0. 17	7. 9–8. 4	Moderate.
100	100	50–90	5–10	6. 3–20. 0	0. 04–0. 06	6. 1–6. 5	Low.
100	100	90–100	30–60	2. 0–6. 3	0. 09–0. 13	6. 1–6. 5	Low.
100	100	50–90	5–10	6. 3–20. 0	0. 04–0. 06	6. 1–6. 5	Low.
95–98	92–97	90–95	70–80	0. 63–2. 0	0. 12–0. 16	7. 9–8. 4	Low.
95–98	92–97	90–95	75–85	0. 63–2. 0	0. 12–0. 16	7. 9–8. 4	Low.
95–99	90–99	90–98	60–75	0. 63–2. 0	0. 04–0. 08	7. 9–8. 4	Low.
95–100	95–100	90–100	80–95	<0. 06	0. 13–0. 19	7. 9–8. 4	High.
90–100	85–100	70–90	55–80	<0. 06	0. 13–0. 15	7. 9–8. 4	High.
100	100	95–100	55–65	0. 63–2. 0	0. 14–0. 18	6. 6–7. 3	Low.
100	96–99	95–99	55–65	0. 63–2. 0	0. 15–0. 19	6. 6–7. 8	Low.
100	100	95–100	55–65	0. 63–2. 0	0. 16–0. 18	7. 9–8. 4	Low.
90–100	90–95	85–100	75–95	0. 2–0. 63	0. 15–0. 18	7. 9–8. 4	Low.
100	100	90–100	55–85	2. 0–6. 3	0. 12–0. 14	7. 9–8. 4	Low.
100	100	96–100	60–98	<0. 06	0. 14–0. 18	6. 6–8. 4	High.
100	90–95	85–100	75–95	0. 63–2. 0	0. 14–0. 16	7. 9–8. 4	Low.
100	100	95–99	70–85	0. 63–0. 2	0. 15–0. 19	7. 4–7. 8	Moderate.
100	100	95–99	80–95	0. 2–0. 63	0. 14–0. 18	7. 4–8. 4	High.
100	90–100	90–98	75–90	0. 2–0. 63	0. 12–0. 15	7. 9–8. 4	Moderate.
95–100	90–100	85–100	70–85	0. 2–0. 63	0. 15–0. 20	7. 9–8. 4	Moderate.
95–100	95–100	90–100	75–95	0. 2–0. 63	0. 14–0. 18	7. 9–8. 4	High.
95–100	90–100	85–90	70–85	0. 2–0. 63	0. 15–0. 17	7. 9–8. 4	Moderate.
100	98–100	75–90	30–50	2. 0–6. 3	0. 10–0. 14	7. 9–8. 4	Low.
100	100	95–100	40–55	2. 0–6. 3	0. 11–0. 14	7. 9–8. 4	Low.

TABLE 4.—*Engineering*

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Classification		
				USDA texture	Unified	AASHO
		Inches	*Inches*			
Springer: SgB	B	>60	0–18	Loamy fine sand	SM or SP–SM	A–3, A–2–4
			18–90	Fine sandy loam	SM or SM–SC	A–2–4 or A–4
St. Paul: SpA	B	>60	0–8	Silt loam	ML, CL	A–4
			8–80	Clay loam	CL	A–6
*Talpa: Ta	D	5–14	0–8	Clay loam	CL	A–6, A–7–6
			8–10	Hard limestone.		
For Yates part, see Yates series.						
Tillman: TcA, TcB	C	>60	0–7	Clay loam	CL	A–7–6, A–6
			7–65	Clay	CH, CL	A–7–6, A–6
			65–90	Shaly clay	CL, CH	A–7–6, A–6
Tipton: TpA	B	>60	0–9	Loam	ML, CL	A–4
			9–64	Clay loam	CL, ML	A–6 or A–4
			64–90	Loam	ML, CL	A–4
Treadway: Tr	D	15–36	0–6	Silty clay loam	CL or ML	A–6 or A–7
			6–24	Clay	CH or CL	A–7
			24–70	Partially weathered red-bed clay.		
Vernon: VeB, VeC	B	20–36	0–7	Clay loam	CL	A–6 or A–7–6
			7–30	Clay	CL, CH	A–6 or A–7–6
			30–48	Shaly clay	CL, CH	A–6 or A–7–6
*Woodward: WoD	B	20–48	0–34	Very fine sandy loam	ML, CL	A–4
			34–50	Weakly cemented sandstone.		
For Quinlan part, see Quinlan series.						
Yates	D	4–10	0–6	Clay loam	CL or SC	A–6
			6–10	Hard limestone.		
Mapped only with the Talpa series.						
*Yomont: Ym, Yn, Yo	B	>60	0–60	Very fine sandy loam	ML or ML–CL	A–4
For Quinlan part of Yo, see Quinlan series.						

TABLE 5.—*Interpretations of engineering*

[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 referring to other series that appear in the first column of this

Soil series and map symbols	Suitability as a source of—		Degree of limitations and soil features affecting—	
	Topsoil	Road subgrade	Highway location	Foundations for low buildings
*Acme: Ac	Fair: clay loam.	Poor: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
For Cottonwood part, see Cottonwood series.				
Altus: AlA	Poor where 5 to 6 inches of fine sandy loam. Fair where 6 to 15 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight

properties of the soils—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*	
100	95–100	70–85	8–25	6. 3–20. 0	0. 07–0. 09	6. 6–7. 3	Low.
100	95–100	80–95	11–35	2. 0–6. 3	0. 09–0. 14	6. 6–7. 8	Low.
100	100	100	75–90	0. 63–2. 0	0. 16–0. 20	6. 6–7. 8	Low.
100	100	100	80–90	0. 2–0. 63	0. 14–0. 18	7. 4–8. 4	Moderate.
75–95	70–95	70–85	65–80	0. 63–2. 0	0. 12–0. 16	7. 9–8. 4	Moderate.
100	95–100	90–98	70–80	0. 2–0. 63	0. 18–0. 20	7. 4–8. 4	Moderate.
95–100	95–100	95–98	85–95	0. 06–0. 2	0. 14–0. 18	7. 9–8. 4	High.
95–100	85–100	80–90	75–95	0. 06–0. 2	0. 13–0. 17	7. 9–8. 4	Moderate.
100	100	90–100	60–85	0. 63–2. 0	0. 12–0. 14	6. 6–7. 3	Low.
100	100	90–100	75–85	0. 63–2. 0	0. 17–0. 19	6. 6–8. 4	Moderate.
100	100	90–100	60–85	0. 63–2. 0	0. 12–0. 14	7. 9–8. 4	Low.
100	100	95–100	85–95	0. 06–0. 2	0. 15–0. 19	7. 9–8. 4	Moderate.
100	100	95–100	90–98	<0. 06	0. 14–0. 18	7. 9–8. 4	High.
95–100	90–100	90–100	80–85	0. 06–0. 2	0. 13–0. 17	7. 9–8. 4	Moderate.
95–100	90–100	95–100	80–95	<0. 06	0. 15–0. 17	7. 9–8. 4	High.
95–100	85–100	65–100	70–90	<0. 06	0. 08–0. 12	7. 9–8. 4	High.
100	100	90–100	55–85	0. 63–2. 0	0. 13–0. 15	7. 9–8. 4	Low.
75–90	70–90	70–80	35–65	0. 63–2. 0	0. 07–0. 10	7. 4–7. 8	Low.
100	100	100	55–65	2. 0–6. 3	0. 16–0. 20	7. 9–8. 4	Low.

properties of the soils

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for table. Absence of entry in a column indicates that properties were not rated]

