

United States  
Department of  
Agriculture

Soil  
Conservation  
Service

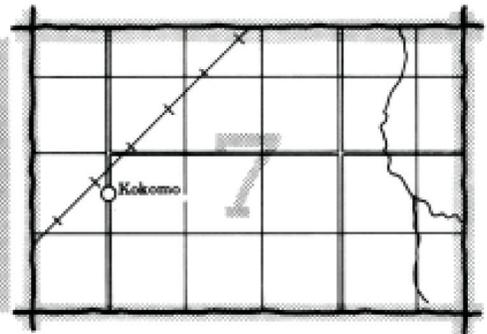
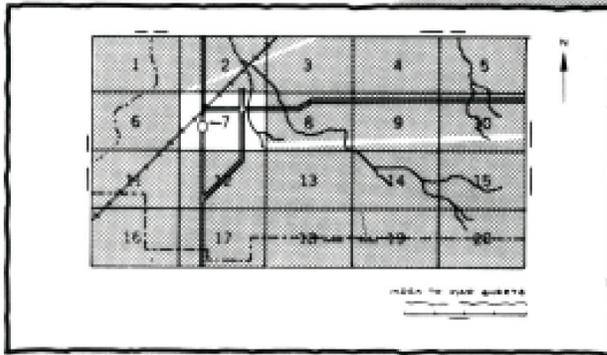
In cooperation with  
Texas Agricultural  
Experiment Station

# Soil Survey of Kimble County Texas



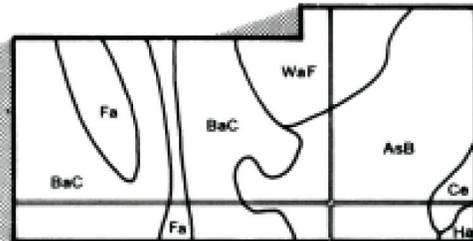
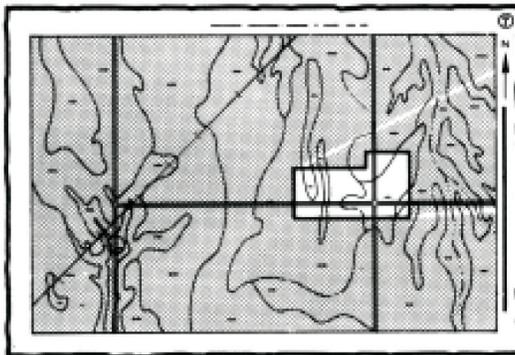
# HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"

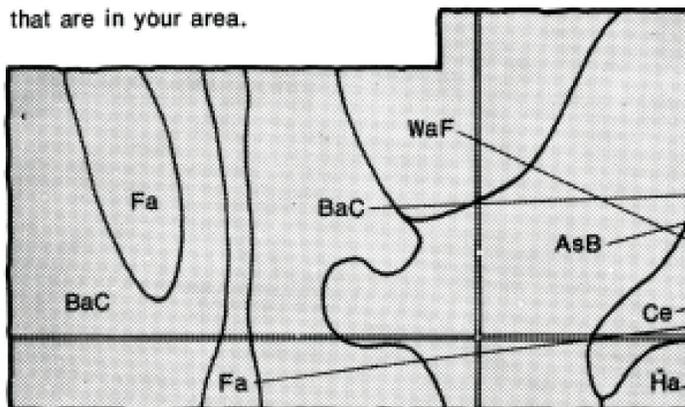


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



4. List the map unit symbols that are in your area.

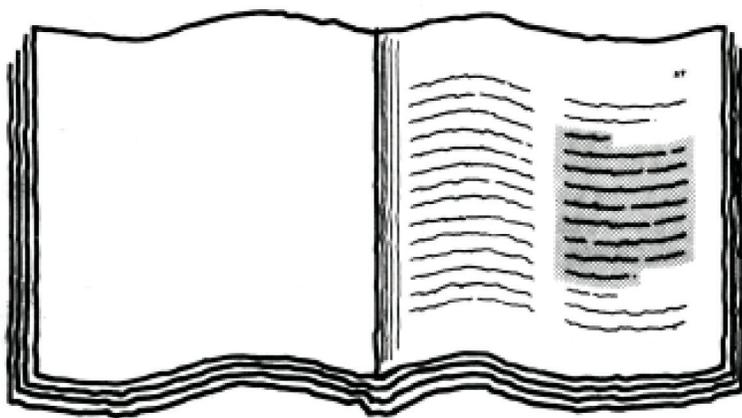


## Symbols

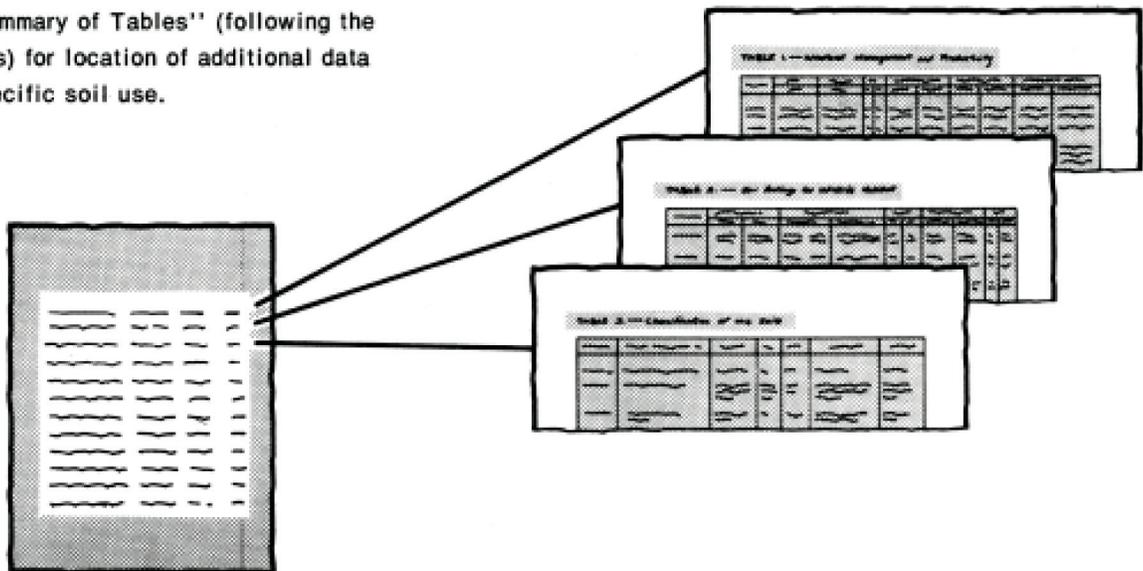
AsB  
BaC  
Ce  
Fa  
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WaF

# THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.

A detailed illustration of a page from the 'Index to Soil Map Units'. It features multiple columns of text, likely listing map unit names and their corresponding page numbers.

6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

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This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1973-1980. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980. 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 Upper Llano Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

*Cover: Teacup Mountain is a familiar landmark in Kimble County. Nuvalde clay loam is in the foreground, and Real and Brackett soils are in the background.*

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Issued May 1982

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# foreword

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This soil survey contains information that can be used in land-planning programs in Kimble County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

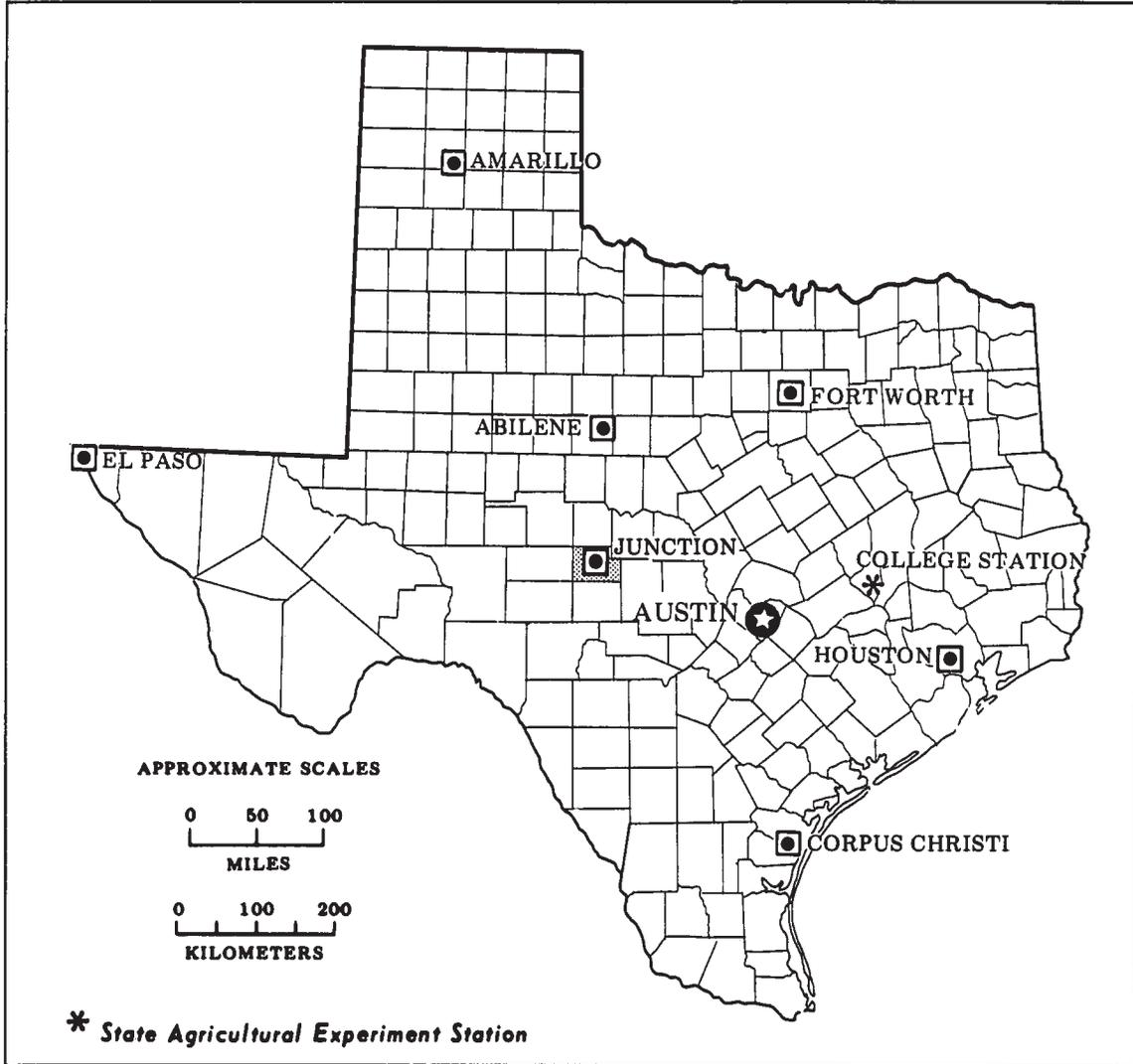
This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



George C. Marks  
State Conservationist  
Soil Conservation Service



*Location of Kimble County in Texas.*

# soil survey of Kimble County, Texas

By Ervin L. Blum, Soil Conservation Service

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

## general nature of the survey area

KIMBLE COUNTY is in the heart of the Texas Hill Country. It is best known for its scenic beauty, more than 250 miles of clear streams, and its abundant big game. It

is in the west-central part of Texas, mainly in the Edwards Plateau Land Resource Area (fig. 1). A small area in the northeastern part of the county is in the Texas Central Plateau Basin Land Resource Area (fig. 2).

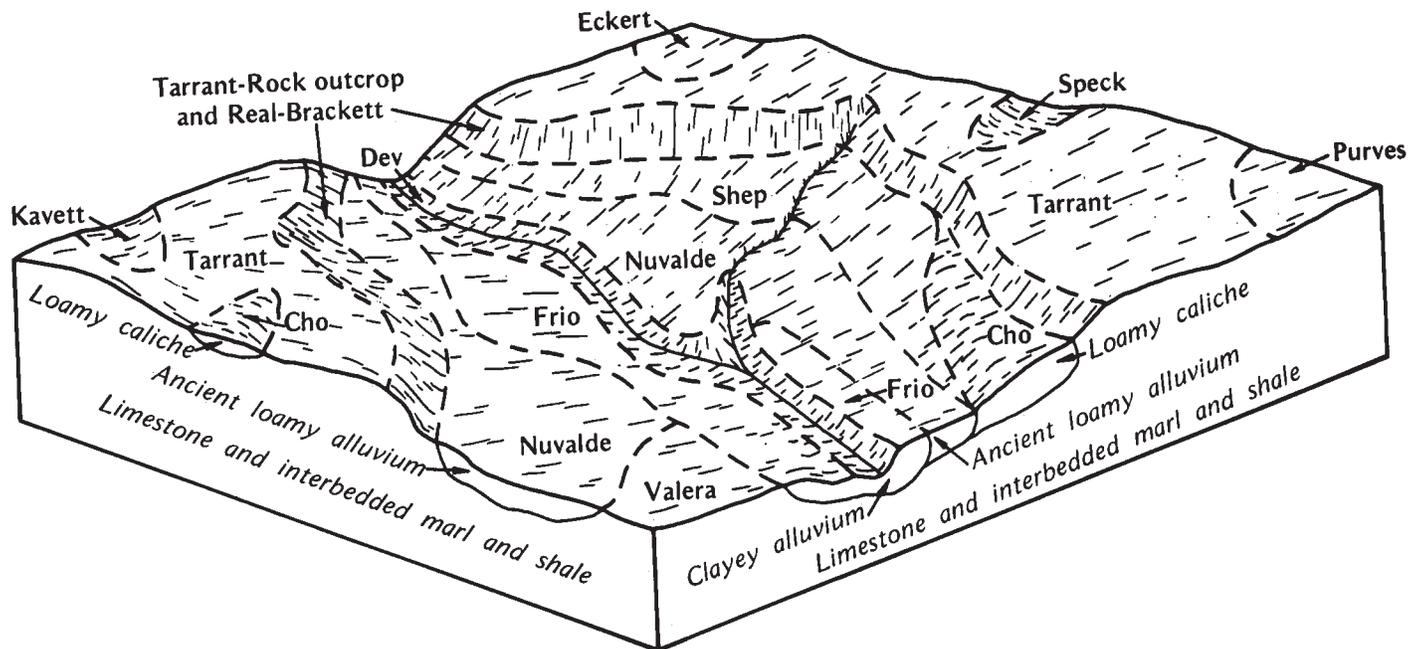


Figure 1.—Soils of the Edwards Plateau Land Resource Area in Kimble County.

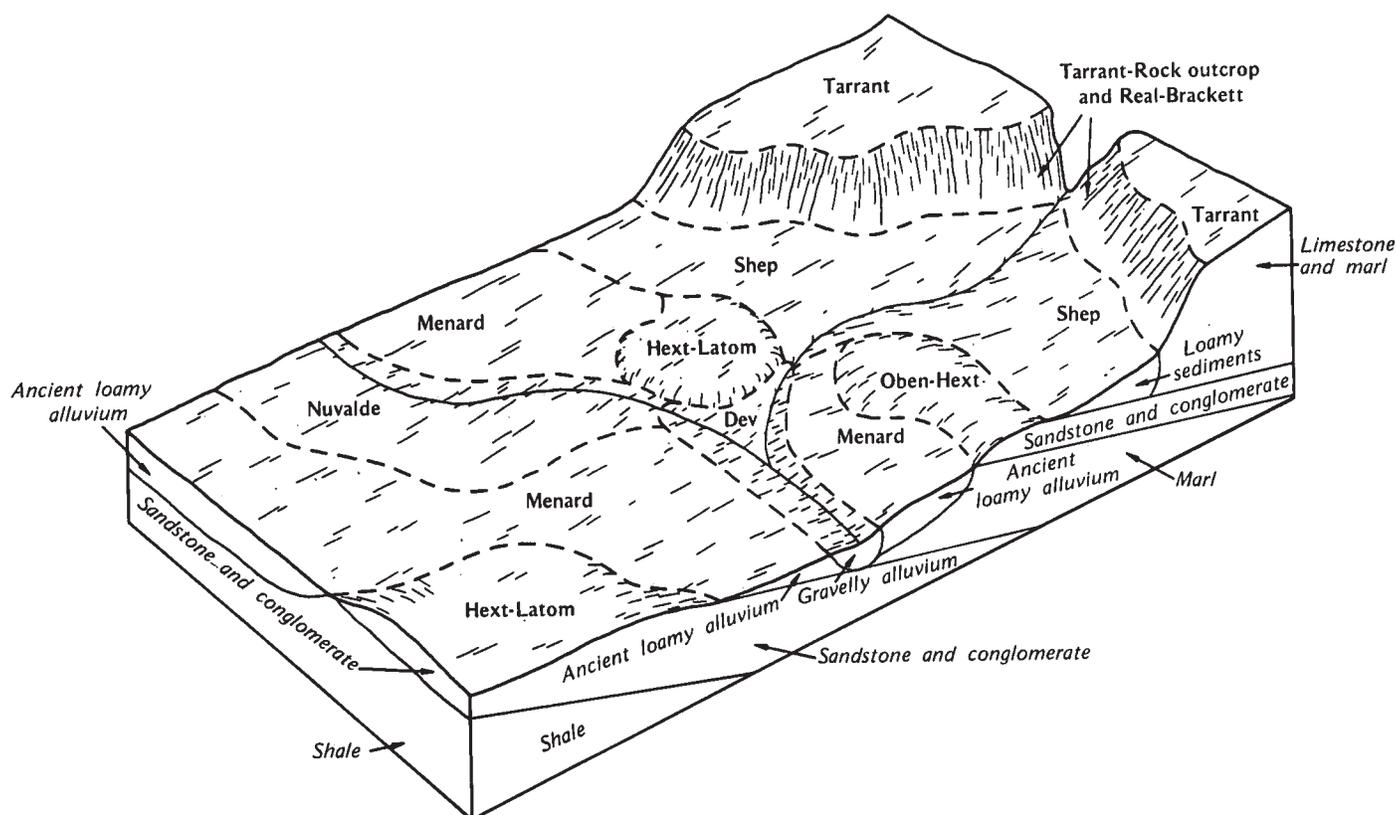


Figure 2.—Relationship of soils of the Central Basin Land Resource Area on the left with soils of the Edwards Plateau on the right.

The county is 1,274 square miles, or 815,360 acres. The landscape is nearly level to undulating and hilly. It is strongly dissected by fairly deep, narrow valleys separated by complex, branching ridges (fig. 3). Elevation ranges from 1,600 to 2,400 feet. The North Llano River and South Llano River meet in the center of the county at the city of Junction and become the Llano River, which flows northeast from Junction. Kimble County is in the Colorado River Basin.

Ranching is the main enterprise in this county. The county is 96 percent rangeland, 1 percent cropland, and 3 percent other land. About 950 acres is irrigated cropland. Beef cattle, sheep, and goats are the principal ranching stock. Leases for hunting white-tailed deer and turkey are a substantial contribution to the income of ranchers. Native and improved pecans are produced. Other crops are apples, peaches, garden vegetables, grain sorghum, hay, oats, and alfalfa.

The soils in Kimble County are dominantly dark, cobbly, and clayey and are in the Edwards Plateau part of the county. The soils in the Central Basin are mostly reddish fine sandy loams.

Kimble County was formed from Bexar County in 1858.

It was organized in 1876 and named for George C. Kimble. Kimble died defending the Alamo. He and about 30 others were from Gonzales, Texas. They were among the last to join the other defenders of the Alamo.

The population of Kimble County is 3,900. Junction is in the center of the county and is the county seat. It has a population of 3,066. Other towns include Roosevelt in the western part and London in the northeastern part.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey.

### climate

The rainfall in Kimble County is of a "Continental" nature bordering on "Mountain" weather. It is characterized by occasional, high intensity summer rainfall that varies greatly from year to year and within short distances. The longtime average annual rainfall is 24.76 inches. The range is from 23 inches in the western

part of the county to 26 inches in the eastern part of the county. Summer droughts are common.

The heavier rainfall patterns occur in two seasons. Spring rainfall during April, May, and June is greatest, and autumn rainfall during September and October is less. Rainfall is lowest in winter, during December, January, February, and March. This rainfall is more effective, however, because of reduced evaporation and transpiration.

The average frost-free period is 219 days and occurs from about April 3 to November 8. The precipitation-evaporation ratio (PE ratio) for Junction in Kimble County is 38.5, which is within the range of the 31-44 PE zone. The average annual temperature is 64.5°. The average annual lake surface evaporation rate is 73 inches. Subfreezing temperatures rarely continue for a period of more than 5 days, and snow is uncommon. The average temperature in January is 45°. The minimum temperature recorded is -11°.

The true spring and fall seasons are short. Warmup is rapid in spring, and hot weather follows quickly. An occasional late frost is seldom damaging to rangeland vegetation, but sometimes it can result in a setback of browse. Peach and apricot trees are the most frequent victims of a late freeze. This area of the Hill Country has average annual temperatures that are a few degrees cooler than nearby areas, which is a favorable condition for growing apples and grapes.

Hot summer weather is most severe in July and August. Rainfall during June and July is erratic, of high intensity, and occurs mainly as thunderstorms. Some thunderstorms include hail. The storms are often followed by a clearing that produces high temperatures and rapid evaporation. The average temperature in July is 84°, and the maximum is 110°.

August is generally a dry, hot month, with a minimum of wind movement. The result is a shortage of "windmill" weather. Pastures that have weak wells or limited water



Figure 3.—Cedar Creek Bottom is being cleared for houses and a golf course. The Nuvalde soil is in the foreground, the Dev soil is along the streams, the Shep soil is on foot slopes, and Tarrant and Kavett soils are on the hills in the background.

storage tanks become low on facilities for watering livestock.