Degree of limitations and soil features affecting—Continued				Soil features affecting—		Corrosivity class for uncoated steel pipe, and contributing soil features
Septic tank filter fields	Sewage lagoons	Farm ponds		Terraces and diversions	Waterways	
		Reservoir areas	Embankments			
Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: 10 to 20 inches of material.	Bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	High: conductivity.
Slight	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	Moderate: sandy clay loam.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—		Degree of limitations and soil features affecting—	
	Topsoil	Road subgrade	Highway location	Foundations for low buildings
Aspermont: AsB, AsC, AsD	Fair: silty clay loam.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate where slopes are less than 6 percent; moderate shrink-swell potential. Severe where slopes are 6 to 12 percent.
Badland: Mapped only in undifferentiated unit with the Owens series; properties too variable to rate.				
Bukreek: BuA, BuB	Fair: 6 to 10 inches of loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
Bukreek, gravelly substratum: BvA, BvB	Fair: 10 to 18 inches of loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
Clairemont: Ca	Fair where 6 to 14 inches of silt loam. Poor where 4 to 6 inches of silt loam.	Fair: fair traffic-supporting capacity.	Moderate: floods once in 5 years; fair traffic-supporting capacity.	Severe: flood hazard.
Cobb: CbB	Fair: 6 to 12 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
Colorado: Cd	Fair: clay loam.	Fair: fair traffic-supporting capacity.	Severe: floods four times in 5 years.	Severe: subject to flooding.
*Cosh: CsB, CsC For Spade part, see Spade series.	Fair where 6 to 10 inches of fine sandy loam. Poor where 4 to 6 inches of fine sandy loam.	Poor: bedrock at depth of 12 to 20 inches.	Severe: bedrock at depth of 12 to 20 inches.	Severe: bedrock at depth of 12 to 20 inches.
*Cottonwood: Ct For Owens part, see Owens series.	Fair where 6 to 10 inches of loam. Poor where 3 to 6 inches of loam.	Poor: bedrock at depth of 3 to 10 inches.	Severe: bedrock at depth of 3 to 10 inches.	Severe: bedrock at depth of 3 to 10 inches.

properties of the soils—Continued

Degree of limitations and soil features affecting—Continued				Soil features affecting—		Corrosivity class for uncoated steel pipe, and contributing soil features
Septic tank filter fields	Sewage lagoons	Farm ponds: Reservoir areas	Farm ponds: Embankments	Terraces and diversions	Waterways	
Moderate where slopes are less than 10 percent; moderate permeability. Severe where slopes are 10 to 12 percent.	Moderate where slopes are less than 7 percent; moderate permeability. Severe where slopes are 7 to 12 percent.	Moderate: moderate permeability.	Moderate: fair resistance to piping and erosion.	Slope	Slope	Moderate: silty clay loam.
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	Moderate: corrosivity.
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	Moderate: corrosivity.
Moderate: floods once in 5 years.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	All features favorable; floods once in 5 years.	All features favorable; floods once in 5 years.	High: silty clay loam.
Moderate where bedrock is at a depth of 24 to 48 inches; moderate permeability. Severe where bedrock is at a depth of 20 to 24 inches.	Moderate where bedrock is at a depth of 40 to 48 inches; moderate permeability. Severe where bedrock is at a depth of 20 to 40 inches.	Moderate where bedrock is at a depth of 36 to 48 inches; moderate permeability. Severe where bedrock is at a depth of 20 to 36 inches.	Moderate where 24 to 48 inches of material; fair resistance to piping and erosion. Severe where 20 to 24 inches of material.	Bedrock at depth of 20 to 48 inches.	Bedrock at depth of 20 to 48 inches.	Low.
Severe: floods four times in 5 years.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: fair resistance to piping and erosion.	Floods four times in 5 years.	Floods four times in 5 years.	Moderate: clay loam.
Severe: bedrock at depth of 12 to 20 inches.	Severe: bedrock at depth of 12 to 20 inches.	Severe: bedrock at depth of 12 to 20 inches.	Severe: 12 to 20 inches of material.	Bedrock at depth of 12 to 20 inches.	Bedrock at depth of 12 to 20 inches.	Low.
Severe: bedrock at depth of 3 to 10 inches.	Severe: bedrock at depth of 3 to 10 inches.	Severe: bedrock at depth of 3 to 10 inches.	Severe: 3 to 10 inches of material.	Bedrock at depth of 3 to 10 inches.	Bedrock at depth of 3 to 10 inches.	High: conductivity.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—		Degree of limitations and soil features affecting—	
	Topsoil	Road subgrade	Highway location	Foundations for low buildings
Devol: DeB	Poor: loamy fine sand.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
Enterprise: EnA, EnB, EnC	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
Frankirk: FnA, FnB	Fair where 6 to 9 inches of clay loam. Poor where 5 to 6 inches of clay loam.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.
Frio: Fo	Fair: silty clay loam.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Severe: flooding hazard.
Hardeman: HaD	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: 5 to 12 percent slopes.
Hensley, moderately deep variant: HeA	Fair where 6 to 8 inches of loam. Poor where 4 to 6 inches of loam.	Fair where 24 to 40 inches of material; fair traffic-supporting capacity; moderate shrink-swell potential. Poor where 20 to 24 inches of material.	Fair where bedrock is at a depth of 24 to 40 inches; fair traffic-supporting capacity; moderate shrink-swell potential. Severe where bedrock is at a depth of 20 to 24 inches.	Severe: bedrock at depth of 20 to 40 inches.
Hilgrave: HgD	Poor: 35 to 70 percent gravel.	Good	Slight where slopes are 3 to 6 percent. Moderate where slopes are 6 to 8 percent.	Slight where slopes are 3 to 6 percent. Moderate where slopes are 6 to 8 percent.
Hollister: HoA	Fair: 6 to 10 inches of silty clay loam.	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.

properties of the soils—Continued

Degree of limitations and soil features affecting—Continued				Soil features affecting—		Corrosivity class for uncoated steel pipe, and contributing soil features
Septic tank filter fields	Sewage lagoons	Farm ponds: Reservoir areas	Farm ponds: Embankments	Terraces and diversions	Waterways	
Slight	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: fair slope stability; poor resistance to piping and erosion.	Soils unstable	Soils unstable	Low.
Slight	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	Low.
Severe: moderately slow permeability.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 3 percent.	Moderate: moderately slow permeability.	Moderate: fair resistance to piping and erosion.	All features favorable.	All features favorable.	High: clay.
Severe: moderately slow permeability.	Slight	Moderate: moderately slow permeability.	Moderate: fair resistance to piping and erosion.	Floods once in 5 years.	Floods once in 5 years.	High: resistivity.
Moderate where slopes are 5 to 10 percent. Severe where slopes are 10 to 12 percent.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	5 to 12 percent slopes; soil unstable.	5 to 12 percent slopes; soil unstable.	Low.
Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate where bedrock is at a depth of 36 to 40 inches. Severe where bedrock is at a depth of 20 to 36 inches.	Moderate: poor resistance to piping and erosion.	Bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	High: clay.
Slight where slopes are 3 to 5 percent. Moderate where slopes are 5 to 8 percent.	Severe: moderately rapid permeability; slopes 7 to 8 percent.	Severe: moderately rapid permeability.	Severe: high permeability.	35 to 70 percent gravel; 3 to 8 percent slopes.	35 to 70 percent gravel; 3 to 8 percent slopes.	Low.
Severe: slow permeability.	Slight	Slight	Moderate: fair slope stability.	Clay at depth of 6 to 10 inches.	Clay at depth of 6 to 10 inches.	High: clay.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—		Degree of limitations and soil features affecting—	
	Topsoil	Road subgrade	Highway location	Foundations for low buildings
*Latom: Lc For Rock outcrop part, see Rock outcrop.	Fair where 6 to 20 inches of loam. Poor where 4 to 6 inches of loam.	Poor: 4 to 20 inches of suitable material.	Severe: bedrock at depth of 4 to 20 inches.	Severe: bedrock at depth of 4 to 20 inches.
Likes: Lk	Poor: fine sand.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity; slopes 6 to 8 percent.	Slight
Lincoln: Ln	Poor: loamy sand and fine sand.	Good	Severe: flooding hazard.	Severe: flooding hazard.
Mangum: Ma	Fair where 6 to 12 inches of silty clay loam. Poor where 4 to 6 inches of silty clay loam.	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: poor traffic-supporting capacity; high shrink-swell potential; flooding hazard.	Severe: flooding hazard; high shrink-swell potential.
Miles: MIB, MIC	Poor: loamy fine sand.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
MnA, MnB, MnC, MnD	Fair: 7 to 14 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
Nipsum: NcB	Poor: clay	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: shrink-swell potential.
Nobscot: Ns	Poor: fine sand.	Good	Slight	Slight

properties of the soils—Continued

Degree of limitations and soil features affecting—Continued				Soil features affecting—		Corrosivity class for uncoated steel pipe, and contributing soil features
Septic tank filter fields	Sewage lagoons	Farm ponds		Terraces and diversions	Waterways	
		Reservoir areas	Embankments			
Severe: bedrock at depth of 4 to 20 inches.	Severe: bedrock at depth of 4 to 20 inches.	Severe: bedrock at depth of 4 to 20 inches.	Severe: 4 to 20 inches of material.	Bedrock at depth of 4 to 20 inches.	Bedrock at depth of 4 to 20 inches.	Low.
Slight where slopes are 3 to 5 percent. Moderate where slopes are 5 to 8 percent.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.	Unstable material.	Unstable material.	Low.
Severe: flooding hazard.	Severe: rapid permeability.	Severe: rapid permeability.	Moderate: fair slope stability; poor resistance to piping and erosion.	Unstable material; flood hazard.	Unstable material; flood hazard.	Low.
Severe: very slow permeability.	Slight	Slight	Severe: fair slope stability; poor resistance to piping and erosion.	Floods four times in 5 years.	Floods four times in 5 years.	High: clay.
Slight	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	14 inches of unstable loamy fine sand.	14 inches of unstable loamy fine sand.	Moderate: sandy clay loam.
Slight where slopes are 0 to 5 percent. Moderate where slopes are 5 to 8 percent.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	Moderate: sandy clay loam.
Severe: slow permeability.	Slight	Slight	Moderate: fair resistance to piping and erosion.	All features favorable.	All features favorable.	High: clay.
Slight	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Severe: poor slope stability; rapid permeability; poor resistance to piping and erosion.	Unstable sand	Unstable sand	Low.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of		Degree of limitations and soil features affecting—	
	Topsoil	Road subgrade	Highway location	Foundations for low buildings
Obaro: OaB, OaC	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
*Owens: Ob For Badland part, see Badland.	Poor: clay	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.
Paducah: PdA, PdB, PdC	Fair: 6 to 12 inches of very fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
Quanah: QhB	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight
*Quinlan: Qr For Rough broken land part of Qr, see Rough broken land.	Fair: 10 to 20 inches of very fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Severe: bedrock at depth of 10 to 20 inches.
Randall: Ra	Poor: clay	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: flooding hazard; high shrink-swell potential.	Severe: flooding hazard; high shrink-swell potential.
Rock outcrop. Mapped only in a complex with the Latom series; properties too variable to rate.				
Rotan: RnA	Fair: 6 to 10 inches of clay loam.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.
Rough broken land: Ro. Properties too variable to rate.				

properties of the soils—Continued

Degree of limitations and soil features affecting—Continued				Soil features affecting—		Corrosivity class for uncoated steel pipe, and contributing soil features
Septic tank filter fields	Sewage lagoons	Farm ponds		Terraces and diversions	Waterways	
		Reservoir areas	Embankments			
Severe: bedrock at depth of 20 to 48 inches.	Moderate where bedrock is at a depth of 40 to 48 inches. Severe where bedrock is at a depth of 20 to 40 inches.	Moderate where bedrock is at a depth of 36 to 48 inches. Severe where bedrock is at a depth of 20 to 36 inches.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	Low.
Severe: very slow permeability.	Moderate where slopes are 2 to 7 percent. Severe where slopes are 7 to 10 percent.	Slight	Moderate: fair slope stability; medium compressibility; fair resistance to piping and erosion.	Bedrock at depth of 12 to 20 inches.	Bedrock at depth of 12 to 20 inches.	High: clay.
Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: fair slope stability; poor resistance to piping and erosion.	All features favorable.	All features favorable.	Moderate: sandy clay loam.
Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Moderate: moderately slow permeability.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	Moderate: moderate resistivity.
Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches; moderately rapid permeability.	Severe: 10 to 20 inches of material.	5 to 12 percent slopes.	5 to 12 percent slopes.	Low.
Severe: very slow permeability.	Slight	Slight	Moderate: fair slope stability; fair resistance to piping and erosion.	Flood hazard	Flood hazard	High: clay; poorly drained.
Severe: moderately slow permeability.	Slight	Moderate: moderately slow permeability.	Moderate: fair resistance to piping and erosion.	All features favorable.	All features favorable.	High: clay.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—		Degree of limitations and soil features affecting—	
	Topsoil	Road subgrade	Highway location	Foundations for low buildings
Rowena: RwA	Fair: 6 to 10 inches of clay loam.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.
Spade Mapped only in an undifferentiated unit with the Cosh series.	Good	Fair where 24 to 40 inches of material. Poor where 20 to 24 inches of material.	None to slight where bedrock is at a depth of 36 to 40 inches. Moderate: where bedrock is at a depth of 20 to 36 inches.	Slight
Springer: SgB	Poor: loamy fine sand.	Fair: fair traffic-supporting capacity.	Slight	Slight
St. Paul: SpA	Fair: 7 to 14 inches of silt loam.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: shrink-swell potential.
*Talpa: Ta For Yates part, see Yates series.	Fair where 5 to 10 percent coarse fragments. Poor where 10 to 20 percent coarse fragments.	Poor: 5 to 14 inches of material.	Severe: bedrock at depth of 5 to 14 inches.	Severe: bedrock at depth of 5 to 14 inches.
Tillman: TcA, TcB	Fair where 6 to 11 inches of clay loam. Poor where 5 to 6 inches of clay loam.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.
Tipton: TpA	Fair: 9 to 15 inches of loam.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.

properties of the soils—Continued

Degree of limitations and soil features affecting—Continued				Soil features affecting—		Corrosivity class for uncoated steel pipe, and contributing soil features
Septic tank filter fields	Sewage lagoons	Farm ponds		Terraces and diversions	Waterways	
		Reservoir areas	Embankments			
Severe: moderately slow permeability.	Slight	Moderate: moderately slow permeability.	Moderate: fair slope stability; high compressibility; good to fair resistance to piping and erosion.	All features favorable.	All features favorable.	High: clay.
Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches; moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate where bedrock is at a depth of 24 to 40 inches; poor resistance to piping and erosion. Severe where bedrock is at a depth of 20 to 24 inches.	Bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	Low.
Slight	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Severe: poor slope stability; poor resistance to piping and erosion.	12 to 20 inches of loose loamy fine sand.	12 to 20 inches of loose loamy fine sand.	Low.
Severe: moderately slow permeability.	Slight: moderately slow permeability.	Moderate: moderately slow permeability.	Moderate: poor resistance to piping and erosion.	All features favorable.	All features favorable.	Moderate: clay loam.
Severe: bedrock at depth of 5 to 14 inches.	Severe: bedrock at depth of 5 to 14 inches.	Severe: bedrock at depth of 5 to 14 inches.	Severe: 5 to 14 inches of material.	Bedrock at depth of 5 to 14 inches.	Bedrock at depth of 5 to 14 inches.	High: resistivity.
Severe: slow permeability.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 3 percent.	Slight	Moderate: high compressibility; fair slope stability.	All features favorable.	All features favorable.	High: clay.
Slight	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: poor resistance to piping and erosion; fair slope stability.	All features favorable.	All features favorable.	Moderate: clay loam.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as a source of—		Degree of limitations and soil features affecting—	
	Topsoil	Road subgrade	Highway location	Foundations for low buildings
Treadway: Tr	Fair where 6 to 7 inches of silty clay loam. Poor where 5 to 6 inches of silty clay loam.	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.
Vernon: VeB, VeC	Fair where 6 to 10 inches of clay loam Poor where 5 to 6 inches of clay loam.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.
*Woodward: WoD For Quinlan part, see Quinlan series.	Good	Fair where 24 to 48 inches of material; fair traffic-supporting capacity. Poor where 20 to 24 inches of material.	Moderate: fair traffic-supporting capacity.	Moderate: 5 to 12 percent slopes.
Yates Mapped only in a complex with the Talpa series.	Poor: 35 to 50 percent coarse fragments.	Poor: 4 to 10 inches of material.	Severe: bedrock at depth of 4 to 10 inches.	Severe: bedrock at depth of 4 to 10 inches.
*Yomont: Ym, Yn, Yo For Quinlan part of Yo, see Quinlan series.	Good	Fair: fair traffic-supporting capacity.	Severe: flooding hazard.	Severe: flooding hazard.