The cooler nights and increased rainfall during fall produce optimal growing conditions for many range plants. Seed production of warm-season plants is greatest during this period. A gradual reduction in moisture and temperature permits range vegetation to cure on the ground.

Table 1 gives the average monthly temperature and precipitation. It is based on 59 years of records from 1910 through 1968.

## **how this survey was made**

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study 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, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to

nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

# general soil map units

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The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

## soil descriptions

### 1. Tarrant

*Very shallow to shallow, undulating, very cobbly soils; on uplands*

This map unit consists of soils on limestone hills and ridgetops. Slopes range from 1 to 8 percent.

The map unit makes up about 66 percent of the county. It is about 85 percent Tarrant soils and about 15 percent other soils. Tarrant soils typically are moderately alkaline, dark grayish brown and dark brown very cobbly clay about 16 inches thick over fractured limestone bedrock.

Other soils in this unit are Cho, Eckrant, Kavett, Purves, and Valera soils. Cho soils are very shallow to shallow, gravelly soils over cemented caliche. Eckrant soils are very shallow to shallow, cobbly clay soils over hard fractured limestone. Kavett and Purves soils are shallow, clayey soils over hard limestone. Valera soils are moderately deep, clayey soils over hard limestone.

The soils in this unit are mainly used as rangeland and wildlife habitat. They are well suited to use as wildlife habitat. Deer and turkey are abundant.

These soils are not suited to cultivated and specialty

crops. Slope, the very shallow rooting depth, and stoniness are the main limitations.

Low rainfall, very low available water capacity, restricted rooting depth, and gravel and cobbles limit the amount of forage produced on rangeland during most years. There is a wide variety of plants, however, which provides a balance of good quality forage for livestock.

The soils in this unit are poorly suited to most urban uses. Depth to rock, slope, and the clayey texture are limitations. These soils are poorly suited to recreation uses, such as campsites and playgrounds. Large stones, depth to rock, and slope are limitations. Scenic areas of these soils are valuable sites for vacation and retirement homes.

### 2. Tarrant-Real-Brackett

*Very shallow to shallow, undulating to steep, very cobbly, gravelly, and loamy soils; on uplands*

This map unit consists of soils on limestone and adobe hillsides. Slopes range from 1 to 50 percent.

The map unit makes up about 13 percent of the county. It is about 50 percent Tarrant soils, 12 percent Real soils, 8 percent Brackett soils, and 30 percent other soils.

Tarrant soils are on the upper slopes. Typically, they are moderately alkaline, very dark grayish brown and dark brown very cobbly clay about 12 inches thick. Below that is fractured limestone bedrock.

Real soils are on the lower slopes. Typically, they are moderately alkaline, grayish brown gravelly clay loam about 16 inches thick that has about 30 percent limestone fragments. Below that to a depth of 80 inches is weakly cemented, platy limestone.

Brackett soils are on the lower slopes. Typically, the surface layer is moderately alkaline, pale brown loam about 8 inches thick. The subsoil, to a depth of 17 inches, is very pale brown, moderately alkaline loam. Below that, to a depth of 60 inches, is very pale brown clay loam interbedded with weakly cemented limestone fragments.

Other soils in this unit are Cho and Shep soils. Cho soils are very shallow to shallow, gravelly soils over cemented caliche. Shep soils are deep and loamy.

The soils in this unit are used as rangeland and wildlife habitat. They are well suited to use as wildlife habitat. Deer and turkey are abundant.

These soils are not suited to cultivated and specialty crops. Slope, the very shallow to shallow rooting depth, and gravel and cobbles are the main limitations. Slope, very low available water capacity, and restricted rooting depth limit the amount of forage produced on rangeland during most years.

The soils in this unit are poorly suited to most urban uses. Slope, depth to rock, corrosion to uncoated steel pipe, and limestone fragments are limitations. The soils are poorly suited to recreation uses, such as camp sites and playgrounds. Excess slope, depth to rock, and limestone fragments are limitations. Scenic areas of these soils are valuable sites for vacation and retirement homes.

### 3. Nuvalde-Dev-Frio

*Deep, nearly level to gently sloping, loamy and very gravelly soils; on uplands and bottom lands*

This map unit consists of soils on upland outwash plains and bottom lands in valleys between limestone hills. Slopes range from 0 to 3 percent.

The map unit makes up about 8 percent of the county. It is about 50 percent Nuvalde soils, 23 percent Dev soils, 12 percent Frio soils, and 15 percent other soils.

Nuvalde soils are on the upland outwash plains. Typically, the surface layer is moderately alkaline, brown clay loam about 16 inches thick. The subsoil, to a depth of 40 inches, is moderately alkaline, brownish clay. The underlying material to a depth of 80 inches is moderately alkaline, pink clay loam with accumulations of calcium carbonate.

Dev soils are on bottom lands. Typically, the surface layer is moderately alkaline, dark grayish brown very gravelly loam about 26 inches thick. To a depth of 72 inches is moderately alkaline, brown very gravelly loam.

Frio soils are on the bottom lands between the higher Nuvalde soils and the lower Dev soils. Typically, the surface layer is moderately alkaline and about 32 inches thick. It is dark grayish brown silty clay loam in the upper 22 inches and brown silty clay below. To a depth of 80 inches is moderately alkaline, brown silty clay.

Other soils in this unit are Cho, Oakalla, Rioconcho, and Shep soils. Cho soils are very shallow to shallow, gravelly soils over cemented caliche. Oakalla soils are deep, loamy soils that formed in alluvium. Rioconcho soils are deep and clayey. Shep soils are deep and loamy and have accumulations of calcium carbonate in the lower part.

The soils in this unit are mainly used as rangeland and wildlife habitat. Deer, turkey, dove, and quail are important game animals. The soils are fairly suited to use as wildlife habitat.

Some larger areas of Nuvalde and Frio soils are well suited to cultivation, and a small acreage is used as cropland. Most of the soils are well suited to cultivated crops and orchards. Grain sorghum, forage hay crops,

wheat, oats, and barley grow well on these soils. Pecan trees, both native and improved, are grown in some areas. Some areas are subject to flooding.

The soils in this unit produce large amounts of forage. These soils receive runoff from higher soils. Native range plants consist of short and mid grasses on the uplands and tall grasses on the bottom lands.

These soils are moderately well suited to most urban uses. Moderate shrink-swell potential upon drying and wetting, low strength affecting roads and streets, and flooding of the Dev and Frio soils are limitations. The Nuvalde soils are moderately well suited to recreation uses, but the Frio and Dev soils are poorly suited to recreation uses. Flooding and gravel in the Dev soils are limitations.

### 4. Menard-Hext-Latom

*Deep to very shallow, gently sloping and undulating, loamy soils; on uplands*

This map unit consists of soils on low ridges and knolls. Slopes range from 1 to 12 percent.

The map unit makes up about 8 percent of the county. It is about 39 percent Menard soils, 13 percent Hext soils, 8 percent Latom soils, and 40 percent other soils.

Menard soils are on upland plains. Typically, the surface layer is neutral, brown fine sandy loam about 9 inches thick. The subsoil, to a depth of 33 inches, is neutral, reddish brown sandy clay loam; to a depth of 41 inches, it is moderately alkaline, strong brown sandy clay loam that contains accumulations of calcium carbonate. The underlying material to a depth of 70 inches is moderately alkaline, pink sandy clay loam.

Hext soils are on low ridges and knolls. Typically, the surface layer is reddish brown, moderately alkaline fine sandy loam about 11 inches thick. The subsoil, to a depth of 19 inches, is moderately alkaline, reddish brown fine sandy loam. The underlying layer to a depth of 24 inches is moderately alkaline, reddish yellow, calcareous fine sandy loam. Below this is pinkish yellow, weakly cemented, marly sandstone.

Latom soils are on knolls. Typically, the surface layer is moderately alkaline, reddish brown gravelly fine sandy loam about 8 inches thick. To a depth of 19 inches is pink, strongly cemented sandstone.

Other soils in this unit are Brackett, Oben, and Real soils. Brackett soils are shallow, loamy soils over cemented conglomerate and sandstone. Real soils are shallow, loamy soils over weakly and strongly cemented, platy limestone. Oben soils are shallow, loamy soils over limestone conglomerate.

The soils in this unit are mainly used as rangeland and wildlife habitat. They are well suited to use as wildlife habitat. Deer, turkey, dove, and quail are the main kinds of wildlife.

Some areas of Menard soils are well suited to cultivated and specialty crops, and a small acreage is

cultivated. The Menard soils are well suited to orchards. The main crops are grain sorghum, forage hay, wheat, oats, barley, fruit trees, grapes, and vegetables. The Hext and Latom soils are not suited to cultivation, because of slope, low available water capacity, the shallow to moderately deep rooting zone, and slope.

In rangeland, forage production on the Menard soils is high. It is low on the Hext and Latom soils because of low available water capacity, the shallow to moderately deep rooting zone, and slope.

The Menard soils are moderately well suited to urban uses, but the Latom and Hext soils are poorly suited. The limitations are low soil strength affecting roads and streets, seepage, the moderate hazard of soil blowing, and depth to rock in the Latom soils.

Menard soils are well suited to most recreation uses. The Hext and Latom soils are poorly suited to most recreation uses. The limitations are low strength affecting roads and streets, seepage, slope, depth to rock, and soil blowing.

## 5. Purves-Tarrant-Eckrant

*Shallow to very shallow, undulating, clayey and very cobbly soils; on uplands*

This map unit consists of soils on hills and divides. Slopes range from 1 to 10 percent.

The map unit makes up about 3 percent of the county. It is about 33 percent Purves soils, 28 percent Tarrant soils, 11 percent Eckrant soils, and 28 percent other soils.

Purves soils are on undulating divides. Typically, the surface layer is moderately alkaline clay about 11 inches thick. It is very dark gray in the upper 7 inches and dark brown below. The underlying material to a depth of 17 inches is limestone bedrock.

Tarrant soils are on the undulating low hillsides. Typically, the surface layer is moderately alkaline, dark grayish brown very cobbly clay about 9 inches thick. The underlying material is fractured limestone bedrock.

Eckrant soils are on the low hilltops and divides. Typically, the surface layer is noncalcareous, moderately alkaline, very dark gray cobbly clay in the upper 5 inches and very dark gray very cobbly clay to a depth of 12 inches. The underlying material is limestone bedrock.

Other soils in this unit are small areas of Nuvalde, Speck, and Valera soils. Nuvalde soils are deep, loamy soils. Speck soils are shallow, loamy soils over limestone bedrock. Valera soils are moderately deep clay over limestone bedrock.

The soils in this unit are mainly used as rangeland and wildlife habitat. Some small areas of the Purves soils are cultivated and planted to oats, wheat, barley, or sorghum for grazing by livestock and wildlife; however, the soils in this unit as a whole are poorly suited to cultivation

because of cobbles and stones, the shallow to very shallow depth to bedrock, and very low available water capacity.

In rangeland, forage production is medium for Purves soils and low for Tarrant and Eckrant soils. The very low available water capacity, depth to rock, gravel, and cobbles limit the amount of forage produced during most years.

These soils are poorly suited or fairly suited to use as wildlife habitat. Deer and turkey inhabit this area.

The soils in this unit are poorly suited to most urban and recreation uses. Cobbles and stones on the surface, shallow to very shallow depth to rock, and high shrink-swell potential upon drying and wetting are the main limitations. Scenic areas of these soils are valuable sites for vacation and retirement homes.

## 6. Kavett-Tarrant

*Shallow to very shallow, gently undulating, clayey and very cobbly soils; on uplands*

This map unit consists of soils on low divides and in shallow drainageways. Slopes range from 0 to 5 percent.

The map unit makes up about 2 percent of the county. It is about 61 percent Kavett soils, 31 percent Tarrant soils, and 8 percent other soils.

Kavett soils are mostly on the divides. A few areas are in shallow drainageways. Typically, the surface layer is moderately alkaline, brownish silty clay about 11 inches thick. To a depth of 13 inches is a layer of strongly cemented platy caliche. Below that is fractured limestone bedrock.

Tarrant soils are on side slopes of ridges and divides. Typically, the surface layer is moderately alkaline, brownish very cobbly silty clay about 9 inches thick. To a depth of 17 inches is fractured limestone bedrock.

Other soils in this unit are small areas that are more than 20 inches deep to platy caliche or limestone bedrock, and small areas of rock outcrop.

The soils in this unit are mainly used as rangeland and wildlife habitat. Some small areas of the Kavett soils are cultivated and planted to oats, wheat, barley, or sorghum for grazing by livestock or wildlife; however, the soils in this unit as a whole are poorly suited to cultivation because of cobbles and stones, the shallow to very shallow depth to bedrock, and very low available water capacity.

In rangeland, forage production is medium on the Kavett soil and low on the Tarrant soils. Very low available water capacity, depth to rock, gravel, and cobbles limit the amount of forage produced during most years.

These soils are poorly suited or fairly suited to use as wildlife habitat. Deer and turkey inhabit this area.

The soils in this unit are poorly suited to most urban and recreation uses. Cobbles and stones on the surface,

the shallow to very shallow depth to rock, and high shrink-swell potential upon drying and wetting are the

main limitations. Scenic areas of these soils are valuable as sites for vacation and retirement homes.

## detailed soil map units

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The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Nuvalde clay loam, 0 to 1 percent slopes, is one of several phases in the Nuvalde series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Hext-Latom complex, undulating, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar.

Kavett-Tarrant association, gently undulating, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop in Tarrant-Rock outcrop complex, steep, is an example.

Table 2 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

### soil descriptions

#### CoC—Cho gravelly loam, 1 to 8 percent slopes.

This undulating soil is on upland ridges of ancient stream terraces. Slopes are convex and average about 5 percent. Areas are mostly oval to irregular in shape and range from 20 to several hundred acres.

Typically, the surface layer is moderately alkaline, grayish brown gravelly loam about 12 inches thick and has about 20 percent limestone gravel. Below that, to a depth of 22 inches is pinkish white strongly cemented caliche. To a depth of 78 inches is moderately alkaline, pink very gravelly loam that is soft caliche and caliche fragments. In some areas the surface layer is loam, clay loam, or gravelly clay loam.

This soil has low natural fertility. It is well drained. Permeability is slow in the caliche layer, and available water capacity is very low. Surface runoff is medium. The root zone is shallow to very shallow. Water erosion and soil blowing are hazards in heavily grazed areas.

Included with this soil in mapping are small areas of Brackett, Nuvalde, Real, and Shep soils. These soils make up less than 15 percent of a mapped area.

This Cho soil is not suited to cultivated crops mainly because of slope, the shallow to very shallow rooting

depth, and susceptibility to water erosion. The soil is mainly used as rangeland.

This soil has poor potential for use as wildlife habitat. Deer, dove, quail, and turkey inhabit areas of this soil. Several woody plants, forbs, and grasses provide cover, browse, mast, and seeds for animals and game birds.

The Cho soil is moderately well suited to urban and recreation uses. Slope, corrosivity to uncoated steel, and the shallow to very shallow depth to strongly cemented caliche are the main limitations.

This soil has been assigned to capability subclass VI<sub>s</sub> and the Very Shallow range site.

**De—Dev very gravelly loam, frequently flooded.**

This nearly level to gently sloping soil is on bottom lands along streams. It is flooded about once a year to 2 years. Slopes range from 0 to 3 percent and average 2 percent. Areas are long and narrow and range from 25 to 200 acres.

Typically, the surface layer is moderately alkaline, dark grayish brown very gravelly loam about 26 inches thick. To a depth of 72 inches is brown, moderately alkaline, very gravelly loam (fig. 4).

This soil has low natural fertility. It is well drained. Permeability is moderately rapid. Available water capacity is low because of the high gravel content. Surface runoff is slow or medium. The root zone is deep. The hazard of soil blowing is slight. Some scouring and deposition occur during floods.

Included with this soil in mapping are small areas of a soil similar to the Dev soil that has less than 35 percent coarse fragments and a dark surface layer less than 20 inches thick. Also included are some nearly barren gravel bars, silt bars, and stream channels. These inclusions make up less than 25 percent of a mapped area.

This Dev soil is poorly suited to cropland because of flooding and because of gravel on the surface and in the soil. The soil is mainly used as rangeland. Many areas have native pecans, and some areas could support new pecan orchards. Orchards need permanent plant cover to prevent erosion caused by floodwater; however, flooding is beneficial to pecan orchards.

This soil has good potential for wildlife habitat. Deer, turkey, squirrel, quail, and dove inhabit areas of this soil. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for animals and game birds.

The Dev soil is poorly suited to urban and recreation uses. Flooding, seepage, and small stones are the main limitations.

This soil has been assigned to capability subclass VI<sub>w</sub> and the Loamy Bottomland range site.

**EcE—Eckert soils, rolling.** These soils are very shallow to shallow. They are on ridges and hills that

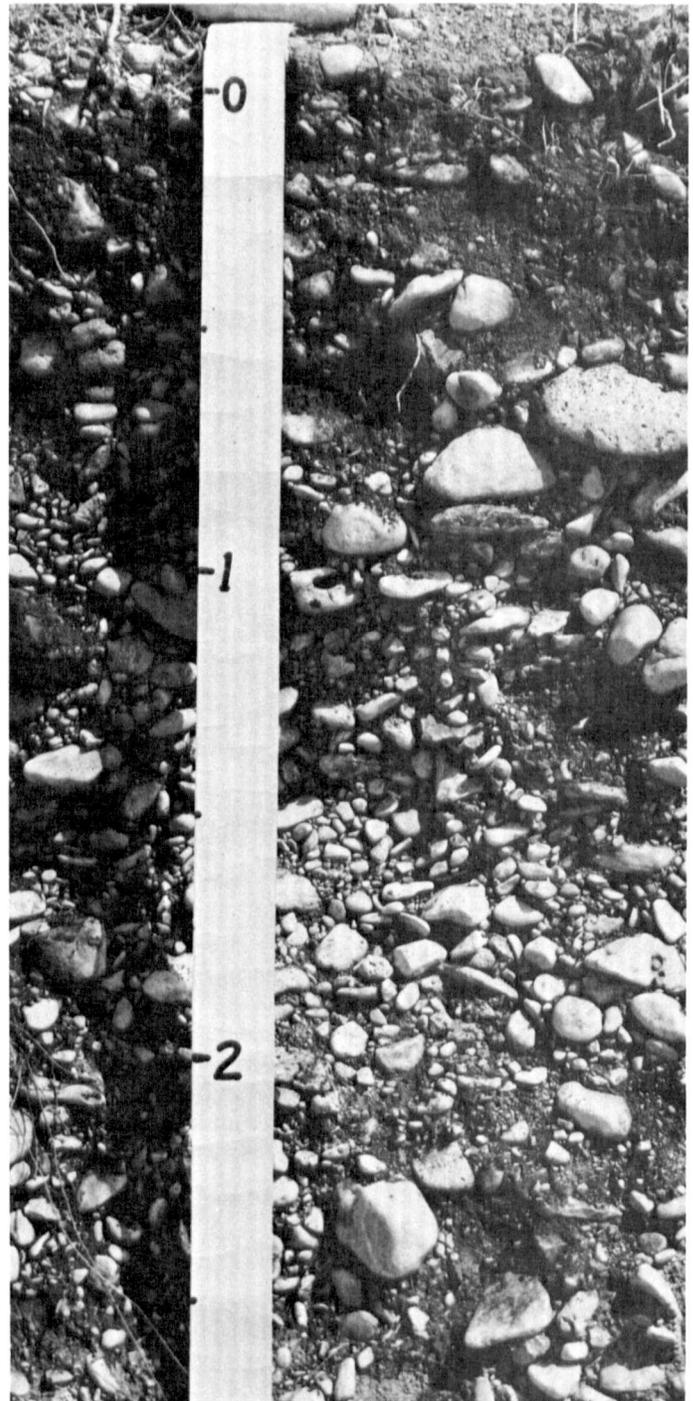


Figure 4.—Profile of Dev very gravelly loam, frequently flooded. This soil contains more than 35 percent gravel. (Scale in feet)

have rounded crests. Slopes are complex, range from 2 to 15 percent, and average about 6 percent. About 2 to 10 percent of the surface area is covered with limestone

rock and cobbles. Areas are irregular in shape and range from 20 acres to several hundred acres.

Typically, the surface layer is moderately alkaline, very cobbly loam about 10 inches thick. Below this is pinkish gray, indurated limestone bedrock that extends to a depth of more than 18 inches.

Transect data indicate that the fine earth fraction of about 35 percent of these soils is loam, 35 percent is silt loam, and 15 percent is fine sandy loam. These soils could have been mapped separately, but they were not because interpretations, use, and management are similar.

These soils have low natural fertility. They are well drained. Permeability is moderate, and available water capacity is very low. Surface runoff is slow to medium. The root zone is shallow to very shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with these soils in mapping are small areas of Latom and Tarrant soils and rock outcrop. Also included are areas of a soil similar to Eckert soils but that is more than 14 inches deep to bedrock. The included soils make up as much as 15 percent of a mapped area.

These Eckert soils are not suited to crops because of slope, the shallow or very shallow rooting depth, and susceptibility to water erosion. They are mainly used as rangeland.

These soils are well suited to use as wildlife habitat. Deer, turkey, dove, and quail inhabit areas of these soils. Several woody plants, forbs, and grasses provide fair cover and good browse for animals and game birds.

Eckert soils are poorly suited to most urban and recreation uses. Slope, cobbles and stones on the surface, and the shallow to very shallow depth to bedrock are the main limitations.

These soils have been assigned to capability subclass VII<sub>s</sub> and the Stony Loam range site.