properties of the soils—Continued

Degree of limitations and soil features affecting—Continued				Soil features affecting—		Corrosivity class for uncoated steel pipe, and contributing soil features
Septic tank filter fields	Sewage lagoons	Farm ponds: Reservoir areas	Farm ponds: Embankments	Terraces and diversions	Waterways	
Severe: very slow permeability.	Slight	Slight	Moderate: poor resistance to piping and erosion; high compressibility; fair slope stability.	Very slow permeability; ponding hazard.	Cuts expose clayey material.	High: clay.
Severe: very slow permeability.	Slight where slopes are 1 to 2 percent. Moderate where slopes are 2 to 5 percent.	Slight	Moderate: fair to good resistance to piping and erosion.	Very slow permeability; cuts expose clayey material.	Cuts expose clayey material.	High: clay.
Severe: bedrock at depth of 20 to 48 inches.	Moderate where bedrock is at a depth of 40 to 48 inches; moderate permeability. Severe where bedrock is at a depth of 20 to 40 inches.	Moderate: moderate permeability.	Moderate where 24 to 48 inches of material; poor resistance to piping and erosion. Severe where 20 to 24 inches of material.	5 to 12 percent slopes; bedrock at depth of 20 to 48 inches.	5 to 12 percent slopes; bedrock at depth of 20 to 48 inches.	Low.
Severe: bedrock at depth of 4 to 10 inches.	Severe: bedrock at depth of 4 to 10 inches.	Severe: bedrock at depth of 4 to 10 inches.	Severe: 4 to 10 inches of material.	Bedrock at depth of 4 to 10 inches.	Bedrock at depth of 4 to 10 inches.	Low.
Severe: flooding hazard.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: fair slope stability; poor resistance to piping and erosion.	Flooding hazard.	Flooding hazard.	Moderate: resistivity.

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*	
Aspermont silty clay loam: 2.3 miles south of Aspermont, on U.S. Highway 83; 100 feet west of highway (modal).	Clayey Permian red beds.	69–304–R 69–305–R	8–20 20–40	14 14	13. 7 13. 3	1. 93 1. 93
Bukreek loam: 9.5 miles southwest of Aspermont, on Farm Road 610; 150 feet north in cultivated field (modal).	Loamy alluvium.	69–308–R 69–309–R	14–34 42–64	16 15	9. 4 9. 7	1. 84 1. 89
Frankirk clay loam: 3.8 miles east of Old Glory; 100 feet north in cultivated field (modal).	Loamy old alluvium (river terrace).	69–306–R 69–307–R	16–35 48–64	17 17	10. 2 5. 1	1. 86 1. 83
Nipsum clay: 3 miles south of Aspermont on U.S. Highway 83, 3 miles east on county road; continue 1.5 miles east on oilfield road; 1 mile north on oilfield road; continue 400 feet north in pasture (modal).	Clayey outwash material.	69–302–R 69–303–R	10–28 28–44	15 13	12. 7 14. 5	1. 89 2. 02
Yomont very fine sandy loam: 14 miles east of Aspermont, on U.S. Highway 380; 400 feet in cultivated field southeast of south end of bridge over Double Mountain Fork of Brazos River (modal).	Alluvium.	69–310–R	8–54	22	1. 8	1. 63

[1] Mechanical analyses according to AASHO Designation T 88 (*1*). 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

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 here reported. The estimated values for traffic-supporting capacity expressed in words should not be assigned specific values. Estimates are generally made to depths of about 5 feet, and interpretations do not apply to greater depths. Included in the mapping units are small areas of other soils 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 *gravel*, *sand*, *silt*, *clay*, *loam*, *surface soil*, *subsoil*, and *horizon*. These and other terms are defined in the Glossary at the back of this publication.

Engineering classification systems

The three systems most commonly used in classifying soil materials for engineering use are the USDA system devised by the United States Department of Agriculture; the Unified soil classification system used by the SCS engineers, Department of Defense, and others; and the AASHO system (*1*) adapted by the American Association of State Highway officials.

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.

In the Unified soil classification system, soils are classified according to particle-size distribution, plasticity index, liquid limit, and organic matter. Soils are grouped into 15 classes. 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 (*8*). In some soils a range is given for both AASHO and Unified systems, because the soils showed a corresponding range in characteristics when observed in the field. This information is useful in helping to determine suitability of a soil as a source of material for construction purposes. Soils on the borderline between two classes are designated by a symbol, such as ML–CL or SM–SC.

The AASHO system is used to classify soils according

test data

procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [1]								Liquid limit	Plasticity index	Classification [2]	
Percentage passing sieve—					Percentage smaller than—						
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	99	97	88	82	48	40	42	25	A–7–6(14)	CL
---	100	99	96	89	80	47	38	41	26	A–7–6(15)	CL
---	---	---	100	81	63	33	31	35	19	A–6(12)	CL
97	93	89	86	77	66	33	27	34	19	A–6(12)	CL
---	---	---	100	78	67	39	35	37	20	A–6(12)	CL
---	---	---	100	73	56	23	20	26	12	A–6(9)	CL
100	99	98	97	94	89	50	41	42	23	A–7–6(13)	CL
100	99	98	95	91	87	50	42	43	26	A–7–6(15)	CL
---	---	---	100	60	40	6	5	24	3	A–4(5)	CL or ML

in this table are not suitable for use in naming textural classes for soil.

[2] Unified and AASHO classification made by SCS personnel.

[3] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. I, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes (*1*).

[4] Based on the Unified Soil Classification System for roads, airfields, embankments, and foundations (*8*).

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. In group A–1 are gravelly soils of high shear strength, or the best soils for subgrade (foundation) and, at the other extreme, clay soils that have low strength when wet. The best soils for subgrade are therefore classified as A–1, the next best A–2, and so on to class A–7, the poorest soils for subgrade. If soil material is near a classification boundary, it is given a symbol showing both classes: for example, A–2 or A–4.

Within each group, the relative engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The AASHO classification for tested soils, with index numbers in parentheses, is shown in table 6; the estimated classification for all soil mapped in the County is given in table 4.

Estimated soil properties significant to engineering

Table 4 provides estimates of soil properties important to engineering. The estimates are based on field classification and descriptions, test data from comparable soils in adjacent areas and from detailed experience in working with the individual kind of soil in the survey area.

In the column headed "Hydrologic group," the soils are placed in one of four groups 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.

Soils in hydrologic group A have high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well drained to excessively drained sands, gravel, or both. These soils have a high rate of water transmission and a low runoff potential.

Soils in hydrologic group B have moderate infiltration rates when thoroughly wetted. They consist chiefly of moderately deep to deep, moderately well drained to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission and a moderate runoff potential.

Soils in hydrologic group C have slow infiltration rates when thoroughly wetted. They consist chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils having moderately fine to fine texture and slow infiltration rate or (3) soils shallow over nearly impervious materials. These soils have a slow water transmission and a very high runoff potential.

Soils in hydrologic group D have very slow infiltration rates when thoroughly wetted. They 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.

The column headed "Depth to bedrock" indicates the depth in inches at which consolidated materials may be found.