**EtC—Eckrant-Tarrant complex, undulating.** This complex consists of shallow and very shallow soils on upland hills and ridges. Slopes range from 1 to 10 percent and average about 4 percent. About 30 percent of the surface is covered with limestone fragments that are mainly gravel and cobble size, but a few are stone size. Areas are irregular in shape and range from 25 acres to several hundred acres.

This complex is about 65 percent Eckrant cobbly clay, 30 percent Tarrant cobbly clay, and 5 percent rock outcrop. Areas of this unit are large, and the composition is variable. The detail is adequate, however, for the foreseeable uses of the soils. Use and management of the soils are similar.

The Eckrant soil is on the crest of ridges and low hills. Typically, the surface layer is moderately alkaline, very dark gray, noncalcareous, and about 12 inches thick. It is

cobbly clay in the upper 5 inches and very cobbly clay below. The underlying material is limestone bedrock.

This soil has low natural fertility. It is well drained. Permeability is moderately slow, and available water capacity is very low. Surface runoff is rapid. The root zone is shallow to very shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

The Tarrant soil is on side slopes of ridges and low hills. Typically, the surface layer is moderately alkaline, very dark grayish brown, calcareous, cobbly silty clay about 9 inches thick. Below that to a depth of more than 80 inches is fractured limestone bedrock with interbedded chalk and marl.

This soil has low natural fertility. It is well drained. Permeability is moderately slow, and available water capacity is very low. Surface runoff is rapid. The root zone is shallow or very shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with the soils in this complex are small areas of Purves, Speck, and Valera soils and rock outcrop.

The soils in this complex are not suited to cultivated crops mainly because of slope, the shallow to very shallow rooting depth, limestone fragments, and susceptibility to water erosion.

These soils are mainly used as rangeland and wildlife habitat. They are well suited to use as wildlife habitat. Deer, turkey, dove, and quail inhabit areas of these soils. Several woody plants, forbs, and grasses provide fair cover and good browse for animals and game birds.

The Eckrant and Tarrant soils are poorly suited to urban and recreation uses. Stoniness, slope, and the shallow to very shallow depth to bedrock are the main limitations. Scenic areas of these soils are valuable as sites for vacation and retirement homes.

Both the Eckrant soil and the Tarrant soil have been assigned to capability subclass VII<sub>s</sub> and the Low Stony Hill range site.

**Fr—Frio silty clay loam, occasionally flooded.** This deep, nearly level to gently sloping soil is on bottom lands along streams (figs. 5, 6). Slopes range from 0 to 2 percent and average about 1 percent. These areas flood on an average of once every 3 to 5 years. Floods usually last for only a few hours. Some flash floods occur. They are caused by runoff from the steep hills in the watershed above these areas. Areas are long and narrow and range from 15 to several hundred acres.

Typically, the surface layer is moderately alkaline and about 32 inches thick. It is dark grayish brown silty clay loam in the upper 22 inches and brown silty clay below. To a depth of 80 inches is moderately alkaline, brown silty clay (fig. 7).



*Figure 5.*—Tall grasses and native pecan trees on Frio silty clay loam. This soil has been assigned to the Loamy Bottomland range site.

This soil has high natural fertility. It is well drained. Permeability is moderately slow, and available water capacity is high. Surface runoff is slow. The root zone is deep. The hazard of soil blowing is moderate. Some scouring and deposition occur during floods.

Included with this soil in mapping are small areas of Cho, Dev, and Nuvalde soils. The included soils make up less than 15 percent of a mapped area.

The Frio soil is mainly used as rangeland, but a few areas are cultivated (fig. 8). Oats, grain sorghum, and hay are the main crops. Native pecan trees are in many areas near streams. This soil is well suited to nonirrigated and irrigated oats, wheat, cotton, grain sorghum, alfalfa, vegetables, and orchards. Leaving crop

residue on the surface helps to control water erosion, prevent soil blowing, and conserve moisture. Diversion terraces help to protect this soil from runoff from adjacent slopes. If the soil is irrigated, a well designed irrigation system and proper application of irrigation water are necessary. Fertilizer also is needed if this soil is irrigated.

This soil is well suited to use as wildlife habitat. Deer, turkey, squirrel, dove, and quail inhabit areas of this soil. Several woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for animals and game birds.

The Frio soil is not suited to urban uses because of the hazard of flooding. Shrink-swell potential is also a

limitation. This soil is moderately well suited to most recreation uses. The silty clay loam surface layer and flooding are limitations.

This soil has been assigned to capability subclass IIw, nonirrigated; capability class I, irrigated; and the Loamy Bottomland range site.

**HtD—Hext-Latom complex, undulating.** This complex consists of moderately deep to very shallow soils on ridges and knolls. Slopes range from 3 to 12 percent and average about 6 percent. About 20 percent of the surface is covered with sandstone fragments coated with caliche and fragments of gravel

conglomerates. Areas are mostly long and narrow and range from 5 to 300 acres.

This complex is about 50 percent Hext fine sandy loam, 35 percent Latom fine sandy loam, and 15 percent other soils and rock outcrop. The soils are so intricately mixed and small in area that it was not practical to map them separately.

Typically, the surface layer of the Hext soil is moderately alkaline, reddish brown fine sandy loam about 11 inches thick. The subsoil, to a depth of 19 inches, is moderately alkaline, reddish brown fine sandy loam. The underlying layer to a depth of 24 inches is moderately alkaline, reddish yellow fine sandy loam that



*Figure 6.*—White-tailed deer are abundant. They are feeding on bottom land vegetation in an area of the Frio soil.

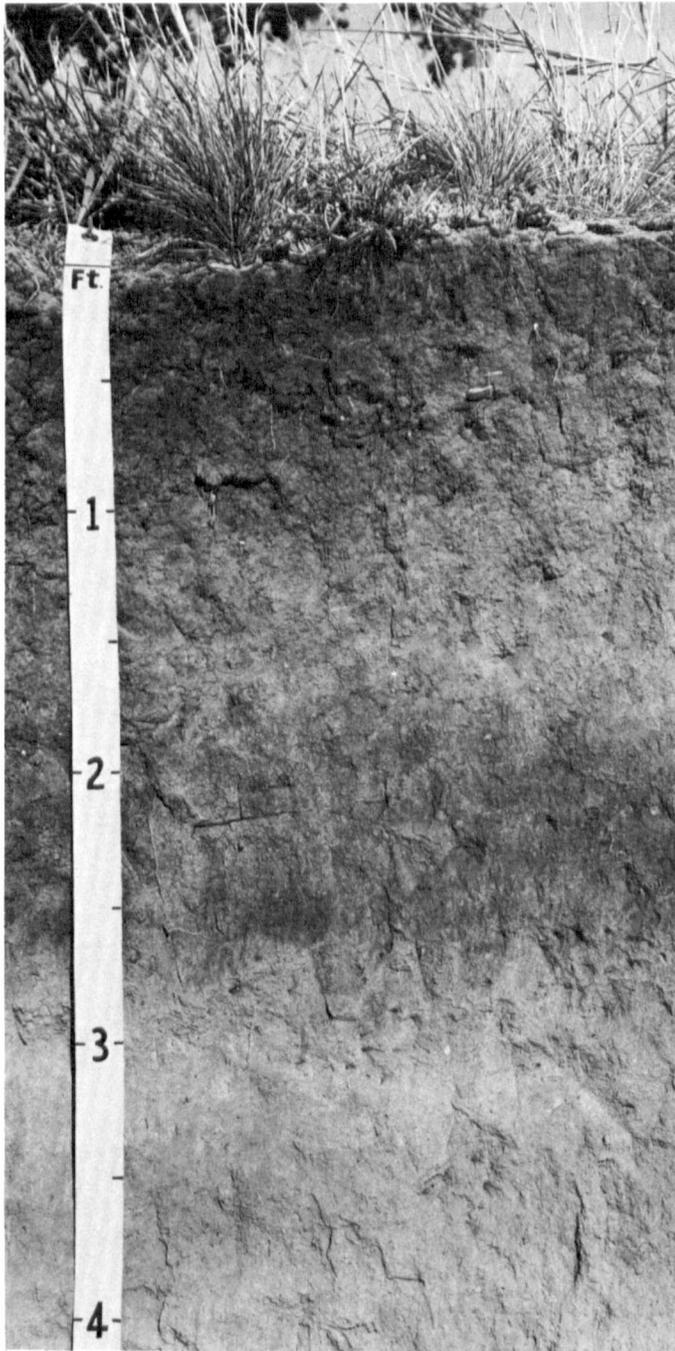


Figure 7.—Profile of Frio silty clay loam, occasionally flooded. This is a deep, dark soil on bottom lands. (Scale in feet)

has about 20 percent calcium carbonate. The underlying layer is pink, weakly cemented, marly sandstone.

The Hext soil has low natural fertility. It is well drained. Surface runoff is slow. Permeability is moderate, and available water capacity is low. The root zone is moderately deep. The hazards of water and wind erosion are moderate.

Typically, the surface layer of the Latom soil is moderately alkaline, reddish brown gravelly fine sandy loam about 8 inches thick. The underlying material to a depth of 19 inches is pink, strongly cemented, calcareous sandstone.

The Latom soil has low fertility. It is well drained. Surface runoff is high. Permeability is moderate, and available water capacity is very low. The root zone is very shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate.

Included with the soils in this complex are areas of Oben and Menard soils. Also included is an area of reddish brown fine sandy loam that is about 10 inches deep to strongly cemented caliche plates. The included soils and rock outcrop make up less than 15 percent of a mapped area.

Most areas of these soils are used as rangeland. A few small areas are used for sorghum, hay, oats, and wheat. The soils in this complex are not suited to cultivation because of slope and the very shallow to moderately deep rooting depth.

These soils are fairly suited to well suited to use as wildlife habitat. Deer, turkey, dove, and quail inhabit areas of these soils. Several woody plants, forbs, and grasses provide fair cover, browse, mast, and seeds for animals and game birds.

The soils in this complex are moderately well suited to most urban uses. Depth to rock, seepage, and slope are limitations. These soils are poorly suited to most recreation uses. Depth to rock is the main limitation.

The Hext soil has been assigned to capability subclass VIe and the Shallow (Central Basin) range site. The Latom soil has been assigned to capability subclass VIIs and the Shallow (Central Basin) range site.

**KTB—Kavett-Tarrant association, gently undulating.** This association consists of shallow and very shallow soils on uplands (fig. 9). These soils are mostly on the tops of divides, but some are in shallow drainageways. Slopes are complex and range from 0 to 5 percent, but they are dominantly 1 to 3 percent. Areas are irregular in shape and range from 40 to several hundred acres.

This association is about 70 percent Kavett soil, 25 percent Tarrant soil, and 5 percent other soils and rock outcrop. Areas of this unit are large and the composition is variable; however, the detail is adequate for the expected uses of the soils.

Kavett soil is on smooth divides. Typically, the surface layer is moderately alkaline silty clay about 11 inches



Figure 8.—Livestock and native pecan trees on Frio silty clay loam, occasionally flooded. The stream is Johnson Fork.

thick. It is dark grayish brown in the upper 6 inches and dark brown below. To a depth of 13 inches is a layer of strongly cemented, platy caliche. Below this to a depth of 20 inches is fractured limestone bedrock. In some areas the surface texture is clay.

The Kavett soil has low natural fertility. It is well drained, and surface runoff is slow. Permeability is moderately slow, and available water capacity is very low. The root zone is shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

The Tarrant soil is on side slopes of ridges and divides. Typically, the surface layer is moderately alkaline, very cobbly silty clay about 9 inches thick. It is very dark grayish brown in the upper 5 inches and dark

grayish brown below. Below this to a depth of 17 inches is fractured limestone bedrock. The surface layer is very cobbly clay in some areas.

The Tarrant soil has low natural fertility. It is well drained. Surface runoff is rapid. Permeability is moderately slow, and available water capacity is very low. The root zone is shallow or very shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with these soils in mapping are small areas of a soil that is more than 20 inches deep to bedrock and small areas of rock outcrop.

Most of the soils in this association are used as rangeland. The Tarrant soil is not suited to cultivation



*Figure 9.*—Abundant grasses and brush in an area of Kavett-Tarrant association, gently undulating.

because of shallow depth and stoniness. The Kavett soil could be cultivated if large areas were available. Occasionally, some small areas of the Kavett soil are planted to oats, wheat, or barley for grazing by wildlife. The soils in the association as a whole, however, are poorly suited to cultivated crops because of excess cobbles and stones and the shallow to very shallow soil depth.

The Kavett soil is fairly suited to use as wildlife habitat, and the Tarrant soil is well suited. Deer, turkey, dove, and quail inhabit areas of these soils. Several woody

plants, forbs, and grasses provide fair cover and browse for animals and game birds.

These soils are poorly suited to urban and recreation uses. Cobbles and stones on the surface, the shallow to very shallow depth to bedrock, and high shrink-swell potential upon drying and wetting are the main limitations.

The Kavett soil has been assigned to capability subclass IIIe and the Shallow (Edwards Plateau) range site. The Tarrant soil has been assigned to capability subclass VIIs and the Low Stony Hill range site.

**MnB—Menard fine sandy loam, 1 to 3 percent slopes.** This gently sloping soil is on upland plains (fig. 10). Slopes range from 1 to 3 percent. The surface has a slightly undulating appearance. Areas are irregular in shape and range from 20 to about 300 acres. Some fields have been slightly eroded by wind.

Typically, the surface layer is brown, neutral fine sandy loam about 9 inches thick. The upper part of the subsoil, to a depth of 33 inches, is reddish brown, neutral sandy clay loam. The lower part of the subsoil, to a depth of 41 inches, is moderately alkaline, strong brown sandy clay loam that contains accumulations of calcium carbonate.

The underlying material to a depth of 70 inches is pink, moderately alkaline sandy clay loam (fig. 11).

This soil has high natural fertility. It is well drained. Permeability is moderate, and available water capacity is medium. Surface runoff is medium. The root zone is deep. The hazards of water erosion and soil blowing are moderate.

Included with this soil in mapping are small areas of Hext, Latom, and Oben soils. Small, nearly level areas of Menard soils and soils that have slopes of more than 3 percent are included. Also included are soils similar to



*Figure 10.*—An area of Menard fine sandy loam, 1 to 3 percent slopes. This soil has been assigned to the Sandy Loam range site. It is an easily tilled soil that is suited to a wide variety of crops.

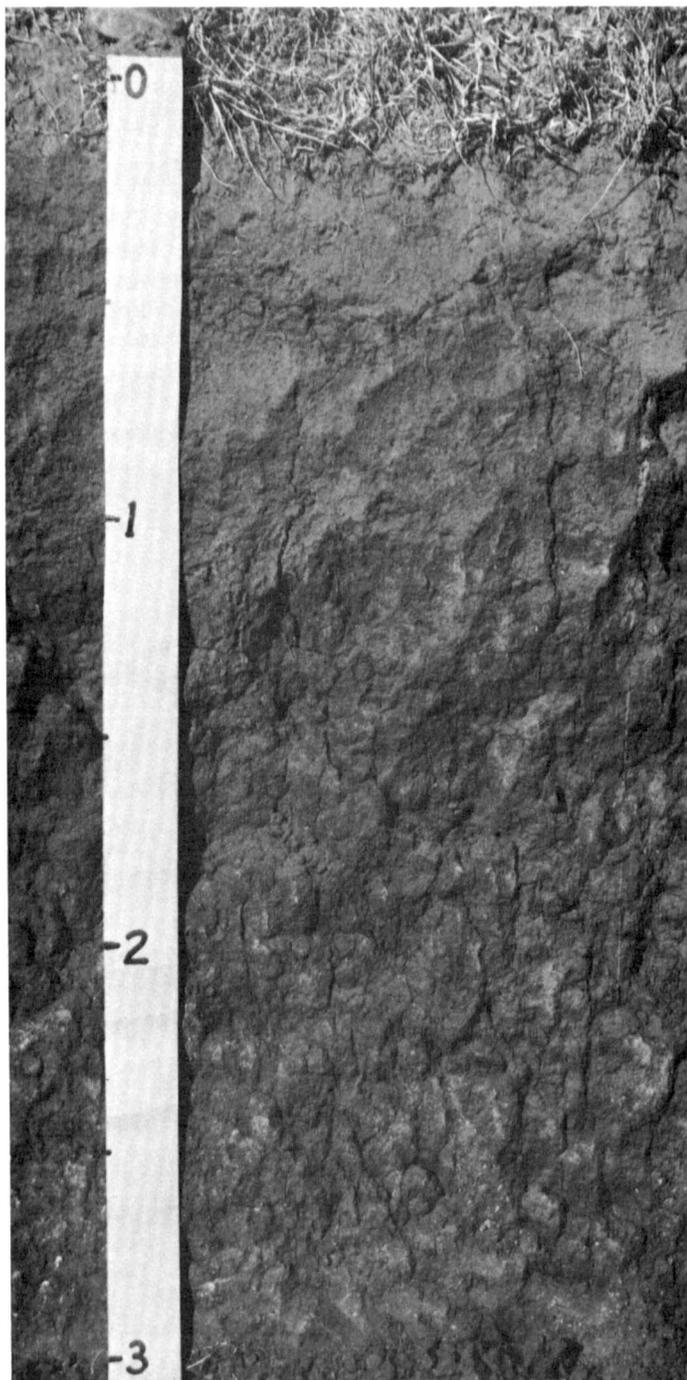


Figure 11.—Profile of Menard fine sandy loam. The sandy clay loam subsoil is below a depth of 1 foot. (Scale in feet)

the Menard soil but that are more than 50 inches deep to caliche. These included soils make up as much as 20 percent of some mapped areas.

This Menard soil is mainly used as rangeland. Some areas are used as cropland, hayland, and pastureland or are used for orchards. Some fruit and pecan orchards are irrigated.

This soil is well suited to grain sorghum, oats, wheat, barley, cotton, alfalfa, pecans, apples, peaches, grapes, blackberries, strawberries, vegetables, ornamental plants, and landscaping plants. It is one of the best soils in the county for fruits, berries, and ornamental plants because there is no chlorosis and because it has high natural fertility and is easy to till.

Fertilizer is needed on both nonirrigated land and on irrigated land. Terraces are needed to help prevent water erosion and to help conserve water. Keeping residue on the surface helps to protect the soil from water erosion and soil blowing and helps conserve moisture. If this soil is irrigated, a properly designed irrigation system and proper application of irrigation water are necessary.

This soil is well suited to use as wildlife habitat. Deer, turkey, dove, and quail inhabit areas of this soil. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seed for animals and game birds.

The Menard soil is well suited to recreation uses and moderately well suited to urban uses. The limitations are low strength affecting roads and streets, seepage, and soil blowing.

This soil has been assigned to capability subclass IIe, nonirrigated; capability subclass IIe, irrigated; and the Sandy Loam range site.

#### **NuA—Nuvalde clay loam, 0 to 1 percent slopes.**

This deep, nearly level soil is on upland outwash plains. Slopes average about 0.6 percent. Areas are irregular in shape and range from 20 to 400 acres.

Typically, the surface layer is about 16 inches thick. It is moderately alkaline, brown clay loam in the upper part and brown silty clay in the lower part. The subsoil, to a depth of 40 inches, is moderately alkaline clay with accumulations of calcium carbonate. It is brown in the upper 14 inches and light brown below. The underlying material to a depth of 80 inches is moderately alkaline, pink clay loam with accumulations of calcium carbonate.

This soil has high natural fertility. It is well drained. Surface runoff is slow. Permeability is moderate, and available water capacity is high. The root zone is deep. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

Included with this soil in mapping are small areas of Cho, Frio, and Shep soils. The included soils make up less than 15 percent of a mapped area.

This Nuvalde soil is mainly used as rangeland, but some areas are planted to oats, barley, grain sorghum, sorghum hay, and pecan orchards. This soil is well

suited to these crops and also to wheat, corn, and alfalfa. Leaving crop residue on the surface helps to protect the soil from water erosion and soil blowing and helps to conserve moisture. If this soil is irrigated, a properly designed irrigation system and proper application of irrigation water are necessary. Fertilizer also is needed if this soil is irrigated.

This soil is fairly suited to use as wildlife habitat. Deer, turkey, dove, and quail inhabit areas of this soil. Several woody plants, forbs, and grasses provide fair cover, browse, mast, and seed for animals and game birds.

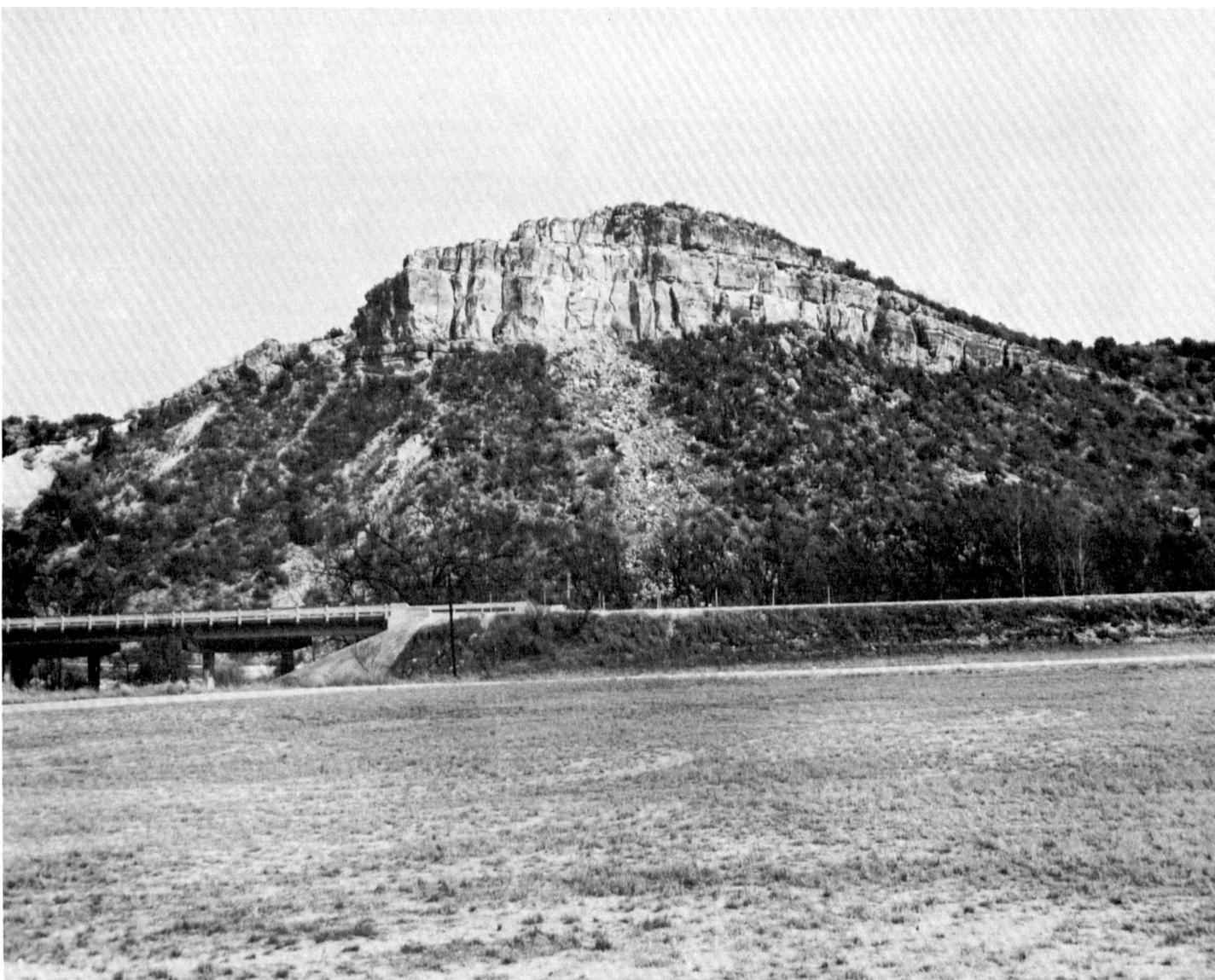
The Nuvalde soil is moderately well suited to most

urban uses. The limitations are the clayey texture, low strength that affects roads and streets, and moderate shrink-swell potential upon drying and wetting. This soil is well suited to recreation uses.

This soil has been assigned to capability subclass IIc, nonirrigated; capability class I, irrigated; and the Clay Loam range site.

**NuB—Nuvalde clay loam, 1 to 3 percent slopes.**

This deep, gently sloping soils on upland outwash plains (fig. 12). Slopes average about 2 percent. Areas are irregular in shape and range from 20 to 600 acres.



*Figure 12.*—Lover's Leap is a landmark near Junction, Texas. Nuvalde clay loam, 1 to 3 percent slopes, is in the foreground. Tarrant-Rock outcrop complex, steep, is on the hills.

Typically, the surface layer of brown, moderately alkaline clay loam is about 15 inches thick. The subsoil from 15 to 50 inches is brown, moderately alkaline clay loam. The underlying material between 50 and 74 inches is pale brown, moderately alkaline clay loam with accumulations of calcium carbonate.

This soil has high natural fertility. It is well drained. Surface runoff is slow. Permeability is moderate, and available water capacity is high. The root zone is deep. The hazards of water erosion and soil blowing are moderate.

Included with this soil in mapping are small areas of Cho, Frio, and Shep soils. These soils make up less than 15 percent of a mapped area.

This Nuvalde soil is mainly used as rangeland, but a few areas are cultivated (fig. 13). Oats, grain sorghum, sorghum hay, and barley are the main crops. This soil is moderately well suited to these crops and to wheat, corn, alfalfa, and pecan orchards. Leaving crop residue on the surface helps to control water erosion, protect the soil from blowing, and conserve moisture. Contour farming and terraces are needed to control runoff. If the soil is irrigated, a properly designed irrigation system and proper application of irrigation water are necessary. Fertilizer also is needed if this soil is irrigated.

This soil is fairly suited to use as wildlife habitat. Deer, turkey, dove, and quail inhabit areas of this soil. Several woody plants, forbs, and grasses provide fair cover, browse, mast, and seed for animals and game birds.



*Figure 13.*—An area of Nuvalde clay loam, which has been assigned to the Clay Loam range site.

The Nuvalde soil is moderately well suited to urban and recreation uses. The limitations are low strength that affects roads and streets, and moderate shrink-swell potential upon drying and wetting.

This soil has been assigned to capability subclass IIe, nonirrigated; capability subclass IIe, irrigated; and Clay Loam range site.

**Oa—Oakalla silty clay loam.** This deep, nearly level to gently sloping soil is on high bottom lands adjacent to large streams. Flooding occurs about once every 10 to 20 years. Areas are mostly long and irregular in shape and range from 20 to 300 acres. Slopes range from 0 to 2 percent but are mostly less than 1 percent.

Typically, the surface layer is moderately alkaline silty clay loam about 40 inches thick. It is dark grayish brown in the upper 17 inches and dark brown below. The underlying material to a depth of 78 inches is moderately alkaline, grayish brown silty clay loam.

This soil has high natural fertility. It is well drained. Surface runoff is slow. Permeability is moderate, and available water capacity is medium. The root zone is deep. The hazards of water erosion and soil blowing are moderate.

Included with this soil in mapping are small areas of Dev, Frio, and Nuvalde soils. Also included are a few small areas that flood more frequently than once every 10 years. The included soils make up less than 15 percent of a mapped area.

This Oakalla soil is mainly used as rangeland. Some small areas are used as cropland or for orchards, hay, or pasture. This soil is well suited to oats, wheat, barley, alfalfa, and pecans. Sorghum and feed crops usually show evidence of chlorosis because the large amount of carbonates tend to cause an iron deficiency. Applications of copperas, or iron chelate, help to overcome this condition. Leaving crop residue on the surface helps to control water erosion, protect the soil from blowing, and conserve moisture. If the soil is irrigated, a properly designed irrigation system and proper application of irrigation water are needed. Fertilizer also is needed if this soil is irrigated.

This soil is well suited to use as wildlife habitat. Deer, turkey, squirrel, dove, and quail inhabit areas of this soil. Several woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for animals and game birds.

The Oakalla soil is moderately well suited to most recreation uses. Flooding is the main limitation. This soil is not suited to urban uses because of the hazard of flooding. Seepage and corrosivity to uncoated steel are other limitations.

This soil has been assigned to capability subclass IIw, nonirrigated; capability class I, irrigated; and the Loamy Bottomland range site.

**OhC—Oben-Hext complex, 1 to 5 percent slopes.**

This complex consists of shallow and moderately deep, undulating soils on uplands. Areas are irregular in shape and range from 25 to 200 acres.

In this complex, the Oben soil and closely similar soils range from 40 to 80 percent, averaging about 60 percent; the Hext soil and closely similar soils range from 0 to 50 percent, averaging about 25 percent; and other soils, mainly Latom soils, range from 0 to 30 percent, averaging about 15 percent. Soils that are closely similar to the Oben soil are deeper to limestone, and soils that are closely similar to the Hext soil have a more clayey subsoil.

In this complex, the Oben soil is on plane and slightly concave slopes, and the Hext soil is on slightly convex slopes. Areas of this complex have variable composition. The soils are so intricately mixed that it is not practical to map them separately. The detail is adequate, however, for the foreseeable uses of the soils.

Typically, the surface layer of the Oben soil is neutral, reddish brown fine sandy loam about 6 inches thick. The subsoil, to a depth of 19 inches, is neutral sandy clay loam that is reddish brown in the upper part and reddish yellow in the lower part. The underlying material to a depth of 25 inches is reddish yellow, weakly and strongly cemented limestone conglomerate.

The Oben soil has low natural fertility. It is well drained. Surface runoff is slow to medium. Permeability is moderate, and available water capacity is moderately low. The root zone is shallow. The hazards of water erosion and soil blowing are moderate.

Typically, the surface layer of the Hext soil is moderately alkaline, reddish brown fine sandy loam about 12 inches thick. The subsoil to a depth of 19 inches is moderately alkaline, reddish brown fine sandy loam. To a depth of 28 inches it is moderately alkaline, reddish yellow fine sandy loam. The underlying material to a depth of 36 inches is moderately alkaline, pink, weakly cemented, marly sandstone.

The Hext soil has low natural fertility. It is well drained and surface runoff is slow. Permeability is moderate, and available water capacity is low. The root zone is moderately deep. The hazards of water erosion and soil blowing are moderate.

Included with this complex are small areas of Latom soils, which make up as much as 15 percent of a mapped area.

The soils in this complex are poorly suited to use as cropland and pastureland. The shallow rooting depth and slope are the main limitations.

These soils are mainly used as rangeland and wildlife habitat. They are fairly suited to well suited to use as wildlife habitat. Deer, turkey, dove, and quail inhabit areas of these soils. Several woody plants, forbs, and grasses provide fair cover, browse, mast, and seeds for animals and game birds.

The Oben and Hext soils are poorly suited to most urban and recreation uses. Depth to rock, slope, and seepage are the main limitations.

Both soils in this complex have been assigned to capability subclass IVe, nonirrigated; and the Shallow (Central Basin) range site.

**PTB—Purves-Tarrant association, gently undulating.** This association consists of shallow and very shallow soils on hills and divides of uplands. Slopes range from 1 to 8 percent and average about 4 percent. Areas are irregular in shape and range from 40 acres to several hundred acres.

This association is about 65 percent Purves clay, 25 percent Tarrant cobbly clay, and about 10 percent rock outcrop and other soils. The percentage of Purves soil ranges from 60 to 80 percent, and the percentage of Tarrant soil ranges from 10 to 40 percent. Areas of this association are variable; however, mapping has been controlled well enough for the anticipated use of the soils. Use and management of the soils are similar.

The Purves soil has slopes of 1 to 5 percent. Typically, the surface layer is moderately alkaline clay about 11 inches thick. It is very dark gray in the upper part and dark brown in the lower part. Below this is limestone bedrock.

The Purves soil has low natural fertility. It is well drained. Runoff ranges from slow to medium. Permeability is moderately slow, and available water capacity is very low. The root zone is restricted because of the shallow depth to limestone. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

The Tarrant soil has slopes of 1 to 8 percent. Typically, the surface layer is moderately alkaline, dark grayish brown very cobbly clay about 9 inches thick. Below that to a depth of 15 inches is fractured limestone bedrock.

The Tarrant soil has low natural fertility. It is well drained. Runoff is rapid, and permeability is moderately slow. The available water capacity is very low. The root zone is restricted because of the shallow depth to limestone. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with the soils in this association are small areas of rock outcrop and Nuvalde and Valera soils.

Most areas of the Purves and Tarrant soils are used as rangeland. Only a few small areas of the Purves soil are cultivated. The Tarrant soil is not suited to cultivation because of cobbles and stones. In a few places, small areas of the Purves soil are planted to oats, wheat, or barley for grazing by wildlife. The soils in this association as a whole, however, are not suited to cultivated crops because of the excess cobbles and stones and the shallow to very shallow soil depth.

The Purves soil is poorly suited to use as wildlife habitat, and the Tarrant soil is well suited. Deer, turkey,

dove, and quail inhabit areas of these soils. Several woody plants, forbs, and grasses provide cover, browse, mast, and seeds for game birds and animals.

The soils in this association are poorly suited to urban and most recreation uses. Depth to rock and slope are the main limitations. Scenic areas of these soils are valuable as sites for vacation and retirement homes.

The Purves soil has been assigned to capability subclass IIIe and the Shallow (Edwards Plateau) range site. The Tarrant soil has been assigned to capability subclass VIIs and the Low Stony Hill range site.

**RbF—Real-Brackett complex, hilly.** This complex consists of very shallow and shallow soils on upland ridges and foothills. These soils are along the base of limestone hills that slope toward the Llano River and are along the larger creeks in the county. Slopes are complex and range from 5 to 25 percent. Areas are irregular in shape and range from 25 to several hundred acres. Nearly vertical channel scarps 2 to 5 feet high are advancing up the lower parts of some drainageways leaving U-shaped gullies.

This association is about 55 percent Real soil, 35 percent Brackett soil, and 10 percent other soils. Areas are large, and the composition is variable. It was not practical to map these soils separately because use and management are similar; however, the detail is adequate for the foreseeable uses of the soils.

The Real soil is on the sides of ridges and hills. Typically, the surface layer is about 16 inches thick. It is grayish brown gravelly clay loam in the upper 8 inches and brown very gravelly clay loam below. The underlying layer to a depth of 80 inches is weakly cemented, platy limestone that becomes chalky and marly with depth.

The Real soil has low natural fertility. It is well drained, and runoff is rapid. Permeability is moderate, and available water capacity is very low. The root zone is shallow. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

The Brackett soil is mostly on mounds or ridges. Typically, the surface layer is moderately alkaline, pale brown loam about 8 inches thick. The subsoil, to a depth of 17 inches, is moderately alkaline, very pale brown loam. The underlying material to a depth of 60 inches is very pale brown, interbedded, weakly cemented limestone fragments with very pale brown clay loam that has rocklike structure.

The Brackett soil has low natural fertility. It is well drained, and runoff is rapid. Permeability is moderately slow, and available water capacity is very low. The root zone is shallow. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

Included with the soils in this complex are small areas of Cho and Tarrant soils. Also included are gently sloping areas of Real and Brackett soils and areas that have slopes of more than 25 percent. These included soils make up about 10 percent of a mapped area.

The soils in this complex are not suited to cultivation because of the shallow depth and slope. Most areas are used as rangeland and wildlife habitat.

The Real and Brackett soils are fairly suited to poorly suited to use as wildlife habitat. Deer, turkey, dove, and quail inhabit areas of these soils. Several woody plants, forbs, and grasses provide cover, browse, mast, and seeds for animals and game birds.

These soils are poorly suited to most urban and recreation uses. Depth to rock and slope are the main limitations.

The Real soil and the Brackett soil have been assigned to capability subclass VIIc and the Steep Adobe range site.

**Ro—Rioconcho clay, occasionally flooded.** This deep, nearly level to gently sloping soil is in drainageways and along narrow flood plains. Slopes range from 0 to 2 percent. Areas range from about 20 to 150 acres. These areas flood once every 4 to 15 years. Most floods last only a few hours.

Typically, the surface layer is calcareous, moderately alkaline clay about 45 inches thick. It is dark grayish brown in the upper part and brown in the lower part. The underlying material to a depth of 80 inches is pale brown clay.

The Rioconcho soil has high natural fertility. It is moderately well drained. Surface runoff is slow. Permeability is slow, and available water capacity is high. The root zone is deep. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

Included with this soil in mapping are small areas of Cho, Menard, and Nuvalde soils. Also included is a soil that is closely similar to this Rioconcho soil but that has a more clayey subsoil. These included soils make up less than 20 percent of a mapped area.

This Rioconcho soil is mainly used as rangeland, but some small areas are used as cropland or for hay or pasture. This soil is well suited to oats, wheat, barley, alfalfa, and pecan orchards. Good management includes leaving crop residue on the surface, timely and limited tillage, and rotation of crops. These practices help control water erosion, protect the soil from blowing, and conserve moisture. If this soil is irrigated, a well designed irrigation system and proper application of irrigation water are needed. Fertilizer also is needed if this soil is irrigated.

This soil is well suited to use as wildlife habitat. Deer, dove, quail, squirrel, and turkey inhabit areas of this soil. Several woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for animals and game birds.

The Rioconcho soil is not suited to urban uses because of the hazard of flooding, high shrink-swell potential, and low strength affecting roads and streets. This soil is poorly suited to most recreation uses. Flooding and the clayey texture are the main limitations.

This soil has been assigned to capability subclass IIc, nonirrigated; capability class I, irrigated; and the Clayey Bottomland range site.

**ShC—Shep clay loam, 1 to 5 percent slopes.** This deep, gently sloping soil is on upland foot slopes. Areas are irregular in shape and range from 20 to several hundred acres.

Typically, the surface layer is brown clay loam about 9 inches thick. The subsoil, to a depth of 24 inches, is light brown clay loam. The underlying material to a depth of 80 inches is light brown clay loam with accumulations of calcium carbonate. This soil is calcareous and moderately alkaline throughout.

The Shep soil has medium natural fertility. It is well drained. Surface runoff is medium. Permeability is moderate, and available water capacity is medium. The root zone is deep. The hazards of water erosion and soil blowing are moderate.

Included with this soil in mapping are small areas of Cho and Nuvalde soils. Also included are a few areas of nearly level and sloping Shep soils. Included soils make up less than 15 percent of a mapped area.

This Shep soil is mainly used as rangeland. A few small areas are used for sorghum, hay, oats, and wheat. This soil is moderately well suited to these crops and to other crops, such as oats, barley, grain sorghum, sorghum hay, and pecan orchards. Leaving crop residue on the surface helps to protect the soil from water erosion and soil blowing and helps to conserve moisture. If this soil is irrigated, a properly designed irrigation system and proper application of irrigation water are needed. Fertilizer also is needed if this soil is irrigated.

This soil is fairly suited to use as wildlife habitat. Deer, dove, quail, and turkey inhabit areas of this soil. Several woody plants, forbs, and grasses provide cover, browse, mast, and seeds for animals and game birds.

The Shep soil is well suited to most urban uses. Low strength affecting roads and streets is the main limitation. This soil is moderately well suited to recreation uses. Slope is the main limitation.

This soil has been assigned to capability subclass IVe, nonirrigated; capability subclass IIIe, irrigated; and the Hardland Slopes range site.

**SpB—Speck clay loam, 0 to 3 percent slopes.** This shallow, nearly level to gently sloping soil is on uplands and low ridges. Slopes average about 2 percent. Areas are irregular in shape and range from 15 to 150 acres.

Typically, the surface layer is dark reddish brown, neutral clay loam about 7 inches thick. The subsoil, to a depth of 14 inches, is neutral, dusky red clay. Below this is limestone bedrock.

The Speck soil has low natural fertility. It is well drained. Surface runoff is medium, and permeability is slow. The available water capacity is very low, and the

root zone is shallow. The hazards of water erosion and soil blowing are slight.

Included with this soil in mapping are small areas of Purves and Tarrant soils. Also included are a few areas of a soil that is less than 14 inches deep to bedrock. Included soils make up less than 15 percent of a mapped area.

This Speck soil is used as rangeland and wildlife habitat. It is poorly suited to use as cropland and pastureland. The limitations are the shallow rooting depth and very low available water capacity.

This soil is fairly suited to use as wildlife habitat. Deer, dove, quail, and turkey inhabit areas of this soil. Several woody plants, forbs, and grasses provide cover, browse, mast, and seeds for animals and game birds.

The Speck soil is poorly suited to most urban and recreation uses. Depth to rock, high shrink-swell potential, and the clayey texture are the main limitations.

This soil has been assigned to capability subclass IIIe and the Redland range site.

**TaC—Tarrant soils, undulating.** This very shallow and shallow soil is on hills and ridges. Slopes are complex. They range from 1 to 8 percent but are mostly 3 to 8 percent. Areas of this soil are above escarpments on high divides or plateaus. They are broad and have some narrow, convex ridges fingering out from them. Shallow, concave drainageways provide drainage in the larger areas. Areas are irregular in shape and range from about 30 to several thousand acres. This is the most extensive map unit in Kimble County.

Typically, the surface layer is calcareous, moderately alkaline very cobbly clay about 16 inches thick. The upper 7 inches is dark grayish brown and has about 50 percent limestone fragments. The lower part is dark brown and has about 75 percent limestone fragments. Below this to a depth of 22 inches is fractured limestone bedrock.

The Tarrant soils have low natural fertility. It is well drained. Surface runoff is rapid. Permeability is moderately slow, and available water capacity is very low. The root zone is shallow to very shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with this soil in mapping are small areas of rock outcrop and Eckrant, Purves, and Valera soils. Also included are a few nearly level and strongly sloping areas of Tarrant soil.

The Tarrant soil is not suited to cultivated crops because of slope, the very shallow and shallow rooting depth, and stoniness. It is mainly used as rangeland and wildlife habitat.

This soil is well suited to use as wildlife habitat. Deer, dove, quail, and turkey inhabit areas of this soil. Several woody plants, forbs, and grasses provide cover, browse, mast, and seeds for animals and game birds.

The Tarrant soil is poorly suited to most urban and recreation uses. Depth to rock, slope, cobbles and rock outcrops, and the clayey texture are limitations. Scenic areas of this soil are valuable as sites for vacation and retirement homes.

This soil has been assigned to capability subclass VIIc and the Low Stony Hill range site.

**TrG—Tarrant-Rock outcrop complex, steep.** This complex consists of very shallow to shallow soils and Rock outcrop on upland hills and ridges (fig. 14). Slopes range from about 8 to 50 percent. Areas are irregular in shape and range from 25 to 1,500 acres. Sheer escarpments that range from 3 to 100 feet in height are along some rock ledges. Other sheer escarpments of 25 to 200 feet are located in areas of rocky hills that have been undercut by streams.

This complex is about 50 percent Tarrant very cobbly clay, 15 percent Tarrant very cobbly silty clay, 25 percent Rock outcrop, and 10 percent other soils. The composition of this complex is variable. It was not practical to map the soils and Rock outcrop separately; however, mapping is adequate for the foreseeable uses of the soils. Use and management are similar.