In the column headed "Depth from surface," the depth, in inches, is given for the major distinctive layers of the soil profile. This profile is one described as typical for each series in the section "Descriptions of the Soils," and the layers indicated are those typical of the layers in all the soils of the series.

In the column headed "Percentage passing sieve," estimates are given for a range in percentage of soil materials passing four different sieve sizes. This information is useful in helping to determine suitability of the soil as material for construction purposes.

Permeability 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 soil are not considered.

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.

A column was not included for salinity because salinity is not a problem in any of the soils of the county.

A column was not included for seasonal water table because a high water table is not a problem in most soils of the county. Lincoln soils have a water table at a depth of 5 to 8 feet. Temporary flooding may occur on the Clairemont, Colorado, Frio, Lincoln, Mangum, Randall, and Yomont soils.

Interpretations of engineering properties 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 some important desirable features also are listed. The ratings and other interpretations in this table are based on estimated engineering properties of the soils in table 4 and on field experience. Although, strictly interpreted, the information applies only to soil depths indicated in table 4, it is reasonably reliable to depths of about 6 feet for most soils, and several feet more for some others. Following are explanations of some of the terms used in table 5.

Topsoil is fertile soil or soil material, ordinarily rich in organic matter, used as a topdressing for lawns, gardens, roadbanks, and the like. The ratings indicate suitability for such use.

Road subgrade is material used to build embankments. The ratings indicate performance of soil material moved from borrow areas for these purposes. The need for sand and gravel is frequently a factor in building roads and other soil-related structures.

Soils of this county were not rated as a source of these materials, because most of the soils of Stonewall County do not have sufficient quantities of the two to warrant consideration. The soils that are a fair source of sand and gravel are: Bukreek loam, gravelly substratum, Devol, Hilgrave, Likes, Lincoln, Nobscot, and Springer. Talpa and Yates soils are poor sources of sand and gravel but have limestone, at a depth of 4 to 14 inches, which may be a source for crushing.

Foundations for low buildings are affected chiefly by features of the undisturbed soil that influence its capacity to support low buildings that have normal foundation loads.

Septic tank filter fields are affected mainly by permeability, location of water table, and susceptibility to flooding. The degree of limitations and principal reasons for assigning moderate or severe limitations are given.

Sewage lagoons are influenced chiefly by soil features such as permeability, location of water table, and slope. The degree of limitation and principal reasons for assigning moderate of severe limitations are given.

Farm pond reservoir areas are affected mainly by seepage loss of water, and the soil features are those that influence such seepage.

Farm pond embankments serve as dams. The soil features, of both subsoil and substratum, are those important to the use of soils for constructing embankments. Irrigation has been omitted from this table because there is only a small acreage of land irrigated by wells that produce a small amount of poor quality water.

Terraces and diversions are affected by cracking, thickness of the soil for construction, and slopes. These structures are not ordinarily used on some soils.

Waterways are natural or shaped watercourses, covered with closely growing grass, that are used to carry off excess water from the terrace system. Soil features indirectly affecting waterways are cracking, water holding capacity, and soil structure, since they directly affect grass growth, thickness of the soil, slope, and erosiveness.

Corrosivity is rated at a depth of 4 feet. Soil properties affecting corrosion of uncoated steel pipe are drainage, texture, acidity, resistivity, and conductivity. Properties that affect corrosion of concrete include texture and reaction, amount of sodium or magnesium sulfate or sodium chloride present in the soil. A column was not included for concrete because all the soils of the county rated low for corrosivity of concrete.

Engineering test data

Table 6 contains the results of engineering tests performed by the Texas Highway Department on several soils in Stonewall 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. The surface layer was not tested. Following are explanations of some of the terms used as headings in table 6.

Parent material is the disintegrated and partly weathered rock from which the soil has formed.

Depth from surface indicates the depth and thickness of the layers for which tests were made. The thickness of the layers varies somewhat from place to place, but the thickness and other properties described are those actually obtained in a specific profile of the soil described.

Shrinkage limit is a measurement of the moisture content at which shrinkage stops. As moisture leaves a soil, the soil decreases in volume in proportion to the loss in moisture, until a point is reached where shrinkage stops even though additional moisture is removed.

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 stipulated percentage to the shrinkage limit.

Shrinkage ratio is the ratio of a given volume change, expressed as a percentage of the dry volume, to the corresponding change in water content above the shrinkage limit, expressed as a percentage of the weight of the oven-dried soil.

Mechanical analyses show the percentage, by weight, of soil particles that pass sieves of specified sizes. Sand and other coarse materials do not pass through the No. 200 sieve, but silt and clay do pass through the No. 200 sieve. Silt is that material larger than 0.002 millimeter in diameter that passes through the No. 200 sieve, and clay is that fraction passing through the No. 200 sieve that is smaller than 0.002 millimeter in diameter. The clay fraction was determined by the hydrometer method, rather than the pipette method most soil scienists 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.

Use of the Soils as Recreational Areas

Outdoor recreation needs in Stonewall County are increasing rapidly. The demands on rural areas can be mutually beneficial to landowners and persons seeking recreational outlets. The soils of Stonewall County are suited to many kinds of outdoor activities. In table 7, the soils are rated as to suitability for recreation.

Table 7 can be used as a general guide in selecting sites for recreational activities. This table gives the degree and kind of limitation of each soil in the county for use as campsites, picnic areas, playgrounds, paths, and trails. The limitations are based on soil characteristics. Esthetic factors that affect the desirability of the site, such as the number of trees or lakes, were not considered. Some soils that have severe limitations are in scenic locations, but these soils would require extensive preparation and maintenance.

Camp areas are tent and trailer sites, and their suitability for the accompanying outdoor activities determined their rating. The site should require little preparation and be suitable for unsurfaced parking for cars and camp trailers.

Picnic areas are rated according to soil features only, so that esthetic factors such as the presence of trees or lakes on the site, which may affect its desirability, are not considered in rating. Factors significant in rating are wetness and flooding hazards, slope, surface soil texture, stoniness, and rockiness.

Playgrounds are areas for baseball, football, and similar organized games. These areas are subject to heavy foot traffic. The soils should be nearly level, have good drainage, and have a firm surface. They should be suitable for the establishment of a vegetative cover where needed.

Paths and trails are for local and cross-country travel by foot or horse. The soil should be used in its natural state. Little or no cutting and filling is done in design and layout of the trails.

Formation and Classification of the Soils

This section discusses the five factors of soil formation and the processes of horizon differentiation. It also classifies the soils by higher categories.

The five major factors of soil formation are climate, living organisms (especially vegetation), parent material, relief, and time. The kind of soil that forms in one area differs from the kind of soil in another area if there has been a difference between the two areas in one or more of the major factors.

Climate and vegetation are the active factors of soil genesis. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body having genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. It may be much or little, but some time is always required for horizon differentiation. Usually a long time is required for the development of distinct horizons.

Climate

The climate of Stonewall County is characterized by dry winters and hot, humid summers. It is uniform, but its effects have been modified locally by relief and runoff. Because rainfall is low and there are long, dry periods, soil development is slow. The soils are seldom wet below the root zone, and as a result, many have a horizon in which calcium carbonate has accumulated.