Tarrant soils are on convex hillside slopes and benches. Typically, the surface layer is moderately alkaline, very dark grayish brown very cobbly clay about 5 inches thick and has about 40 percent limestone fragments. To a depth of 12 inches is moderately alkaline, dark brown very cobbly clay that has about 65 percent limestone fragments. Below this is fractured limestone bedrock (fig. 15).

The Tarrant soils have low natural fertility. They are well drained. Surface runoff is rapid. Permeability is moderately slow, and available water capacity is very low. The root zone is shallow or very shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

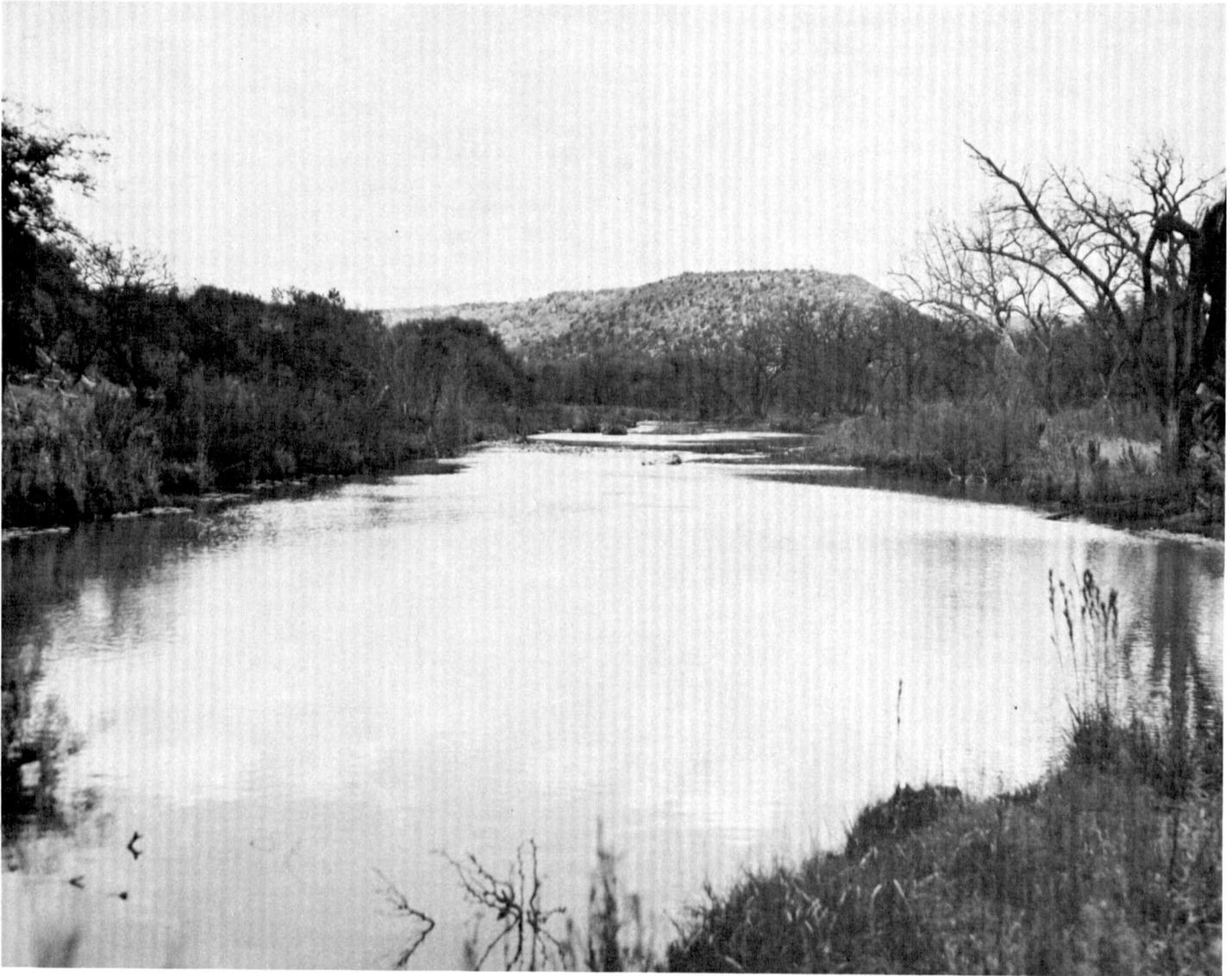
The Rock outcrop in this association consists of exposures of limestone bedrock on escarpments and ridgetops and along benches on the sides of ridges.

Included with this complex are small areas of the Real and Eckrant soils. Also included are areas of gently sloping to sloping Tarrant soils and very steep Tarrant soils on slopes with gradients of more than 50 percent.

The Tarrant soils are not suited to cultivated crops because of slope, the shallow and very shallow rooting depth, Rock outcrop, and stoniness. These soils are used as rangeland and wildlife habitat.

These soils are well suited to use as wildlife habitat. Deer, dove, quail, and turkey inhabit areas of these soils. Several woody plants, forbs, and grasses provide cover, browse, mast, and seeds for animals and game birds.

Tarrant soils are poorly suited to most urban and recreation uses. Depth to rock, Rock outcrop, slope, and the clayey texture are limitations. Scenic areas of these soils are valuable as sites for vacation and retirement homes.



*Figure 14.*—An area along the Llano River. The soil in the foreground has been assigned to the Loamy Bottomland range site. Tarrant-Rock outcrop complex, steep, is on the hill.

These soils have been assigned to capability subclass VII<sub>s</sub> and the Steep Rocky range site.

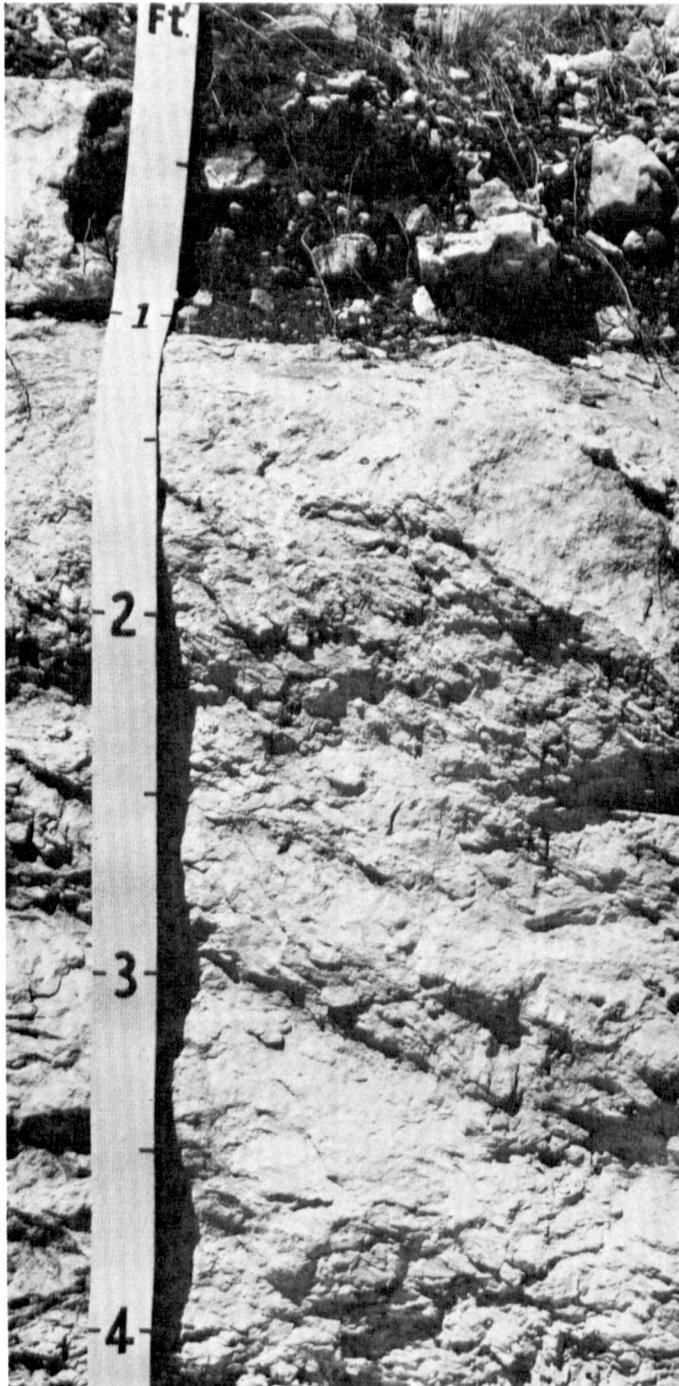
**VaB—Valera clay, 1 to 3 percent slopes.** This moderately deep, gently sloping soil is in upland valleys and on plateaus. Slopes average about 2 percent. Areas are long, oval, or rounded and range from 20 to 250 acres.

Typically, the surface layer is about 23 inches thick. It is moderately alkaline, dark grayish brown clay in the upper 12 inches, and moderately alkaline dark brown

clay below. The subsoil, to a depth of 28 inches is moderately alkaline, brown clay. To a depth of 33 inches is cemented caliche. Below this to a depth of 36 inches is fractured limestone bedrock.

The Valera soil has high natural fertility. It is well drained. Permeability is moderately slow. Surface runoff ranges from slow to medium. The root zone is moderately deep. The hazards of water erosion and soil blowing are moderate.

Included with this soil in mapping are small areas of Kavett, Nuvalde, and Tarrant soils. About 10 percent of some mapped areas are nearly level Tarrant soils. The



*Figure 15.*—Profile of Tarrant cobbly clay over hard limestone bedrock. This soil is on upland hills. (Scale in feet)

included soils make up less than 15 percent of a mapped area.

This Valera soil is mainly used as rangeland. A few areas are cropped to oats, barley, wheat, and grain sorghum or sorghum hay. The soil is moderately well suited to nonirrigated and irrigated oats, barley, wheat, corn, alfalfa, grain sorghum, and sorghum hay. Good management includes leaving crop residue on the surface when crops are not being grown, timely and limited tillage, and rotation of crops. These practices help to control soil blowing and water erosion and to conserve moisture. If the soil is irrigated, a properly designed irrigation system and proper application of irrigation water are necessary. Fertilizer also is needed if the soil is irrigated.

This soil is fairly suited to use as wildlife habitat. Deer, dove, quail, and turkey inhabit areas of this soil. Several woody plants, forbs, and grasses provide cover, browse, mast, and seeds for animals and game birds.

The Valera soil is poorly suited to most urban and recreation uses. High shrink-swell potential, the clayey texture, and depth to rock are limitations.

This soil has been assigned to capability subclass IIe, nonirrigated; capability subclass IIe, irrigated; and the Clay Loam range site.

# prime farmland soils

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This section provides information about prime farmland soils in Kimble County. It defines and discusses requirements and lists the prime farmland soils.

Each year thousands of acres of land throughout the United States are converted from agricultural to industrial, urban, and other uses. Some of this land includes prime farmland.

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. The supply of high quality farmland is limited. The U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, must encourage and facilitate the use of our Nation's prime farmland with wisdom and foresight.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops if treated and managed using acceptable farming methods. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland includes that currently being used for crops, pasture, rangeland, or other purposes except urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has a favorable temperature and growing season and an acceptable level of acidity or alkalinity. This land has few or no rocks and is permeable to water and air. Prime farmland is not excessively erosive or saturated with water for long periods and is not flooded during the growing season. Slope ranges mainly from 0 to 6 percent. For more detailed information regarding the criteria for prime farmland, consult the local staff of the Soil Conservation Service.

About 103,069 acres, or approximately 12.6 percent of Kimble County, meets the soil requirements for prime farmland. Areas are scattered throughout the county. Much of this land is adjacent to rivers and perennial

streams in long, narrow valleys and wide, deep, nearly level clay loam areas. Also, areas of deep, reddish sandy loam soils in the northeastern part of the county are prime farmland soils.

Crops grown on prime farmland are mainly sorghum and small grain, which are used for grazing. In 1980, only about 10 percent, or 8,250 acres, of prime farmland was cropped. The rest, 95,000 acres or 90 percent, is presently used as rangeland or is idle. Grazing by a large population of deer has resulted in many cropland fields reverting to grazing land.

The detailed soil map units that make up prime farmland in Kimble County are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 2. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed soil map units."

Soils that have limitations, such as a high water table, flooding, or inadequate rainfall, may qualify as prime farmland if those limitations can be overcome by corrective measures, such as drainage, flood control, or irrigation. Onsite investigation is necessary to determine whether the corrective measures have been effective.

The soils in the map units listed below meet the requirements for prime farmland, unless the soils are urban or built-up land or they flood less than once every 2 years during the growing season.

Fr—Frio silty clay loam, occasionally flooded  
 MnB—Menard fine sandy loam, 1 to 3 percent slopes  
 NuA—Nuvalde clay loam, 0 to 1 percent slopes  
 NuB—Nuvalde clay loam, 1 to 3 percent slopes  
 Oa—Oakalla silty clay loam  
 Ro—Rioconcho clay, occasionally flooded  
 ShC—Shep clay loam, 1 to 5 percent slopes  
 VaB—Valera clay, 1 to 3 percent slopes

Urban or built-up land is any contiguous unit of land of 10 acres or more that is used for residences, industrial sites, commercial sites, construction sites, institutional sites, public administration sites, railroad yards, small parks, cemeteries, airports, golf courses, sanitary landfills, sewage treatment plants, water control structures and spillways, or shooting ranges.



# use and management of the soils

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This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

## **crops**

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given

in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1979, the acreage used as cropland totaled about 10,200 acres and about 950 acres was irrigated, according to records of the local field office of the Soil Conservation Service.

The main limitation for crops is low rainfall. Potential for increased production on the deeper soils is high, but the low rainfall and shallow rooting depth restrict many of the soils to use as rangeland.

Other management concerns are the hazards of water erosion and soil blowing. Water erosion is a hazard in the larger areas and on the more sloping Nuvalde, Rioconcho, Shep, and Valera soils. Runoff can damage these soils unless they are protected. Plant cover, contour farming, terraces, and grassed waterways help to minimize the risk of water erosion.

Soil blowing is a moderate hazard during periods of severe drought. It is most severe on the clayey Rioconcho and Valera soils. These soils can be damaged in a few hours if winds are strong and the soils are powdery and bare of plant cover or surface mulch. Maintaining plant cover, surface mulch, or a rough surface through proper tillage minimizes the risk of soil blowing.

Loss of the surface layer through water erosion or soil blowing is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging if the soil is shallow or the depth of the root zone is limited by a layer, such as the indurated caliche layer in Kavett soils. Second, water erosion on farmland results in sedimentation of streams. Controlling water erosion minimizes the pollution of streams by sediment and improves the quality of water for urban use, recreation, and wildlife. Soil blowing results in pollution of the air and deposits drifts of productive soil material along fence rows and on roads.

Erosion control practices should provide protective surface cover, reduce runoff, and increase water intake. A cropping system that keeps a plant cover on the soil for long periods can hold erosion losses to amounts that do not reduce yields.

Minimum tillage and leaving crop residue on the surface of the soil increase water intake and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area but are difficult to use successfully on soils that have a clayey surface layer, such as the Rioconcho and Valera soils.

Emergency tillage helps to control soil blowing when crop residue does not furnish enough protection. Emergency tillage roughens the surface to slow the movement of the wind. Frio, Nuvalde, Oakalla, Rioconcho, and Valera soils are suited to emergency tillage.

Contour farming is another erosion control practice used in the survey area. It is best adapted to short slopes and to soils that have smooth, uniform slopes. Contour farming is needed in some areas of Frio, Nuvalde, Oakalla, Rioconcho, and Valera soils and in all areas that have field terraces.

Grassed waterways minimize the hazard of erosion by uncontrolled runoff. They are also good outlets for field terraces or diversion terraces.

Field terraces and diversion terraces reduce the length of slopes and slow runoff and erosion. Diversion terraces upslope from cropland divert runoff away from the cropland. Terraces are most practical on deep, well drained soils that have smooth slopes, such as Frio, Nuvalde, and Oakalla soils. Some other soils are less suited because of irregular slopes or shallowness over hard caliche.

Information regarding the design of erosion control practices for each kind of soil is available in local offices of the Soil Conservation Service.

Natural soil fertility of the deeper soils is medium or high. Farm manure is best for maintaining fertility or improving it if it is depleted. If large amounts are used, however, the subsequent crop may be damaged in years of drought. Spreading the manure in a thin layer over large areas reduces the danger of damage by overfertilization. Applying commercial fertilizer to nonirrigated land improves yields. Fertilizing irrigated land increases yields substantially. Commercial fertilizer should be applied according to the results of soil tests, the need of the crop, and the expected level of yields. The Cooperative Extension Service can help in determining the kind and amount of fertilizer needed. The nutrients that have the greatest effect on yield are nitrogen, phosphorus, and iron. No lime is needed because large amounts are naturally in all of the soils.

Soil tilth is important in the germination of seeds and in the rate of water intake. Soils that have good tilth are granular, porous, and friable. Tilth can be improved by adding large amounts of organic matter, such as manure or crop residue. Because Rioconcho and Valera soils are high in content of clay, it is hard to keep them in good tilth. If the soils are plowed when wet, they tend to be cloddy when dry. Preparing a good seedbed is difficult in a cloddy soil. Fall plowing generally results in good tilth

in spring, but soil blowing can be a concern if the soil is left bare of vegetation.

The crops currently grown in Kimble County are cotton, grain sorghum, wheat, oats, barley, hay and grazing crops, and a small acreage of vegetables and pear orchards. Irrigation would improve their growth. Because irrigation water is not abundant, it is usually used for vegetables rather than for grain or hay crops. Deep soils that have good natural drainage and that warm up early in spring are especially well suited to many vegetables, such as tomatoes, onions, squash, carrots, radishes, peppers, okra, beans, spinach, asparagus, eggplant, turnips, beets, and cucumbers. These soils are also well suited to some varieties of blackberries and grapes. Pecans are best suited to deep, well aerated soils that are deeply moistened by floodwater. Pecans are presently being grown on some of the Frio and Dev soils, which are well suited. Pecan orchards are also suited to Nuvalde soils, but irrigation is necessary.

The latest information and suggestions on growing new crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Water for irrigation is scarce, and the demand for water for irrigation is constantly increasing. The energy needed to pump water is becoming more expensive; therefore, efficient irrigation is essential. Irrigation water should be used on the best soils. It should be applied uniformly, without water loss, in amounts and at intervals that promote adequate plant growth. Proper irrigation wets the entire root zone so that most of the water is below the rapid evaporation area.

Sprinkler irrigation is less efficient in hot, dry areas. On some windy summer days, 40 percent of the water pumped is lost to evaporation before it soaks into the soil. Some sprinkler systems wet only the surface layer where evaporation loss is great. Because sprinklers require water under pressure, pumping costs are greater than for surface irrigation. The advantage of sprinkler irrigation is that little land leveling is required.

Row irrigation or border irrigation, if the system is properly designed and properly used, is generally the most efficient. More labor and more land leveling, however, may be required.

The best soils for irrigation are level and have a deep root zone and high available water capacity, as exemplified by the Frio, Menard, Nuvalde, Oakalla, and Rioconcho soils.

### **yields per acre**

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 3. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 3 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

### land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (5). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined 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. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

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 or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that 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.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

*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 very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6. There are no capability units in this survey.

The acreage of soils in each capability class and subclass is shown in table 4. The capability classification of each map unit is given in the section "Detailed soil map units."

### rangeland

About 782,700 acres, or 96 percent of all land, is rangeland. Raising livestock is the major enterprise in the county. In 1978 there were 75,000 angora goats, 53,000 sheep, and 25,000 cattle (3). A large population of white-tailed deer also uses the rangeland. In 1977 the

deer population was estimated at 75,000, and in 1979 it was estimated at 106,000.

The very shallow and shallow Tarrant, Real, Eckrant, and Brackett soils on the limestone hills have a wide variety of plants. Included in this variety are perennial forbs and evergreen woody plants, such as live oak and Ashe juniper. This kind of rangeland is well suited to deer, goats, and sheep. In the valleys are the deep Nuvalde, Frio, Oakalla, Dev, and Shep soils. These soils have a mixture of mid and short grasses, forbs, and shrubs. Many cattle are raised in the valleys, which have the highest forage production potential in the county. The sandier Menard, Hext, Latom, and Oben soils in the northeastern part of the county support redberry juniper, a few live oak, shinnery oak, Spanish oak, some shrubs, and grasses and forbs. There are fewer evergreens here; however, these areas are excellent habitat for deer. Rainwater percolates deeper and faster through sandy soils, therefore, less is lost by evaporation and more is used for plant growth.

Many changes in the vegetation have occurred in the last 100 years. These changes were caused by a change in the kinds of grazing animals; by the use of fencing, which caused a change from sporadic to continuous grazing; and by a reduction in grass fires.

The grazing animals once consisted of mostly deer, bison, prairie dogs, and rabbits. The bison and prairie dogs have gone; however, deer are more abundant and large numbers of goats, sheep, and cattle have been added. Animals have plant preferences, therefore, some plants have been grazed out of the composition. Because of continuous grazing of other plants, reproduction was prevented. In the past, prairie fires controlled some plants; therefore, when the fires were stopped, these plants increased in the composition. Spiny and poisonous plants increased in most areas because they were able to produce seeds in spite of the heavy grazing.

Many woody plants have increased in recent years. The Tarrant, Eckrant, Real, and Brackett soils have had an increase in live oak, Ashe juniper, persimmon, algerita, catclaw, and lotebush. The Nuvalde, Shep, and Frio soils have had an increase in mesquite, juniper, lotebush, and cactus. The sandy loam soils in the northeast have had an increase in redberry juniper, whitebrush, catclaw, lotebush, persimmon, mesquite, Ashe juniper, and algerita. Indiangrass, little bluestem, Canada wildrye, cane bluestem, most herbaceous legumes, and most perennial forbs have decreased. Additional changes in the plant community are discussed in each range site description.

Plant growth is highest during April, May, and June when rainfall and temperatures are most favorable. Another period of growth is during September and October. The fall growth period is very important because many plants need growth to produce seed. Also, fall growth is needed for winter forage.

Drought in the summer is very common. Low or erratic rainfall in July and August combined with very high evaporation rates cause a depletion of soil moisture. Most supplemental feeding of livestock is done in the coldest part of winter. This time of the year is not as critical for deer as it is for cattle. Deer die-offs occur during summer droughts.

Ranchers are mainly concerned with forage production for their livestock. In the past, woody plants were considered undesirable because they used moisture that could have been used by forage plants. Cleared land was also valuable. Now, other values and income opportunities are becoming important to ranchers. For example, land that is still largely a natural savannah may sell for four times as much as land that has had the woody plants removed. Land on which heavy equipment has killed and mangled the trees is now judged as unsightly. Today, the scenic, recreation, and aesthetic values largely determine land prices. Also, deer and turkey depend on woody cover for much of their food and cover. Some ranchers earn as much as one-half of their net income from hunting leases.

Woody plants have other values. Posts made from Ashe juniper are the best available because they do not need wood preservatives to prevent decay. Some 80-year old posts in fences are still standing.

Cedar oil is another valuable product of Ashe juniper. This oil is difficult to synthesize, so it probably will continue to be extracted from juniper. An oil processing plant in Kimble County has the capacity to process 20 acres of juniper each day. Dry wood is ground and then steamed to extract the oil. Some juniper fiber is used by oil well drillers to regulate the consistency of the drilling mud.

Wildlife use Ashe juniper for protection in cold weather. The golden-cheeked warbler, a rare and endangered species, depends on this plant for nest-building material. This bird nests only in the "Texas Hill Country" because it must have old-growth Ashe juniper in its habitat. Apparently, other important needs are springs and small creeks. These birds are seen foraging through deciduous trees in the water areas. These habitats should be identified and carefully preserved. The birds are very rare and sightings are coveted by many birdwatchers.

Another product from rangeland is wood for home heating. Some ranchers now sell firewood by the cord. Live oak and mesquite are well suited to use as firewood and are abundant on some soils. Live oak is most abundant on the shallow and very shallow Tarrant soils, and mesquite is now abundant on most areas of deep soils, such as the Menard and Nuvalde soils.

Water erosion is a severe hazard along roads on the steep Real, Brackett, and Tarrant soils. Most roadside ditches develop into gullies on these steep soils. Unused roads on steep land should be smoothed out and reseeded to adapted grasses.

The main management concern for ranchers is to achieve maximum or near maximum production and still preserve the plant, soil, and water resources. Half of the annual plant growth should be left ungrazed. This is necessary in order to prevent erosion, increase water intake, and to keep plants healthy and vigorous.

Grasses grow most rapidly when they have a large amount of green foliage. Deferred or intermittent grazing is necessary so that plants can reproduce. Reseeding is necessary on former cropland or on severely overgrazed land. Some thinning or spot clearing of woody plants is beneficial for livestock and wildlife.

Woody plants, such as mesquite, supply only a little forage, use a lot of water, and are overabundant. As early as the 1880's, mesquite was invading the prairies in this part of the state. It is now abundant on all of the deep, moderately deep, and shallow soils. Mesquite has a much deeper root system than grasses and draws water from greater depths. The water that has penetrated to these greater depths can also supply springs. To some degree, mesquite is responsible for drying up springs or for reducing their flow. If most of the mesquite is removed, springs and streams generally flow yearlong. Although juniper is not so deep rooted as mesquite, but it, too, stops or slows the flow of springs if it is overabundant.

Evidence of dried-up springs returning to their natural state is apparent in the northwest corner of the county in the North Llano River Watershed. One rancher plowed up the mesquite growing on Nuvalde soils. A deep gully in the areas was filled, smoothed, and seeded. After the first rain, a small spring appeared in this former gully. At a nearby ranch in an area of Tarrant soils, about one-half of the juniper was removed from 300 acres. An intermittent spring, which was located in the middle of this area, has flowed continuously since the juniper was removed. At another ranch on Bear Creek in an area of mainly Tarrant soils, the owner cut most of the young Ashe juniper and some of the old juniper. This rancher reports that springs in this area have doubled in flow.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 5 shows, for each soil, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. Explanation of the column headings in table 5 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients

have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

*Potential annual production* is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of plants, reducing undesirable brush species, conserving water, and controlling erosion water and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

#### range sites

In the following paragraphs, the plant community is described for each of the 13 range sites in this county.

**Clayey Bottomland range site.** The Rioconcho soil in map unit Ro is in this range site. The climax vegetation is a prairie consisting of about 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The potential plant community is—

- indiagrass and little bluestem—15 percent
- silver bluestem—5 percent
- sideoats grama—20 percent
- vine-mesquite, buffalograss, and curlymesquite—15 percent
- plains bristlegrass and green sprangletop—5 percent
- plains lovegrass—5 percent

- Texas needlegrass—10 percent
- tall dropseed and meadow dropseed—5 percent
- orange zexmania, velvet bundleflower, Engelmann-daisy, and bushsunflower—10 percent
- live oak and hackberry—10 percent.

Indiangrass, little bluestem, and plains bristlegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced mainly by sideoats grama, vine-mesquite, Texas needlegrass, and buffalograss. If heavy grazing continues, the plant community will be invaded by threeawns, tridens, juniper, mesquite, lotebush, algerita, and persimmon.

**Clay Loam range site.** The Nuvalde soil in map units NuA and NuB and the Valera soil in map unit VaB are in this range site. The climax vegetation is a prairie consisting of 85 percent mid grasses, 10 percent forbs, and 5 percent woody plants.

The potential plant community is—

- sideoats grama—25 percent
- silver bluestem—5 percent
- vine-mesquite—5 percent
- buffalograss and curlymesquite—5 percent
- little bluestem, green sprangletop, and indiagrass—10 percent
- Texas needlegrass—10 percent
- Canada wildrye—5 percent
- plains bristlegrass—5 percent
- tall dropseed and meadow dropseed—5 percent
- plains lovegrass—5 percent
- Arizona cottontop—5 percent
- orange zexmania, Engelmann-daisy, and hairy tubetongue—10 percent
- greenbrier, bumelia, and live oak—5 percent.

Sideoats grama, vine-mesquite, and Canada wildrye are preferred by domestic livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by Texas needlegrass, buffalograss, silver bluestem, and plains lovegrass. If heavy grazing continues, the plant community will be invaded by threeawn grasses, tridens, mesquite, lotebush, juniper, and undesirable forbs.

**Hardland Slopes range site.** The Shep soil in map unit ShC is in this range site. The climax vegetation is a mid grass prairie consisting of 80 percent grasses, 5 percent forbs, and 15 percent shrubs and trees.

The potential plant community is—

- sideoats grama—25 percent
- plains lovegrass—10 percent
- Texas needlegrass—5 percent
- slim tridens, little bluestem, and rough tridens—10 percent
- vine-mesquite—5 percent
- curlymesquite and buffalograss—5 percent
- silver bluestem—5 percent

- tall dropseed—5 percent
- tall and hairy grama—5 percent
- orange zexmania—5 percent
- hairy tubetongue and gray coldina—5 percent
- Ashe juniper—5 percent
- live oak, elbowbush, and littleleaf sumac—5 percent
- knife condalia—5 percent.

Sideoats grama, little bluestem, and silver bluestem are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced mainly by rough tridens, fall witchgrass, buffalograss, and hooded windmillgrass. If heavy grazing continues, the plant community will be invaded by threeawns, tridens, mesquite, algerita, pricklypear, and juniper.

**Loamy Bottomland range site.** The Dev soil in map unit De, the Frio soil in map unit Fr, and the Oakalla soil in map unit Oa are in this range site. The climax vegetation is mid grass and tall grass pecan savannah consisting of 70 percent grasses, 10 percent forbs, and 20 percent woody plants.

The potential plant community is—

- sideoats grama—10 percent
- pinhole and cane bluestem—10 percent
- plains lovegrass—5 percent
- vine-mesquite, curlymesquite, and buffalograss—5 percent
- indiagrass, little bluestem, and switchgrass—15 percent
- Canada wildrye, Virginia wildrye, Texas bluegrass, and western wheatgrass—15 percent
- Texas needlegrass and southwestern bristlegrass—10 percent
- pecan, cedar, elm, hackberry, sycamore, poison ivy, and walnut—20 percent
- bushsunflower, least snoutbean, orange zexmania, and Engelmann-daisy—10 percent.

Switchgrass, indiagrass, and Engelmann-daisy are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by Texas needlegrass, southwestern bristlegrass, and buffalograss. If heavy grazing continues, the plant community eventually will be dominated by annual grasses, such as rescuegrass; low quality forbs, such as iceweed; and a dense stand of brush consisting of woody plants, such as algerita, persimmon, and mesquite.

**Low Stony Hill range site.** The Eckrant soil in map unit EtC and the Tarrant soil in map units EtC, KTB, PTB, and TaC are in this range site. The climax vegetation is mid grass savannah consisting of 80 percent grasses, 10 percent forbs, and 10 percent woody plants (fig. 16).



Figure 16.—Eckrant and Tarrant soils have been assigned to the Low Stony Hill range site. The juniper has been killed in this area.

The potential plant community is—

- little bluestem—25 percent
- Texas cupgrass and indiagrass—5 percent
- green sprangletop, cane bluestem, and silver bluestem—10 percent
- sideoats grama—20 percent
- slim tridens and rough tridens—5 percent
- Texas needlegrass—5 percent
- plains lovegrass and fall witchgrass—5 percent
- buffalograss, curlymesquite, tall dropseed, and meadow dropseed—5 percent
- live oak—5 percent

- kidneywood, hackberry, and skunkbush sumac—5 percent
- Engelmann-daisy, velvet bundleflower, bushsunflower, and orange zexmania—10 percent.

Little bluestem, indiagrass, and sideoats grama are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by Texas needlegrass, fall witchgrass, and hairy grama. If heavy grazing continues, the plant community will be invaded by hairy tridens, red grama, pricklypear, Ashe juniper, and persimmon.

**Redland range site.** The Speck soil in map unit SpB is in this range site. The climax vegetation is a post oak savannah consisting of 85 percent grass, 5 percent forbs, and 10 percent trees.

The potential plant community is—

- little bluestem—30 percent
- big bluestem and indiagrass—10 percent
- Texas needlegrass and plains lovegrass—10 percent
- sideoats grama—15 percent
- tall dropseed and meadow dropseed—5 percent
- silver bluestem—5 percent
- Texas cupgrass—5 percent
- curlymesquite and buffalograss—5 percent
- orange zexmania and velvet bundleflower—5 percent
- live oak and post oak—10 percent.

Big bluestem, little bluestem, indiagrass, and Texas cupgrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced mainly by sideoats grama, silver bluestem, and curlymesquite. If heavy grazing continues, the plant community will be invaded by such plants as threeawns, red grama, tridens, and juniper.

**Sandy Loam range site.** The Menard soil in map unit MnB is in this range site. The climax vegetation is a mid grass prairie consisting of 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The potential plant community is—

- little bluestem—20 percent
- sideoats grama—15 percent
- cane bluestem and pinhole bluestem—5 percent
- hooded windmillgrass—5 percent
- plains bristlegrass—5 percent
- indiagrass—5 percent
- Virginia wildrye and Canada wildrye—5 percent
- buffalograss and curlymesquite—5 percent
- plains lovegrass and Texas needlegrass—10 percent
- sand lovegrass—5 percent
- live oak and post oak—10 percent
- trailing ratany, bushsunflower, and Engelmann-daisy—10 percent.

Little bluestem, indiagrass, Canada wildrye, and sideoats grama are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced mainly by plains bristlegrass, sand lovegrass, and hooded windmillgrass. If heavy grazing continues, the plant community will be invaded by threeawn, fringleaf paspalum, lotebush, juniper, persimmon, algerita, and whitebrush.

**Shallow (Edwards Plateau) range site.** The Kavett soil in map unit KTB and the Purves soil in map unit PTB are in this range site. The climax vegetation is a prairie consisting of 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The potential plant community is—

- little bluestem—20 percent
- sideoats grama—25 percent
- cane bluestem—5 percent
- green sprangletop, vine-mesquite, plains lovegrass, and Texas cupgrass—15 percent
- buffalograss and curlymesquite—5 percent
- Texas needlegrass, Virginia wildrye, and Canada wildrye—10 percent
- fall witchgrass—5 percent
- orange zexmania and bushsunflower—5 percent
- elbow bush, live oak, and hackberry—10 percent.

Little bluestem, sideoats grama, vine-mesquite, and green sprangletop are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss, plains lovegrass, Texas needlegrass, and curlymesquite. If heavy grazing continues, the plant community will be invaded by hairy tridens, threeawn grasses, red grama, and juniper.

**Shallow (Central Basin) range site.** The Hext and Latom soils in map unit HtD, and the Oben and Hext soils in map unit OhC are in this range site. The climax vegetation consists of 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The potential plant community is—

- little bluestem—25 percent
- sideoats grama—10 percent
- indiagrass—5 percent
- Canada wildrye—5 percent
- hooded windmillgrass—5 percent
- pinhole bluestem—10 percent
- plains bristlegrass—5 percent
- buffalograss and curlymesquite—5 percent
- hairy grama and Wright threeawn—5 percent
- rough tridens, slim tridens, and fall witchgrass—5 percent
- tall grama and hairy grama—5 percent
- hairy tubetongue, rock daisy, and guara—5 percent
- orange zexmania and hoary blackfoot—5 percent
- live oak—5 percent.

Little bluestem, indiagrass, Canada wildrye, and plains bristlegrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by sideoats grama, hooded windmillgrass, and Wright threeawn. If heavy grazing continues, the plant community will be invaded by hairy tridens, lotebush, persimmon, mesquite, whitebrush, and juniper.

**Steep Adobe range site.** The Real and Brackett soils in map unit RbF are in this range site. The climax vegetation is a mid grass savannah consisting of 80 percent grasses, 5 percent forbs, and 15 percent woody plants.

The potential plant community is—

- little bluestem—30 percent
- Nealley grama and sideoats grama—20 percent
- silver bluestem and tall dropseed—10 percent
- slim tridens and rough tridens—10 percent
- fall witchgrass, canyon mulhy, tall grama, and hairy grama—10 percent
- orange zexmania, hoary blackfoot, wooly-white—5 percent
- kidneywood and Ashe juniper—5 percent
- live oak and Texas oak—10 percent.

Little bluestem and sideoats grama are preferred by livestock; therefore, they are grazed out first if grazing is

not controlled. These plants are replaced mainly by slim tridens, tall grama, and silver bluestem. If heavy grazing continues, the plant community will be invaded by threeawns, dropseeds, cenizo, yucca, juniper, and catclaw.

**Steep Rocky range site.** The Tarrant soil in map unit TrG is in this range site (fig. 17). The climax vegetation is a mid-grass savannah consisting of 75 percent grasses, 10 percent forbs, and 15 percent woody plants.

The potential plant community is—



*Figure 17.*—Live oak and juniper trees are on this area of Tarrant-Rock outcrop complex, steep. This complex has been assigned to the Steep Rocky range site.

- indiagrass and little bluestem—30 percent
- green sprangletop, Nealley grama, and sideoats grama—25 percent
- slim tridens and rough tridens—5 percent
- hairy grama and Wright threeawn—5 percent
- Texas wintergrass—5 percent
- silver bluestem and fall witchgrass—5 percent
- orange zexmania and bushsunflower—5 percent
- velvet bundleflower and showy mendora—5 percent
- Texas oak and live oak—5 percent
- hackberry and bumelia—5 percent
- Ashe juniper, kidneywood, and Lindheimer silktassle—5 percent.

Indiagrass, little bluestem, green sprangletop, and Texas cupgrass are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced mainly by hairy tridens, red grama, threeawns, juniper, persimmon, algerita, and lotebush. If heavy grazing continues, the plant community will be invaded by hairy tridens, red grama, juniper, persimmon, and algerita.

**Stony Loam range site.** The Eckert soil in map unit EcE is in this range site. The climax vegetation is a mid grass and live oak savannah consisting of 80 percent grasses, 10 percent forbs, and 10 percent woody plants.

The potential plant community is—

- little bluestem and green sprangletop—25 percent
- sideoats grama—10 percent
- Arizona cottontop—5 percent
- fall witchgrass—5 percent
- plains lovegrass and Texas needlegrass—10 percent
- hooded windmillgrass—5 percent
- silver bluestem—5 percent
- vine-mesquite—5 percent
- Wright threeawn and hairy grama—10 percent
- bushsunflower, hairy tubetongue, and orange zexmania—10 percent
- live oak—10 percent.

Little bluestem, sideoats grama, and Arizona cottontop are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by hooded windmillgrass, pinhole bluestem, and fall witchgrass. If heavy grazing continues, the plant community will be invaded by such plants as threeawns, hairy tridens, catclaw, persimmon, and Ashe juniper.

**Very Shallow range site.** The Cho soil in map unit CoC is in this range site. The climax vegetation is a mid grass prairie consisting of 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The potential plant community is—

- sideoats grama—25 percent
- little bluestem—10 percent
- buffalograss and curlymesquite—15 percent
- slim tridens and rough tridens—10 percent

- silver bluestem—10 percent
- Wright threeawn—5 percent
- fall witchgrass—5 percent
- Texas needlegrass—5 percent
- tall grama and hairy grama—5 percent
- rock daisy and guara—5 percent
- catclaw and ephedra—5 percent.

Little bluestem, sideoats grama, and forbs are preferred by livestock; therefore, they are grazed out first if grazing is not controlled. These plants are replaced by buffalograss, slim tridens, and Texas needlegrass. If heavy grazing continues, buffalograss and Texas needlegrass will have low vigor and the plant community will be invaded by such plants as threeawns, Ashe juniper, algerita, and mesquite.

## landscaping and gardening

Landscaping is easier if as much of the natural topography and vegetation as possible is preserved during construction. Large cut and fill areas make it difficult to protect the soil from erosion and are difficult to smooth out. Cuts in the Tarrant, Real, and Brackett soils are especially hard to cover because of the lack of suitable fill material. Stable building foundations on large fill areas are difficult to establish because of the potential for settling. Deep fill areas around trees can kill the trees.

Most yard and garden plants grow best in soils that are deep, friable, loamy, and fertile. Because garden areas are small, unfavorable soil characteristics generally can be modified. The clayey surface layer of Kavett, Frio, Nuvalde, Rioconcho, and Valera soils can be made easier to till by adding organic material, such as compost, manure, or grass clippings.

The depth of the root zone and the large amount of lime in the soils are the most important characteristics that affect suitability. Large plants, such as pecan, pear, oaks, and grapes, require less care if they are planted in the deepest soils, such as Nuvalde and Menard soils. Dev, Frio, and Oakalla soils are also deep but are subject to flooding. Homesites on thin soils, such as Cho, Eckert, Eckrant, Real, Brackett, and Tarrant soils, need the addition of topsoil for adequate growth of most trees, shrubs, and grasses.

Yellowing of leaves, although sometimes a symptom of disease, generally indicates that fertilizer is needed. Fertilizer should be added according to the results of soil tests. A good balance of nutrients is essential, and soil testing helps to maintain a balance in the soil. If tests are not made, the following general guidelines may be used. Only those soils that will be irrigated should be fertilized, unless they have a sandy surface layer, such as the Menard, Oben, and Hext soils. The soils in this county have an abundant supply of calcium carbonate. Reaction ranges from neutral to moderately alkaline. The

pH value ranges from about 6.6 to 8.4; therefore, no addition of lime is needed.

Nitrogen is the main fertilizer needed on lawns. Plants need large amounts of nitrogen to grow rapidly and to keep their dark green color. To obtain the greatest efficiency, several feedings are needed during the season of maximum growth. Two or three applications during the growing season are better than one large application before the growing season.

Phosphorus is needed to insure good seed or fruit production. A fertilizer with both phosphorus and nitrogen is usually best for gardens. Phosphorus readily reacts with the calcium compounds that are present in all Kimble County soils. Compounds are formed whereby the phosphorus is rendered unavailable to plants. To insure an adequate supply of phosphorus, it should be added in generous quantities, applied in pellet form, or applied as a concentrated band. Phosphorus does not move in the soil so it should be applied at planting time and to a depth at which roots contact it.

Most soils have a moderate supply of potassium, but it is essential for high yields. If irrigation is used, potassium should be included in the fertilizer mix.

Adequate amounts of the trace elements, such as boron, copper, zinc, iron, and manganese, are generally present in all the soils; however, the amount of zinc and iron is not adequate for all plants. Pecan trees in moderately alkaline soils may need zinc. Periodic use of foliage sprays containing zinc is an effective treatment. On these moderately alkaline soils, peaches, pyracanthas, grapes, roses, blackberries, pears, strawberries, beans, black-eyed peas, and St. Augustine grass may have an iron deficiency. Much iron is in the soils, but, as with phosphorus, iron may be in the form of compounds that plants cannot utilize. Iron deficiency is most likely to be a problem in Shep, Oakalla, Dev, Brackett, Real, Rioconcho, Nuvalde, and Frio soils. Iron deficiency is not a problem for plants grown on Menard, Oben, and Speck soils.

Most soil problems can be overcome by applying a thick layer of manure; iron deficiency is no exception. Manure can be applied at rates of up to 20 tons per acre. If the manure does not relieve the deficiency, iron can be supplied in the form of iron chelates using foliage sprays or as iron sulfate or iron chelates applied directly to the soil. Sprays on foliage are effective but must be repeated after rainfall and when new foliage develops. Soil treatment with iron is typically done annually, and is sometimes more effective if applied in concentrated bands or if the iron sulfate is mixed in about equal parts with sulfur and manure. Compost can be substituted for manure.