TABLE 7.—*Soil limitations and major features affecting recreational development*

[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]

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
*Acme: Ac For Cottonwood part of Ac, see Cottonwood series.	Moderate: clay loam.	Moderate: clay loam.	Moderate: clay loam.	Moderate: clay loam.
Altus: AlA	Slight	Slight	Slight	Slight.
Aspermont: AsB, AsC, AsD	Moderate: silty clay loam.	Moderate: silty clay loam.	Moderate where slopes are less than 6 percent; silty clay loam. Severe where slopes are 6 to 12 percent.	Moderate: silty clay loam.
Badland: Mapped only in an association with the Owens series. Properties too variable to rate.				
Bukreek: BuA, BuB	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 3 percent.	Slight.
Bukreek, gravelly substratum: BvA, BvB.	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 3 percent.	Slight.
Clairemont: Ca	Moderate: flood hazard.	Moderate: flood hazard.	Moderate: flood hazard.	Slight.
Cobb: CbB	Slight	Slight	Slight where slopes are 1 to 2 percent; bedrock at depth of 40 to 48 inches. Moderate where slopes are 2 to 3 percent; bedrock at depth of 20 to 40 inches.	Slight.
Colorado: Cd	Severe: flooding	Moderate: flooding	Severe: flooding	Moderate: flooding.
*Cosh: CsB, CsC For Spade part, see Spade series.	Slight	Slight	Severe: bedrock at depth of 12 to 20 inches.	Slight.
*Cottonwood: Ct For Owens part, see Owens series.	Slight	Slight	Severe: bedrock at depth of 3 to 10 inches.	Slight.
Devol: DeB	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand.
Enterprise: EnA, EnB, EnC	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 5 percent.	Slight.
Frankirk: FnA, FnB	Moderate: clay loam; moderately slow permeability.	Moderate: clay loam.	Moderate: clay loam; moderately slow permeability.	Moderate: clay loam.
Frio: Fo	Moderate: silty clay loam; moderately slow permeability; severe flood hazard during season of use.	Moderate: silty clay loam; flood hazard during season of use.	Moderate: silty clay loam; moderately slow permeability.	Moderate: silty clay loam.

TABLE 7.—*Soil limitations and major features affecting recreational development*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Hardeman: HaD	Slight where slopes are 5 to 8 percent. Moderate where slopes are 8 to 12 percent.	Slight where slopes are 5 to 8 percent. Moderate where slopes are 8 to 12 percent.	Moderate where slopes are 5 to 6 percent. Severe where slopes are 6 to 12 percent.	Slight.
Hensley, moderately deep variant: HeA.	Moderate: slow permeability.	Slight	Moderate: bedrock at depth of 20 to 40 inches; slow permeability.	Slight.
Hilgrave: HgD	Moderate where 35 to 50 percent coarse fragments on surface. Severe where 50 to 70 percent coarse fragments on surface.	Moderate where 35 to 50 percent coarse fragments on surface. Severe where 50 to 70 percent coarse fragments on surface.	Severe: 35 to 70 percent coarse fragments on surface.	Moderate where 35 to 50 percent coarse fragments on surface. Severe where 50 to 70 percent coarse fragments on surface.
Hollister: HoA	Moderate: silty clay loam; slow permeability.	Moderate: silty clay loam.	Moderate: silty clay loam; slow permeability.	Moderate: silty clay loam.
*Latom: Lc For Rock outcrop part, see Rock outcrop.	Slight	Slight	Severe: bedrock at depth of 4 to 20 inches.	Slight.
Likes: Lk	Severe: loose fine sand.	Severe: loose fine sand.	Severe: loose fine sand.	Severe: loose fine sand.
Lincoln: Ln	Severe: flooding hazard.	Severe: flooding hazard.	Severe: flooding hazard.	Moderate: loamy fine sand; flooding hazard.
Mangum: Ma	Severe: very slow permeability; flooding hazard.	Moderate: silty clay loam; flooding hazard.	Severe: flooding hazard.	Moderate: silty clay loam; flooding hazard.
Miles: MnA, MnB, MnC, MnD	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent. Severe where slopes are 6 to 8 percent.	Slight.
MIB, MIC	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand.
Nipsum: NcB	Severe: clay	Severe: clay	Severe: clay	Severe: clay.
Nobscot: Ns	Severe: fine sand	Severe: fine sand	Severe: fine sand	Severe: fine sand.
Obaro: OaB, OaC	Slight	Slight	Moderate: bedrock at depth of 20 to 48 inches.	Slight.
*Owens: Ob For Badland part, see Badland.	Severe: clay	Severe: clay	Severe: clay	Severe: clay.
Paducah: PdA, PdB, PdC	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 5 percent.	Slight.
Quanah: QhB	Slight	Slight	Slight where slopes are 1 to 2 percent. Moderate where slopes are 2 to 3 percent.	Slight.

TABLE 7.—*Soil limitations and major features affecting recreational development*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
*Quinlan: Qr For Rough broken land part, see Rough broken land.	Moderate: slopes of 8 to 15 percent.	Moderate: slopes of 8 to 15 percent.	Severe: slopes of 8 to 15 percent.	Slight.
Randall: Ra	Severe: clay; flooding hazard.	Severe: clay; flooding hazard.	Severe: clay; flooding hazard.	Severe: clay.
Rock outcrop: Mapped only in a complex with Latom series. Properties too variable to rate.				
Rotan: RnA	Moderate: clay loam; moderately slow permeability.	Moderate: clay loam.	Moderate: clay loam; moderately slow permeability.	Moderate: clay loam.
Rough broken land: Ro. Properties too variable to rate.				
Rowena: RwA	Moderate: clay loam; moderately slow permeability.	Moderate: clay loam.	Moderate: clay loam; moderately slow permeability.	Moderate: clay loam.
Spade Mapped only in an undifferentiated unit with Cosh soils.	Slight	Slight	Slight where slopes are 1 to 2 percent. Moderate where slopes are 2 to 5 percent.	Slight.
Springer: SgB	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand.	Moderate: loamy fine sand.
St. Paul: SpA	Moderate: moderately slow permeability.	Slight	Moderate: moderately slow permeability.	Slight.
*Talpa: Ta For Yates part, see Yates series.	Moderate: clay loam.	Moderate: clay loam.	Severe: bedrock at depth of 5 to 14 inches.	Moderate: clay loam.
Tillman: TcA, TcB	Moderate: clay loam; slow permeability.	Moderate: clay loam.	Moderate: clay loam; slow permeability.	Moderate: clay loam.
Tipton: TpA	Slight	Slight	Slight	Slight.
Treadway: Tr	Severe: very slow permeability.	Moderate: silty clay loam.	Severe: very slow permeability.	Moderate: silty clay loam.
Vernon: VeB, VeC	Severe: very slow permeability.	Moderate: clay loam.	Severe: very slow permeability.	Moderate: clay loam.
*Woodward: WoD For Quinlan part, see Quinlan series.	Moderate: slopes	Slight where slopes are 5 to 8 percent. Moderate where slopes are 8 to 12 percent.	Severe: slopes	Slight.
Yates Mapped only in a complex with the Talpa series.	Moderate: clay loam; 35 to 50 percent coarse fragments.	Moderate: clay loam; 35 to 50 percent coarse fragments.	Severe: bedrock at depth of 4 to 10 inches.	Moderate: clay loam; 35 to 50 percent coarse fragments.
*Yomont: Ym, Yn, Yo For Quinlan part of Yo, see Quinlan series.	Severe: flooding hazard.	Moderate: flooding hazard.	Severe: flooding hazard.	Moderate: flooding hazard.

Living organisms

Plants, micro-organisms, earthworms, and other forms of animal life are important in the formation of soils. The kinds and amounts of plants and their size are determined partly by the climate and parent material.

In Stonewall County, the vegetation is mostly grass, but there are some brushy plants and small hardwood trees. The grasses are tall or short, depending on the kind of parent material. Devol, Nobscot, and Spring soils, which have sandy parent material, support tall grasses; Frankirk, Rotan, and Tillman clay loam, which have a parent material much higher in clay content, support short grasses.

The prairie type of vegetation contributes large amounts of organic matter to the soil. Grass, leaves, and stems fall, decay, and darken the surface. Roots decompose and distribute organic matter in the solum and provide food for earthworms and micro-organisms. In some areas, burrowing animals offset the leaching of soluble minerals and destroy soil structure by mixing the soil.

Man also has influenced soil formation by clearing and plowing the soils for crops, fencing the range, and allowing it to be overgrazed, thus changing the vegetation. In harvesting his crops, he has failed to control runoff and soil blowing. Because of these practices, organic matter has been depleted, and silt and clay particles have been blown from the plow layer. Heavy machinery and untimely tillage have compacted the soils and have slowed the infiltration of water and air.