The soil in its natural state is more attractive than greatly altered areas. Likewise, native plants that grow naturally at the homesite are nearly always in good health and, therefore, are more attractive and practical than plants from a different climate. As a general rule,

native plants should be used in landscape gardening wherever possible.

## recreation

The soils of the survey area are rated in table 6 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 6, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 6 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

*Camp areas* require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

*Picnic areas* are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not

wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

*Paths and trails* for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

*Golf fairways* are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

## wildlife habitat

Willard Richter, biologist, Soil Conservation Service, assisted in preparing this section.

Kimble County has large deer and turkey populations and has many miles of clear fishing streams (fig. 18). The game species in the county are white-tailed deer, turkey, bobwhite quail, mourning dove, squirrels, peccary, and ducks. Fur bearers common to this county are raccoon, fox, opossum, skunk, and ring-tailed cat. Nutria and beaver are found along streams. Coyote and bobcat are the most common predatory species, although a cougar is occasionally sighted.

Numerous songbirds are found in Kimble County. Seasonal species that breed here include the golden-cheeked warbler, which is listed as a rare and endangered species by the Texas Parks and Wildlife. Cardinal, titmouse, chickadee, meadowlark, and house finch are common year-round residents, and the loggerhead shrike, sparrow hawk, and scrub jay are common winter residents. Numerous species of owls and hawks, including the great horned owl, barn owl, screech owl, red-tailed hawk, harris hawk, and red-shouldered hawk are year long residents.

Leasing lands for recreational hunting is a major source of income for many landowners. The steep canyon lands and the several species of oak provide habitat for all species.

The clear streams provide excellent habitat for catfish, largemouth bass, and several species of sunfish. Waterfowl populations are largest during fall and spring migration periods. Waterfowl are found on stock ponds and perennial spring-fed streams.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and

abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 7, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are kleingrass, lovegrass, and clover.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild

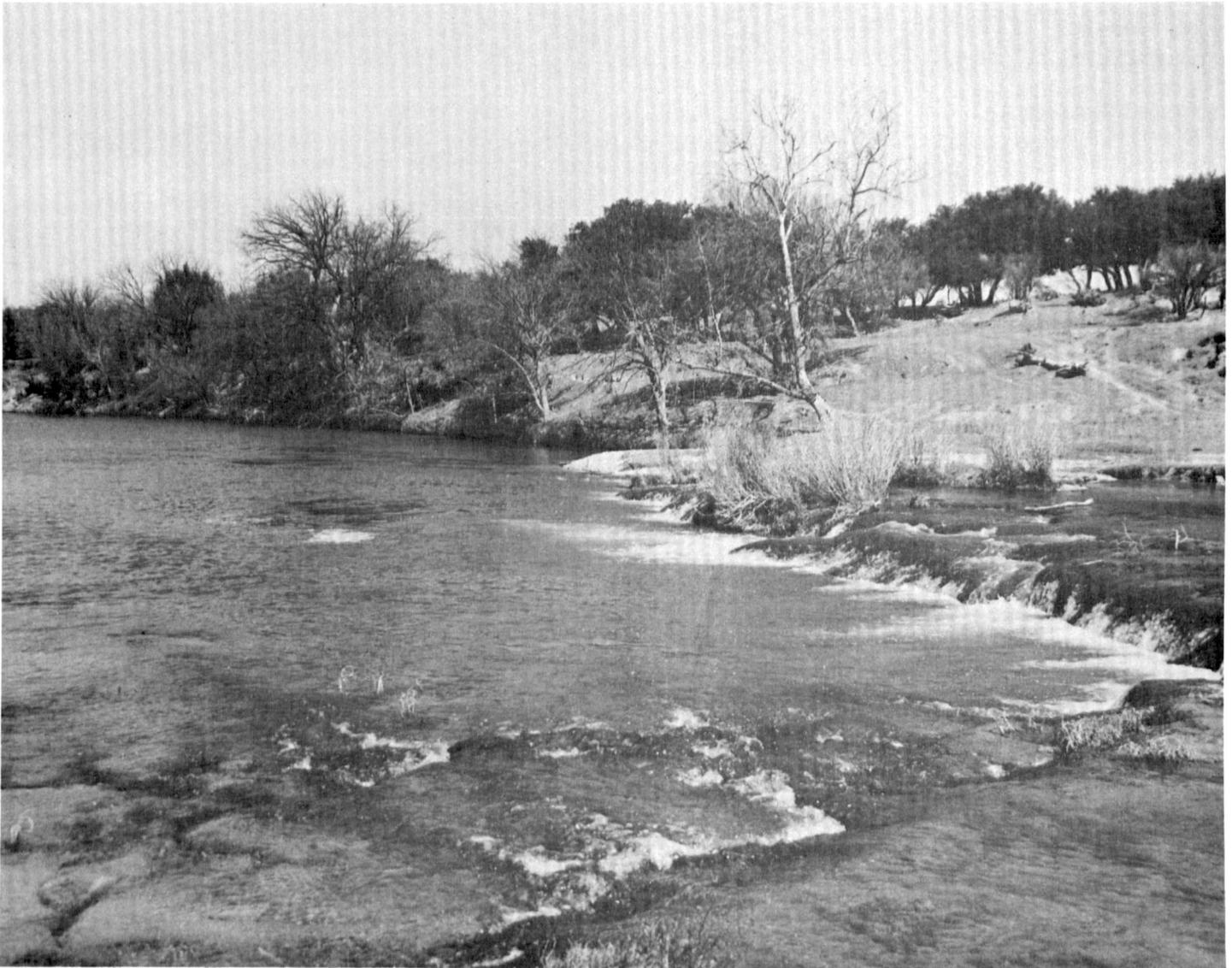


Figure 18.—Shep and Nuvalde soils are on uplands on the right above this area of the Llano River.

herbaceous plants are bluestem, indiagrass, sideoats grama, Engelmann-daisy, and sunflower.

*Shrubs* are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, wild plum, rusty blackhaw, redbud, agarito, elbowbush, and grapes.

The habitat for various kinds of wildlife is described in the following paragraphs.

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, cottontail, and red fox.

*Habitat for rangeland wildlife* consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, sage grouse, turkey, coyote, fox, skunk, dove, bobwhite quail, rabbit, and numerous songbirds.

## engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the

performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

### building site development

Table 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a

flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

#### **sanitary facilities**

Table 9 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 9 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 9 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic

layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

#### construction materials

Table 10 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place

after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

*Sand and gravel* are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 10, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*Topsoil* is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts,

are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

### **water management**

Table 11 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

*Embankments, dikes, and levees* are raised structures of soil material, generally less than 20 feet high,

constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

*Irrigation* is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

*Grassed waterways* are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.



# soil properties

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Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 15.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## engineering index properties

Table 12 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

*Classification* of the soils is determined according to the Unified soil classification system (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 15.

*Rock fragments* larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit* and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

## physical and chemical properties

Table 13 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

*Moist bulk density* is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition.

In table 13, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## soil and water features

Table 14 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

*Flooding*, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 14 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

*Cemented pans* are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion

than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

## engineering index test data

Table 15 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by State Department of Highway and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Specific gravity (particle index)—T 100 (AASHTO), D 698 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

## classification of the soils

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The system of soil classification used by the National Cooperative Soil Survey has six categories (6). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 16, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

**ORDER.** Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

**SUBORDER.** Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is *Ust* (*Ust*, meaning dry or burnt, plus *oll*, from Mollisol).

**GREAT GROUP.** Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Calciustolls (*Calci*, meaning calcic horizon, plus *Ust*, the suborder of the Mollisols that have an ustic moisture regime).

**SUBGROUP.** Each great group has a typical subgroup. Other subgroups are intergrades or extragrades. The typical is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Lithic* identifies the subgroup that typifies the great group. An example is Lithic Calciustolls.

**FAMILY.** Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties

and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is clayey-skeletal, montmorillonitic, thermic Lithic Calciustolls.

**SERIES.** The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series. An example is the Tarrant series, which is a member of the clayey-skeletal, montmorillonitic thermic Lithic Calciustolls.

### soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (4). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (6). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

#### Brackett series

The Brackett series consists of shallow, loamy, well drained, sloping to steep soils on uplands (fig. 19). These calcareous soils formed in material weathered from interbedded limestone and calcareous clay loam. Slopes range from 5 to 25 percent.

Typical pedon of Brackett loam in an area of Real-Brackett complex, hilly; from Kimble County Courthouse on U.S. Highway 290, 2.7 miles southeast to the access



Figure 19.—Profile of Brackett loam in an area of Real-Brackett complex, hilly (Scale in feet)

with Interstate 10, 5.3 miles southeast on Interstate 10 to Segovia, 0.27 mile southeast on Farm Road 2169, and 75 feet north in rangeland:

- A—0 to 8 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate very fine subangular blocky structure parting to weak fine granular; hard, friable; many roots; about 5 percent by volume limestone fragments and pebbles; calcareous; moderately alkaline; clear wavy boundary.
- B2ca—8 to 17 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; hard, friable; about 15 percent by volume pebbles and limestone fragments 1 centimeter to 6 centimeters in diameter and many soft masses of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.
- Cr—17 to 60 inches; very pale brown (10YR 8/3) interbedded weakly cemented limestone fragments with very pale brown clay loam that has rocklike structure; calcareous; moderately alkaline.

The solum ranges from 10 to 20 inches in thickness. Content of coarse fragments in the A and B horizons ranges from a few to about 35 percent by volume limestone fragments 1 centimeter to 7 centimeters in diameter. The calcium carbonate equivalent ranges from 40 to 75 percent. The A and B horizons are loam, clay loam, gravelly loam, or gravelly clay loam.

The A horizon is light gray, pale brown, light brownish gray, brown, or grayish brown. The B horizon is pale yellow, very pale brown, light brownish gray, light gray, white, or light yellowish brown.

The Cr horizon is weakly cemented to strongly cemented limestone, chalks, and limy earth intermixed with limestone fragments.

### Cho series

The Cho series consists of very shallow to shallow, well drained, undulating soils on uplands. These soils formed in calcareous loams and clay loams over indurated caliche in the upper part and softer caliche below. Slopes range from 1 to 8 percent.

Typical pedon of Cho gravelly loam, 1 to 8 percent slopes; from Kimble County Courthouse on U.S. Highway 290, 1 mile southeast, 0.9 mile west on Farm Road 2169, and 40 feet south in rangeland:

- A1—0 to 12 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; few roots; about 20 percent by volume caliche fragments 0.5 centimeter to 5 centimeters in diameter; calcareous; moderately alkaline; abrupt wavy boundary.
- C1cam—12 to 22 inches; pinkish white (7.5YR 8/2), indurated caliche, pink (7.5YR 7/4) moist; a continuous layer of strongly cemented caliche that breaks to platelike fragments; some laminar plates in the upper 0.5 centimeter; calcareous; moderately alkaline; clear wavy boundary.

**C2ca**—22 to 78 inches; pink (7.5YR 8/4) very gravelly loam, pink (7.5YR 7/4) moist; massive; hard, friable; about 50 percent soft to weakly cemented caliche and 50 percent caliche fragments; calcareous; moderately alkaline.

The solum ranges from 7 to 18 inches in thickness. The A horizon is brown, grayish brown, or dark grayish brown. Texture of the A horizon is loam, gravelly loam, gravelly clay loam, or clay loam with a clay content of 20 to 35 percent. The soil contains about 2 to 30 percent by volume of caliche fragments in the A horizon. Calcium carbonate equivalent in the soil fraction less than 20 millimeters is 40 to about 60 percent.

The Ccam horizon ranges from 2 to 12 inches in thickness. The Cca horizon is pink and pinkish white. Texture is loam or clay loam. Calcium carbonate ranges from 40 to 70 percent. Limestone pebbles and gravel comprise about 2 to 50 percent by volume.

### Dev series

The Dev series consists of deep, very gravelly and loamy, well drained soils on bottom lands. These soils formed in calcareous, loamy and gravelly alluvial sediment of recent origin. Slopes range from 0 to 3 percent.

Typical pedon of Dev very gravelly loam, frequently flooded; from Kimble County Courthouse, 1 mile southeast on U.S. Highway 290, 1 mile west on Farm Road 2169 to Texas Tech Center, 0.3 mile west, and 150 feet west in rangeland:

**A**—0 to 26 inches; dark grayish brown (10YR 4/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine granular and subangular blocky structure; hard, friable; few roots and pores; about 50 percent by volume subrounded pebbles and a few cobbles and stones; calcareous; moderately alkaline; diffuse wavy boundary.

**Cca**—26 to 72 inches; brown (10YR 5/3) very gravelly loam, brown (10YR 4/3) moist; massive; hard, friable; about 65 percent by volume subrounded limestone pebbles with a few cobbles and stones; calcium carbonate accumulations on the lower sides of fragments; calcareous; moderately alkaline.

The A horizon ranges from 20 to 40 inches in thickness. The 10- to 40-inch control section contains 35 to 85 percent by volume rounded limestone pebbles as much as 7.5 centimeters across and few cobbles and stones. The content of carbonates in the soil fraction smaller than 20 millimeters ranges from 40 to 70 percent by weight. Texture of the fine earth fraction is loam or clay loam.

The A horizon is dark grayish brown, grayish brown, brown, or dark brown.

The C horizon is brown or pale brown.

### Eckert series

The Eckert series consists of very shallow to shallow, loamy, very cobbly, well drained soils on upland hills. These soils formed over dolomite limestone. Slopes range from 1 to 15 percent.

Typical pedon of Eckert very cobbly loam in an area of Eckert soils, rolling; from Kimble County Courthouse 2.7 miles north to intersection of U.S. Highway 83 and U.S. Highway 377, 15.3 miles northeast on U.S. 377 to intersection of U.S. 377 and Ranch Road 385, 17.8 miles southeast on Ranch Road 385 to intersection of Ranch Road 385 and county road, 2 miles north on county road, and 25 feet east in rangeland:

**A**—0 to 10 inches; brown (7.5YR 4/2) very cobbly loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky and granular structure; hard, friable; about 12 percent by volume angular limestone gravel and about 40 percent angular limestone cobbles; noncalcareous; moderately alkaline; abrupt wavy boundary.

**R**—10 to 18 inches; pinkish gray, indurated dolomite limestone.

The solum ranges from 4 to 14 inches deep to dolomitic limestone. Content of coarse fragments in the solum ranges from 35 to 70 percent by volume angular gravel, cobbles, and stones. Reaction ranges from neutral to moderately alkaline. Some pedons are weakly effervescent when dilute hydrochloric acid is applied.

The A horizon is brown, dark grayish brown, dark brown, or dark reddish gray. Texture of the fine earth fraction is silt loam, fine sandy loam, or loam. Clay content ranges from 16 to 27 percent.

The R horizon is hard limestone. Many fragments have crystalline dolomite formations. Hardness is more than 3 on Mohs' scale.

### Eckrant series

The Eckrant series consists of very shallow to shallow, undulating, well drained, cobbly and clayey soils on uplands. These soils formed over limestone. Slopes range from 1 to 15 percent.

Typical pedon of Eckrant cobbly clay in an area of Eckrant-Tarrant complex, undulating; from Kimble County Courthouse, 2.7 miles southeast on U.S. Highway 290 to access with Interstate 10, 13 miles southeast on Interstate 10 to access road of old Segovia Road, 1.6 miles continuing southeast parallel to Interstate 10, and 100 feet south in rangeland:

**A11**—0 to 5 inches; very dark gray (10YR 3/1) cobbly clay, black (10YR 2/1) moist; moderate fine subangular blocky structure parting to weak fine granular; very hard, firm; common fine roots; about 10 percent by volume limestone cobbles and 20

percent limestone gravel; noncalcareous; moderately alkaline; clear irregular boundary.

A12—5 to 12 inches; very dark gray (10YR 3/1) very cobbly clay, black (10YR 2/1) moist; moderate fine subangular blocky structure parting to weak fine granular; very hard, firm; common fine roots; about 30 percent limestone cobbles and 15 percent limestone gravel; noncalcareous; moderately alkaline; abrupt wavy boundary.

R—12 to 20 inches; fractured limestone bedrock.

The solum ranges from 4 to 20 inches deep to limestone. The weighted average of coarse fragments in the solum ranges from 35 to 80 percent by volume gravel, cobbles, and stones. Coarse fragments that are more than 7.5 centimeters in diameter comprise 15 to 55 percent by volume. Reaction ranges from moderately alkaline to neutral.

The A horizon is very dark gray, very dark grayish brown, or dark brown. Texture is cobbly clay or very cobbly clay. The fine earth fraction ranges from 40 to 60 percent clay. Secondary calcium carbonate is present in some fractures. The underlying limestone bedrock has fractures, cracks, and crevices. In some pedons the bedrock is interbedded with softer limy material.

### Frio series

The Frio series consists of deep, loamy, well drained soils on bottom lands. These soils formed in calcareous loamy and clayey alluvial sediments. Slopes range from 0 to 2 percent.

Typical pedon of Frio silty clay loam, occasionally flooded; from Kimble County Courthouse 0.35 mile west on U.S. Highway 290, 1.8 miles southwest on U.S. Highway 377, 0.4 mile east through gate and along ranch road, and 10 feet north in rangeland:

A11—0 to 22 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; strong fine granular structure; hard, firm; many fine roots; moderately alkaline; diffuse smooth boundary.

A12—22 to 32 inches; brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, firm; few roots; few threads and films of calcium carbonate; calcareous; moderately alkaline; diffuse smooth boundary.

Cca—32 to 80 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; massive; hard, firm; few threads and films and a few soft masses of calcium carbonate; calcareous; moderately alkaline.

The calcium carbonate equivalent of the 10- to 40-inch control section ranges from 15 to 40 percent. COLE of the upper 40 inches of soil ranges from .040 to .060. Texture is silty clay or silty clay loam. Content of clay ranges from 35 to 50 percent.

The A horizon ranges from 22 to 50 inches in thickness. It is very dark grayish brown, dark grayish brown, dark brown, or grayish brown.

The C horizon is grayish brown or brown.

### Hext series

The Hext series consists of moderately deep, well drained soils on uplands. These soils formed in weakly consolidated sandstone. Slopes range from 1 to 12 percent.

Typical pedon of Hext fine sandy loam in an area of Hext-Latom complex, undulating; from Kimble County Courthouse, 2.7 miles north to intersection of U.S. Highway 83 and U.S. Highway 377, 9.5 miles northeast on U.S. Highway 377, 0.55 mile east on caliche county road, and 20 feet south in rangeland:

A1—0 to 11 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 fine roots and pores; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B2—11 to 19 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine roots and pores; few concretions and fragments of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

Cca—19 to 24 inches; reddish yellow (5YR 6/6) fine sandy loam, light reddish brown (5YR 6/4) moist; massive; slightly hard, very friable; about 20 percent by volume concretions and fragments of calcium carbonate 1 centimeter to 6 centimeters in diameter; calcareous; moderately alkaline; clear wavy boundary.

Cr—24 to 35 inches; pink, weakly cemented, marly sandstone; calcareous; moderately alkaline.

The solum ranges from 20 to 40 inches deep to weakly cemented, calcareous sandstone. Content of coarse fragments in the solum ranges from a few to about 30 percent by volume. The calcium carbonate equivalent of the control section ranges from 15 to 40 percent throughout.

The A horizon ranges from 6 to 18 inches in thickness. It is brown or reddish brown.

The B horizon is brown, light brown, reddish brown, or light reddish brown. Texture is fine sandy loam or loam. Content of silicate clay ranges from 8 to 18 percent.

The C1ca horizon is fine sandy loam or loam. Content of calcium carbonate concretions and fragments ranges from 15 to 50 percent. The Cr horizon is calcareous, weakly cemented sandstone, conglomerate, or sandy marl.

## Kavett series

The Kavett series consists of shallow, nearly level to gently undulating, well drained soils on uplands. These soils formed on indurated caliche resting on limestone and interbedded marls and chalk. Slopes range from 0 to 5 percent.

Typical pedon of Kavett silty clay in an area of Kavett-Tarrant association, gently undulating; from the intersection of U.S. Highway 290 and U.S. Highway 377 in Junction, Texas; 16 miles southwest on 377; 4.5 miles west on gravel county road; 0.5 mile southwest on private road; and 15 feet south of the road in rangeland:

A11—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; very hard, firm; many roots; few angular fragments of limestone; calcareous; moderately alkaline; gradual smooth boundary.

A12—6 to 11 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine subangular and angular blocky structure; very hard, very firm; few limestone gravel; calcareous; moderately alkaline; abrupt smooth boundary.

Ccam—11 to 13 inches; pinkish white (7.5YR 8/2) indurated platy caliche, pink (7.5YR 7/4) moist; caliche in fractured plates 5 to 14 inches across; calcareous; moderately alkaline; abrupt wavy boundary.

R—13 to 20 inches; limestone bedrock with cemented carbonates plugging fractures and crevices.

The solum ranges from 10 to 20 inches deep to indurated caliche and limestone. Content of coarse limestone fragments ranges from a few to as much as 15 percent by volume.

The A horizon is very dark grayish brown, dark grayish brown, dark brown, or grayish brown. Texture is silty clay or clay. Clay content ranges from 40 to 50 percent.

The Ccam horizon ranges from strongly cemented to indurated and is with or without a laminar cap in the upper 5 to 25 millimeters. The R horizon ranges from indurated limestone to limestone interbedded with chalks and marls.