Parent material

The soils of the Central Rolling Red Plains Resource Area developed from six different kinds of parent material: (1) ancient alluvial outwash, (2) shale and clay from the Permian red beds, (3) sandstone and packsand from the Permian red beds, (4) recent deposits of alluvium, (5) limestone, gypsum, and dolomite, and (6) wind-laid sand.

Frankirk, Miles, and Rotan soils are among those that developed from a thick mantle of ancient alluvial outwash. Areas of Tillman and Vernon soils are examples of those that developed over Permian shale and clay. Many of the soils developed from Permian sandstone and packsand. Examples are Obaro, Paducah, Quinlan, and Woodward soils. Clairemont and Yomont soils, which are on the flood plains of the major creeks, are examples of soils that developed from recent alluvium. Talpa and Yates soils developed over limestone. Acme and Cottonwood soils formed in gypsum beds. Enterprise, Hardeman, and Nobscot are the main soils that developed in wind-laid sand.

Relief

The influence of relief on soil development is related mainly to its effect on drainage and runoff. If other factors of soil development are equal, the degree of profile development depends on the amount of water that enters a soil. For example, Vernon soils, which are gently sloping, absorb less moisture and normally have a less well developed profile than Rotan soils, which are nearly level.

Time

The characteristics of a soil are affected by the length of time that the soil-forming factors have been active. A long time generally is required for the formation of well-defined, genetically related horizons. Miles and Nobscot soils are examples of those soils that have been in place a long time and have approached equilibrium with their environment. They are mature and show marked horizon differentiation. Clairemont is an example of a young soil that has a weakly developed profile.

Processes of Horizon Differentiation

The processes involved in the formation of soil horizons in Stonewall County are (1) accumulation of organic matter, (2) leaching of calcium carbonates and bases from surface layers and redepositing them in lower layers, and (3) formation and translocation of silicate clay minerals. More than one of these processes has been active in most soils.

The accumulation of organic matter in the upper part of the profile is important in the formation of an A1 horizon. The soils of Stonewall County are generally low in organic-matter content because the organic matter decomposes rapidly.

The upper part of nearly all the soils of this county has been leached of carbonates and bases to some degree. Some soil scientists agree that the removal of bases precedes the translocation of silicate clay minerals. This leaching has contributed to the development of horizons. For example, Miles soils have been leached of most carbonates and show distinct horizons.

The translocation of clay minerals has also contributed to horizon development. The eluviated A horizon of some soils is lower in clay content than the B horizon, which usually has an accumulation of clay in pores and on ped surfaces. In the soils of this county, translocation of carbonates, soluble salts, and silicate clays is among the more important processes in horizon differentiation. Miles soils are examples of those in which silicate clays have accumulated in the B horizon.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics, assemble knowledge about them, see their relationship to one another and to the whole environment, and understand their behavior and their response to manipulation. First through classification, and then through use of the soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The current system of classification was adopted by the National Cooperative Soil Survey in January 1965. The system has six categories. Beginning with the most inclusive, the categories are the order, the suborder, the great group, the subgroup, the family, and the series. The placement of some soil series in the current system, particularly in families, may change as more precise information becomes available. Readers interested in the development of the system should refer to the latest literature available (*4*, *7*). Table 8 shows the classifica-

TABLE 8.—*Classification of soil series*

Series	Family	Subgroup	Order
Acme	Loamy, mixed, thermic, shallow	Torriorthentic Haplustolls	Mollisols.
Altus [1]	Fine-loamy, mixed, thermic	Pachic Argiustolls	Mollisols.
Aspermont	Fine-silty, mixed, thermic	Typic Ustochrepts	Inceptisols.
Bukreek [2]	Fine-loamy, mixed, thermic	Typic Paleustolls	Mollisols.
Bukreek, gravelly substratum.	Fine-loamy, mixed, thermic	Typic Paleustolls	Mollisols.
Clairemont	Fine-silty, mixed, calcareous, thermic	Typic Ustifluvents	Entisols.
Cobb	Fine-loamy, mixed, thermic	Udic Haplustalfs	Alfisols.
Colorado	Fine-loamy, mixed, calcareous, thermic	Typic Ustifluvents	Entisols.
Cosh	Loamy, mixed, thermic, shallow	Udic Rhodustalfs	Alfisols.
Cottonwood	Loamy, mixed, calcareous, thermic, shallow	Ustic Torriorthents	Entisols.
Devol [3]	Coarse-loamy, mixed, thermic	Udic Haplustalfs	Alfisols.
Enterprise	Coarse-silty, mixed, thermic	Typic Ustochrepts	Inceptisols.
Frankirk	Fine, mixed, thermic	Udic Argiustolls	Mollisols.
Frio [4]	Fine, mixed, thermic	Cumulic Haplustolls	Mollisols.
Hardeman	Coarse-loamy, mixed, thermic	Typic Ustochrepts	Inceptisols.
Hensley, moderately deep variant.	Clayey, mixed, thermic	Lithic Rhodustalfs	Alfisols.
Hilgrave	Loamy-skeletal, mixed, thermic	Aridic Haplustalfs	Alfisols.
Hollister	Fine, mixed, thermic	Pachic Paleustolls	Mollisols.
Latom	Loamy, mixed, calcareous, thermic	Lithic Ustic Torriorthents	Entisols.
Likes	Mixed, thermic	Typic Ustipsamments	Entisols.
Lincoln	Sandy, mixed, thermic	Typic Ustifluvents	Entisols.
Mangum	Fine, mixed, calcareous, thermic	Vertic Ustifluvents	Entisols.
Miles	Fine-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Nipsum	Fine, mixed, thermic	Cumulic Haplustolls	Mollisols.
Nobscot	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols.
Obaro	Fine-silty, mixed, thermic	Typic Ustochrepts	Inceptisols.
Owens	Clayey, mixed, thermic, shallow	Typic Ustochrepts	Inceptisols.
Paducah [5]	Fine-silty, mixed, thermic	Typic Haplustalfs	Alfisols.
Quanah [6]	Fine-silty, mixed, thermic	Typic Calciustolls	Mollisols.
Quinlan	Loamy, mixed, thermic, shallow	Typic Ustochrepts	Inceptisols.
Randall	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols.
Rotan	Fine, mixed, thermic	Pachic Paleustolls	Mollisols.
Rowena	Fine, mixed, thermic	Vertic Calciustolls	Mollisols.
Spade	Coarse-loamy, mixed, thermic	Aridic Ustochrepts	Inceptisols.
Springer	Coarse-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
St. Paul	Fine-silty, mixed, thermic	Pachic Argiustolls	Mollisols.
Talpa	Loamy, mixed, thermic	Lithic Calciustolls	Mollisols.
Tillman	Fine, mixed, thermic	Typic Paleustolls	Mollisols.
Tipton	Fine-loamy, mixed, thermic	Pachic Argiustolls	Mollisols.
Treadway	Fine, mixed, thermic	Ustertic Camborthids	Aridisols.
Vernon	Fine, mixed, thermic	Typic Ustochrepts	Inceptisols.
Woodward	Coarse-silty, mixed, thermic	Typic Ustochrepts	Inceptisols.
Yates	Loamy-skeletal, mixed, nonacid, thermic	Lithic Ustorthents	Entisols.
Yomont	Coarse-silty, mixed, calcareous, thermic	Typic Ustifluvents	Entisols.

[1] These soils are outside the range of the Altus series in that the B3 horizon is yellower and the C horizon is lighter in color. This difference does not alter use, management, or behavior.

[2] These soils are taxadjuncts to the Bukreek series in that the secondary carbonates are slightly deeper. This difference does not alter use, management, or behavior.

[3] These soils are outside the range of the Devol series in that the A horizon is more yellow in color. This difference does not alter use, management, or behavior.

[4] These soils are taxadjuncts to the Frio series in that the hue of the B horizon is 5YR as opposed to 7.5YR as defined in the Frio series. This difference does not alter use, management, or behavior.

[5] These soils are taxadjuncts to the Paducah series in that the secondary carbonates are at slightly greater depths than described for the Paducah series. This difference does not alter use, management, or behavior.

[6] These soils are outside the range of the Quanah series in that they are redder. This difference does not alter use, management, or behavior.

tion of the soils in this county according to the family, subgroup, and order.

Additional Facts About the County

Buffalo hunters first came into the area in about 1870. Rath City, a collection of dugouts and tents, was located in the southwestern part of the county.

Stonewall County was created from Bexar Territory in 1876. It was named for Thomas J. (Stonewall) Jackson, officer of the Confederate Army. The new county was attached to Jones County for law and court purposes, until it became organized in 1888. Rayner, a cow camp, was the first county seat. In 1890 Aspermont won the county seat designation from Rayner. Controversy over the seat of government lasted until 1898 (*5*).

The first actual settlement was made in the early 1880's about 4 miles south of present Aspermont. Population of Stonewall County was 1,024 in 1890; 5,320 in 1910; 5,589 in 1940; and 3,017 in 1960. The figure for 1970 is 2,397.

Climate [5]

The climate of Stonewall County is subtropical and continental. It is characterized by dry winters; hot, humid summers; and an extreme annual range in temperature. Frequent surges of drier, polar airmasses block the moist tropical air from the Gulf of Mexico during November through March, and winter precipitation is light. Snow falls occasionally during winter months, but it is insignificant as a source of moisture. Rare, exceptionally heavy snowfalls, about once in 10 to 20 years, bias snowfall data. A light, steady drizzle, in contrast to the thundershowers late in spring and early in summer, is most common in winter.

Rainfall, most of it from thunderstorms, is extremely variable. In 1941, the wettest year since 1912, 41.02 inches fell at Aspermont; while in 1956, the driest year, 7.65 inches was recorded. Seventy percent of the mean annual precipitation falls from May, the wettest month, through October. Late in spring, moist, tropical air from the Gulf of Mexico produces moderate to heavy afternoon, evening, or nighttime thundershowers. The most violent thunderstorms occur late in spring or early in summer.

In an average year, thunderstorms occur on 42 days. Common periods of drought, downpours that produce excessive runoff, and occasional combinations of heavy rain, high winds, and hail all adversely affect soils and crops in the county.

Temperatures, like rainfall, are extremely variable, particularly during the colder months, November through March. Cold fronts often are accompanied by sharp drops in temperature. However, sunshine and southwesterly winds bring rapid warming, so that cold spells are short and rarely last longer than about 48 hours.

The prevailing winds are south-southeasterly April through October, southerly in November and in January through March, and south-southwesterly in December. Windspeeds are strongest during intense thunderstorms, but these are squalls of short duration. The strongest sustained winds occur in February, March, and April. These winds often produce duststorms.

Stonewall County receives about 65 percent of the total possible sunshine in winter, and 78 percent in summer. The mean monthly relative humidity, measured at noon, Central Standard Time, is 52 percent in January, 45 percent in April, 45 percent in July, and 48 percent in October. The mean annual free water (lake) evaporation is 68 inches. Approximately two-thirds of this amount evaporates during the six-month period of May through October.

The mean length of the warm season (freeze-free period) in Stonewall County is 220 days. The mean dates of the last occurrence of 32° F. or below in the spring, and the first occurrence of 32° or below in the fall, are March 31 and November 10, respectively. One year in five, on an average, a freeze occurs after April 10 in the spring; also one year in five, on an average, a freeze occurs before November 1 in the fall. The mean length of the period between the last occurrence of 28° or below in the spring and the first occurrence of 28° or below in the fall is 245 days. Table 9 summarizes climatological data for Stonewall County.

Ranching and Farming

Cattle ranching and farming are of major importance in Stonewall County. About 66 percent of agricultural income is from livestock. The economy centers around oil and ranching supplies and marketing.

The major cash crop is cotton. Wheat is grown for grain on most farms, but much of the acreage also is used for pasture. Grain sorghum and forage sorghum also are grown and fed to livestock. Some peanuts are grown, and a peanut drier is located in Aspermont. Irrigation farming in the county is limited. Most of the water is low quality or limited quantity.

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[5] By ROBERT B. ORTON, climatologist for Texas, National Weather Service.

TABLE 9.—*Temperature and*

[Data from Aspermont, Stonewall County, for the period 1940–1969;

Month	Temperature [1]				
	Average daily maximum [1]	Average monthly highest [1]	Average daily minimum [1]	Average monthly lowest [1]	Average total [2]
	°F	°F	°F	°F	
January	58. 6	79. 9	29. 6	9. 7	0. 69
February	61. 9	78. 1	32. 3	17. 0	. 99
March	69. 5	87. 9	39. 1	19. 0	. 97
April	80. 7	95. 1	52. 0	37. 3	1. 85
May	87. 5	100. 1	59. 4	45. 9	3. 59
June	92. 6	102. 4	66. 1	55. 8	2. 93
July	98. 7	104. 5	70. 8	63. 5	2. 09
August	97. 3	107. 4	68. 7	60. 1	2. 01
September	87. 4	99. 5	61. 7	47. 0	2. 48
October	79. 9	95. 0	51. 0	37. 3	2. 38
November	68. 6	85. 1	41. 5	26. 5	1. 21
December	59. 0	78. 1	32. 0	16. 9	. 83
Year	78. 5	92. 8	50. 4	36. 3	22. 02

[1] Average length of record, 8 years (1962–69).
[2] Average length of record, 30 years (1940–69).
[3] Average length of record, 14 years.

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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.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

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 precentage of the cation-exchange capacity.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas such as those of the southwestern United 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.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

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—

Loose.—Noncoherent; does not hold together in a mass when dry or moist.

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.

precipitation data

elevation 1,750 feet. The symbol < means less than]

Precipitation												
Probability, in percent, of receiving selected amounts during month								Average number of days that have [3]—			Snow, sleet [2]	
0 or trace	0.50 inch or more	1.00 inch or more	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 or more	0.50 inch or more	1.00 inch or more	Average total	Maximum monthly
											Inches	*Inches*
5	55	32	9	4	<1	<1	<1	2	([4])	([4])	1.6	15.6
10	60	36	15	4	1	<1	<1	3	([4])	([4])	1.5	8.0
6	62	35	10	4	2	<1	<1	3	1	([4])	.9	8.0
<1	80	65	40	20	7	5	2	4	1	([4])	.1	1.5
<1	98	93	75	55	38	28	15	5	3	1	0	0
1	85	70	50	35	22	13	11	5	2	1	0	0
1	80	65	42	20	11	10	5	3	2	1	0	0
5	70	52	31	18	9	6	4	3	2	1	0	0
5	75	63	39	27	19	10	10	4	2	1	0	0
6	82	82	45	29	20	10	7	3	1	1	([5])	([5])
13	55	35	15	7	3	1	<1	3	1	([4])	.3	4.0
6	58	38	19	7	4	1	1	2	1	([4])	1.0	9.5
											5.4	15.6

[4] Less than one-half.
[5] Trace, an amount too small to measure.

Decreaser. Any of the climax range plants most heavily grazed. Because they are the most palatable, they are the first to be destroyed by overgrazing.

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.

Erosion pavement. A layer of gravel or stones on the ground surface that remains after the fine particles are removed by wind or water. Desert pavements result from exposure to dry winds.

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.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Gravel. Coarse rounded or angular fragments, not prominently flattened, that range in size from 2 millimeters to 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:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

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 1, 2, and 3. 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.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Loam. The textural class name of any soil that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

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 dimen-

sion; 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.

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 a depth of 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.

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.

Plasticity index. The numerical differences between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other dilutents that commonly shows as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes, irreversibly to hardpan or to irregular aggregates on repeated wetting and drying, or it is the hardened relicts of the soft, red mottles. It is a form of the material that has been called laterite.

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.

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 degree 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

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Only the upper part of this, modified by organisms and other soil-building forces, is regarded by soil scientists as soil. Most American engineers speak of the whole regolith, even to great depth, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

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.

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 anl 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 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 kept 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 partciles, 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.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

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program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).