## Latom series

The Latom series consists of very shallow to shallow, well drained, moderately permeable soils on uplands. These soils formed on strongly cemented, calcareous sandstone or conglomerate. Slopes range from 3 to 12 percent.

Typical pedon of Latom gravelly fine sandy loam in an area of Hext-Latom complex, undulating; from Kimble County Courthouse, 2.7 miles northwest to intersection of U.S. Highway 83 and U.S. Highway 377, 9.5 miles

northeast on U.S. Highway 377, 0.57 mile east on caliche county road, and 20 feet south in rangeland:

A1—0 to 8 inches; reddish brown (5YR 4/4) gravelly fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, very friable; few fine roots and pores; about 20 percent by volume sandstone fragments coated with caliche; calcareous; moderately alkaline; abrupt smooth boundary.

R—8 to 19 inches; pink (7.5YR 8/4), strongly cemented, calcareous sandstone; thin calcium carbonate coatings in cracks.

The solum ranges from 4 to 14 inches deep to weakly cemented and strongly cemented, calcareous sandstone or conglomerate.

The A horizon is reddish brown, brown, or grayish brown. Texture is fine sandy loam or loam. Coarse fragments are caliche or sandstone and range from a few to 35 percent by volume.

The R horizon has a hardness of 3 to 4 on Mohs' scale. The bedrock is weathered, calcareous sandstone or conglomerate.

## Menard series

The Menard series consists of deep, gently sloping, well drained soils on uplands that formed in loamy, calcareous sediment of ancient alluvium. Slopes range from 1 to 3 percent.

Typical pedon of Menard fine sandy loam, 1 to 3 percent slopes; from the town of London in the northeastern part of the county, 0.5 mile south and 1.0 mile east on county roads, through a cattleguard, 500 feet east on private ranch road, and 600 feet north in rangeland:

A1—0 to 9 inches; brown (7.5YR 4/4) fine sandy loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; slightly hard, friable; many roots; neutral; clear smooth boundary.

B21t—9 to 19 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, firm; few fine tubes and pores; few clay films on faces of peds; neutral; gradual smooth boundary.

B22t—19 to 33 inches; reddish brown (2.5YR 5/4) sandy clay loam, reddish brown (2.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm; few fine tubes and pores; few clay films on faces of peds; neutral; gradual smooth boundary.

B3ca—33 to 41 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 4/6) moist; weak medium subangular blocky structure; hard, firm; many threads, films, and very fine soft masses and a few concretions of calcium carbonate comprising

about 5 percent by volume; calcareous; moderately alkaline; gradual wavy boundary.

**Cca**—41 to 70 inches; pink (5YR 8/4) sandy clay loam, pink (5YR 7/4) moist; massive; hard, firm; about 30 percent by volume soft masses of calcium carbonate; about 20 percent by volume weakly cemented limestone fragments 1 centimeter to 4 centimeters in diameter; calcareous; moderately alkaline.

The solum ranges from 30 to more than 50 inches deep to free calcium carbonate.

The A horizon ranges from 7 to 12 inches in thickness. It is reddish brown or brown. Reaction is neutral or mildly alkaline.

The Bt horizon is red, reddish brown, yellowish red, brown, or light brown. Clay content ranges from 20 to 35 percent. Reaction is neutral or mildly alkaline.

The B3ca horizon is red, reddish yellow, light brown, or yellowish red. Texture is sandy clay loam or clay loam.

The Cca horizon has soft masses and concretions of calcium carbonate that range from 10 to 35 percent by volume.

### Nuvalde series

The Nuvalde series consists of deep, nearly level to gently sloping, well drained, loamy soils on upland plains of ancient alluvium (fig. 20). Slopes range from 0 to 3 percent.

Typical pedon of Nuvalde clay loam, 0 to 1 percent slopes; from Kimble County Courthouse, 1 mile southeast on U.S. Highway 290, 1 mile west on Farm Road 2169 to Texas Tech Center, and 280 feet south in rangeland:

**A11**—0 to 8 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, friable; many fine roots and pores; calcareous; moderately alkaline; clear wavy boundary.

**A12**—8 to 16 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, friable; many fine roots and pores; calcareous; moderately alkaline; gradual wavy boundary.

**B21**—16 to 30 inches; brown (7.5YR 5/4) clay, brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; hard, friable; few roots and pores; few fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

**B22ca**—30 to 40 inches; light brown (7.5YR 6/4) clay, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; hard, friable; few very fine roots;

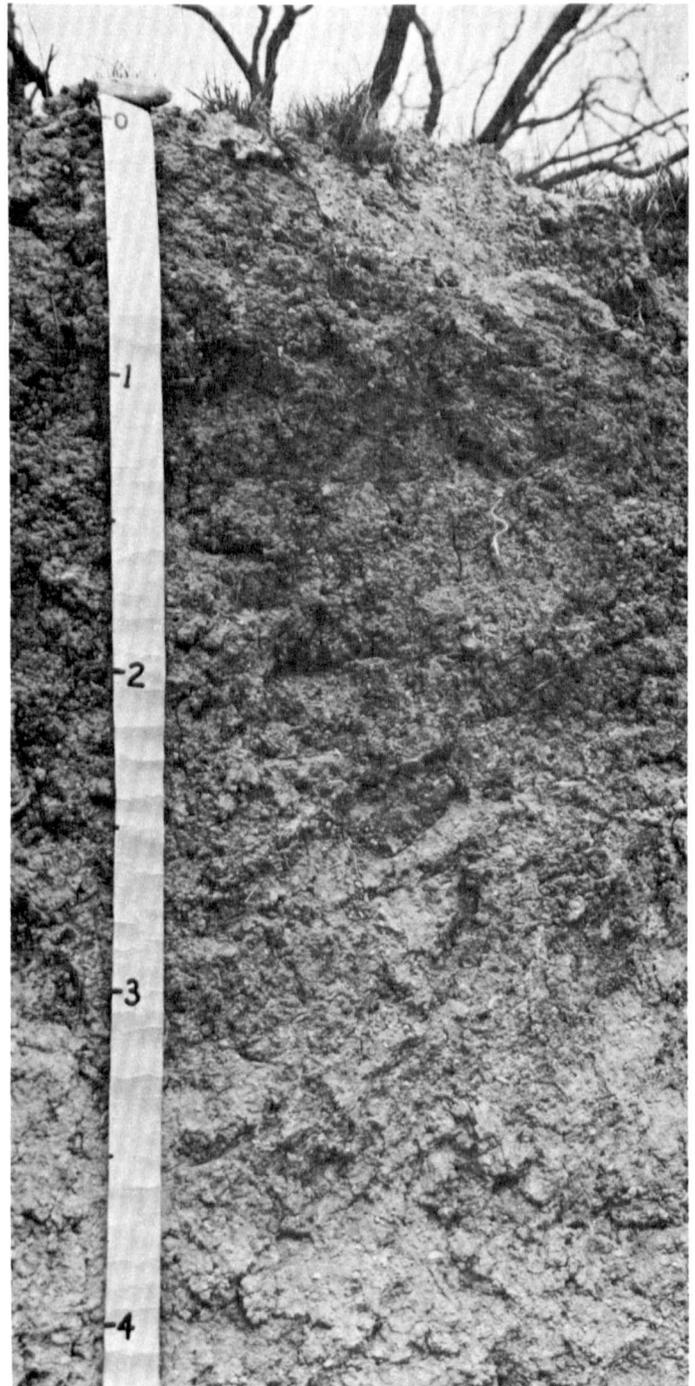


Figure 20.—Profile of Nuvalde clay loam. The surface layer to a depth of 8 inches is clay loam, and the subsoil is subangular blocky clay. (Scale in feet)

about 10 percent by volume soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

C1ca—40 to 60 inches; pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure; hard, friable; about 25 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

C2ca—60 to 80 inches; pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure; hard, friable; about 25 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 20 to 50 inches in thickness. Total clay content of the 10- to 40-inch control section ranges from 35 to 50 percent. Content of silicate clay ranges from 25 to 35 percent.

The A horizon ranges from 10 to 19 inches in thickness. It is dark grayish brown, grayish brown, or brown.

The B2 and B2ca horizons are brown, pale brown, or light brown. Texture is clay loam, silty clay loam, clay, or silty clay. The calcium carbonate equivalent ranges from 15 to 35 percent.

The Cca horizon has 20 to 35 percent visible soft masses and concretions of calcium carbonate.

### Oakalla series

The Oakalla series consists of deep, well drained, loamy soils on bottom lands. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Oakalla silty clay loam, from Kimble County Courthouse, 0.5 mile southeast on U.S. Highway 290, 1.7 miles east on Farm Road 2169, and 0.1 mile north in a field:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure parting to moderate fine granular; hard, friable; few roots; few very fine fragments of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

A11—8 to 17 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure parting to moderate fine granular; hard, friable; few roots; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

A12—17 to 40 inches; dark brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable; many pores; many threads, films, and very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—40 to 78 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; massive; hard, friable;

many threads, films, and very fine soft masses of calcium carbonate; calcareous; moderately alkaline.

The calcium carbonate equivalent of the 10- to 40-inch control section ranges from 40 to 50 percent. The mollic epipedon ranges from 20 to 40 inches in thickness. Content of limestone pebbles ranges from 0 to 8 percent by volume.

The A horizon ranges from 20 to 40 inches in thickness. It is very dark grayish brown, dark grayish brown, or dark brown. Silicate clay content ranges from 25 to 35 percent.

The C horizon is brown, yellowish brown, or light yellowish brown. Texture is loam, clay loam, or silty clay loam.

### Oben series

The Oben series consists of shallow, well drained, loamy soils on uplands. These soils formed on weathered conglomerate. Slopes range from 1 to 5 percent.

Typical pedon of Oben fine sandy loam in an area of Oben-Hext complex, 1 to 5 percent slopes, from Kimble County Courthouse, 2.7 miles north to intersection of U.S. Highway 83 and U.S. Highway 377, 11.8 miles northeast on U.S. Highway 377, 1.15 miles east on county road, 0.7 mile south, 0.6 mile east, 0.5 mile south, and 30 feet east in rangeland:

A1—0 to 6 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine roots; few pores; neutral; clear smooth boundary.

B21t—6 to 13 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, friable; few fine roots; few pores; patchy clay films on faces of peds; neutral; clear wavy boundary.

B22t—13 to 19 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 3/6) moist; weak medium subangular blocky structure; hard, friable; few pores; patchy clay films on faces of peds; about 5 percent rock fragments as much as 1 centimeter in diameter; neutral; gradual wavy boundary.

R—19 to 25 inches; reddish yellow limestone conglomerate; weakly cemented to strongly cemented; fragmented and platy in upper few inches.

The solum ranges from 9 to 20 inches in thickness. Coarse fragments in the solum range from a few to about 30 percent by volume. The fragments are pebbles and cobbles of chert, quartz, sandstone, and conglomerate.

The A1 horizon ranges from 4 to 7 inches in thickness. It is brown or reddish brown.

The B2t horizon ranges from 5 to 15 inches in thickness. It is brown, yellowish red, or reddish brown.

The R horizon is indurated caliche, limestone conglomerate, or noncalcareous sandstone fragments. It ranges from weakly cemented to strongly cemented.

Oben soils in areas of Oben-Hext complex, 1 to 5 percent slopes, have developed over cemented limestone conglomerate instead of the common sandstone parent rock. These soils are considered taxadjuncts to the Oben series. Behavior, use, and management of these soils, however, are identical to the Oben series.

### Purves series

The Purves series consists of shallow, well drained, clayey soils on uplands. These soils formed on interbedded limestone and marl. Slopes range from 1 to 8 percent.

Typical pedon of Purves clay in an area of Purves-Tarrant association, gently undulating; from the intersection of U.S. Highway 290 and Farm Road 385 in the eastern part of the county, 0.25 of a mile east on U.S. Highway 290, and 80 feet south in rangeland:

- A11—0 to 7 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; strong fine granular and subangular blocky structure; very hard, firm; many roots; few soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.
- A12ca—7 to 11 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; strong fine granular and subangular blocky structure; very hard, firm; many roots; few soft masses and concretions of calcium carbonate; lower 3 inches contains about 20 percent limestone fragments; calcareous; moderately alkaline; abrupt smooth boundary.
- R—11 to 14 inches; indurated limestone bedrock.

The solum ranges from 8 to 20 inches in thickness. Coarse fragments of limestone that are 0.5 centimeter to 25 centimeters across make up as much as 30 percent by volume of the solum. Clay content of the A horizon ranges from 40 to 55 percent.

The A11 horizon ranges from 6 to 12 inches in thickness. It is very dark gray, dark brown, very dark grayish brown, or dark grayish brown. Texture is clay or silty clay. Structure ranges from moderate to strong and from granular to subangular blocky. The A12 horizon ranges from 4 to 8 inches in thickness. It is similar in color to the A11 horizon. Structure ranges from moderate to strong and from subangular blocky to granular.

The R horizon ranges from indurated limestone to interbedded limestone and chalk or marl.

### Real series

The Real series consists of shallow and very shallow, well drained, hilly, gravelly soils on uplands (fig. 21). These soils formed in material weathered from limestone and chalk. Slopes range from 5 to 25 percent.

Typical pedon of Real gravelly clay loam in an area of Real-Brackett complex, hilly; from Kimble County Courthouse, 8.0 miles southeast on Interstate 10 to intersection with Farm Road 2169 in Segovia, 0.25 mile southeast on Farm Road 2169, and 30 feet north in rangeland:

- A1—0 to 8 inches; grayish brown (10YR 5/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to weak fine granular; hard, friable; many roots and pores; about 30 percent by volume limestone fragments 0.5 centimeter to 10 centimeters in diameter; calcareous; moderately alkaline; clear wavy boundary.
- A1ca—8 to 16 inches; brown (10YR 5/3) very gravelly clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; hard, friable; few roots; about 45 percent by volume limestone fragments 1 centimeter to 7 centimeters in diameter; calcareous; moderately alkaline; abrupt wavy boundary.
- Cr—16 to 80 inches; white (10YR 8/2), weakly cemented platy limestone that becomes chalky and marly with increasing depth.

The solum ranges from 8 to 20 inches in thickness. The weighted average of coarse fragments in the solum ranges from 35 to 80 percent by volume and consists of limestone fragments mostly from 1 centimeter to 7 centimeters in diameter. The calcium carbonate equivalent of the solum ranges from 40 to 65 percent.

The A horizon is grayish brown, brown, dark grayish brown, or dark gray. Texture of the fine earth fraction ranges from clay loam to loam.

The Cr horizon is weakly cemented limestone with a hardness of less than 3 on Mohs' scale, marl with rocklike structure, or chalk.

### Rioconcho series

The Rioconcho series consists of deep, clayey, moderately well drained soils on flood plains. These soils formed in clayey sediment. Slopes range from 0 to 2 percent.

Typical pedon of Rioconcho clay, occasionally flooded; from the Kimble County Courthouse, 2.7 miles north to intersection of U.S. Highway 83 and U.S. Highway 377, 9.1 miles northeast on U.S. Highway 377, 0.1 mile north on county road, 0.45 mile northeast on ranch road, and 15 feet north in rangeland:

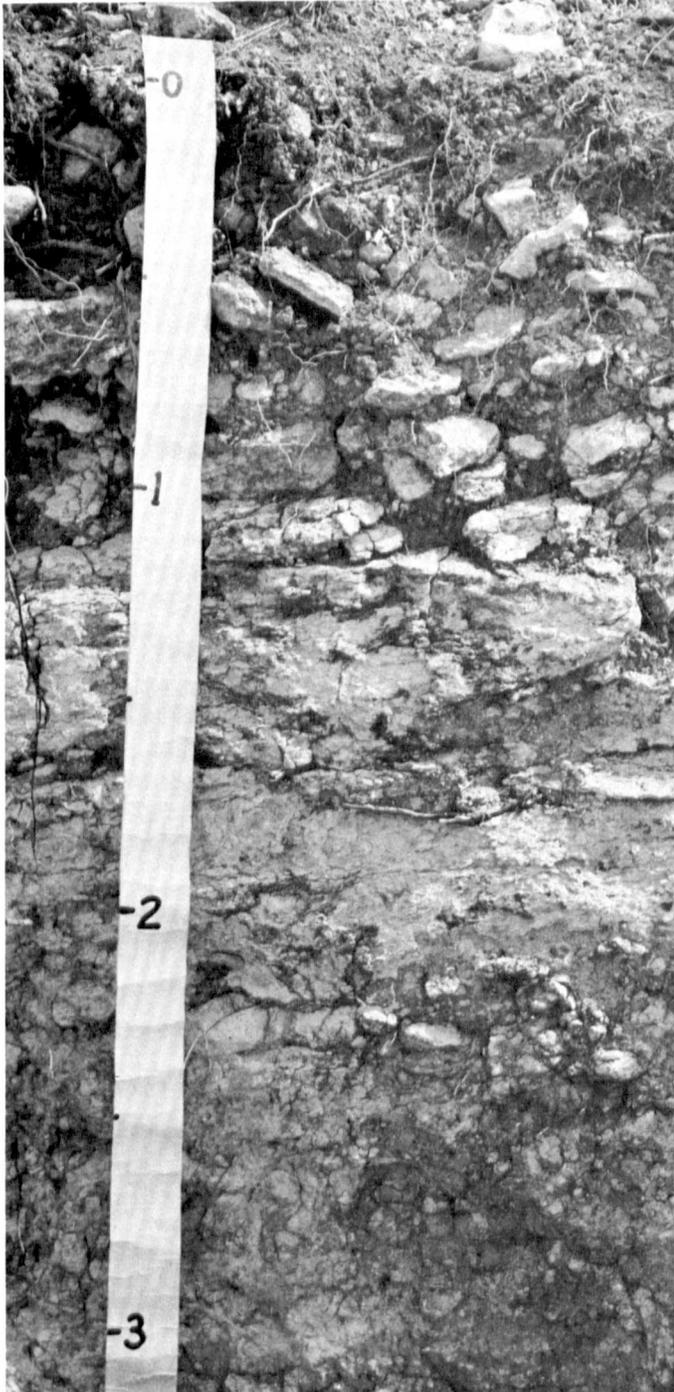


Figure 21.—Profile of Real gravelly clay loam in an area of Real-Brackett complex, hilly. This soil is underlain by cemented limestone and chalky marl. (Scale in feet)

A11—0 to 18 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, firm;

common roots; few wormcasts and pores; few very fine limestone and caliche fragments; calcareous; moderately alkaline; gradual wavy boundary.

A12—18 to 45 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; very hard, firm; few roots and pores; few very fine limestone and caliche fragments; calcareous; moderately alkaline; diffuse wavy boundary.

C—45 to 80 inches; pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; massive; very hard, firm; common threads, films, soft masses, and concretions of calcium carbonate and limestone fragments; calcareous; moderately alkaline.

Texture throughout the horizons is clay, clay loam, or silty clay loam. When dry, these soils have cracks that range from 1 centimeter to 2.5 centimeters in width and that extend to depths of 20 to 30 inches. COLE ranges from 0.075 to 0.09. The 10- to 40-inch control section has a clay content ranging from 35 to 55 percent and a calcium carbonate equivalent from 15 to about 25 percent.

The A horizon ranges from 21 to 50 inches in thickness. It is dark grayish brown, very dark grayish brown, brown, or dark brown. Reaction is mildly alkaline or moderately alkaline.

The C horizon is very pale brown, pale brown, or brown.

### Shep series

The Shep series consists of deep, well drained, gently sloping, loamy soils on uplands. These soils formed in loamy alluvial and colluvial sediment. Slopes range from 1 to 5 percent.

Typical pedon of Shep clay loam, 1 to 5 percent slopes; from Kimble County Courthouse, 0.5 mile southeast on U.S. Highway 290, 2.1 miles east on Farm Road 2169, and 80 feet south in rangeland:

A1—0 to 9 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, friable; few roots; common pores; common wormcasts; few caliche pebbles 0.5 centimeter to 3 centimeters in diameter; calcareous; moderately alkaline; clear smooth boundary.

B2—9 to 24 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, friable; few roots; common pores; few caliche pebbles; few threads and films and very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

C1ca—24 to 54 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable; common very fine pores; few caliche pebbles 0.5 centimeter to 3 centimeters in diameter;

about 10 percent threads and films and very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

**C2ca**—54 to 80 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable; common pores; few very fine masses and concretions of calcium carbonate; calcareous; moderately alkaline.

Thickness of the solum and depth to distinct accumulations of calcium carbonate range from 22 to 38 inches. Texture throughout is loam, clay loam, or sandy clay loam. The silicate clay content of the 10- to 40-inch control section ranges from 20 to 35 percent.

The A horizon ranges from 6 to 12 inches in thickness. It is grayish brown or brown.

Thickness of the B horizon ranges from 12 to 25 inches. It is pink, light brown, pale brown, or brown.

The Cca horizon is pink or light brown. It contains 5 to 20 percent visible secondary carbonates as soft masses, threads, films, and concretions.

### Speck series

The Speck series consists of shallow, well drained, clayey soils on uplands. These soils formed on indurated limestone bedrock. Slopes range from 0 to 3 percent.

Typical pedon of Speck clay loam, 0 to 3 percent slopes; from the intersection of U.S. Highway 290 and Farm Road 385 in the southeast corner of the county, north 0.9 mile on Farm Road 385, and west 280 feet in rangeland:

**A1**—0 to 7 inches; dark reddish brown (5YR 3/2) clay loam, dark reddish brown (5YR 2/2) moist; moderate fine subangular blocky structure; very hard, firm; common roots; few chert pebbles; neutral; clear smooth boundary.

**B2t**—7 to 14 inches; dusky red (2.5YR 3/2) clay, very dusky red (2.5YR 2/2) moist; moderate fine blocky structure; very hard, very firm; patchy clay films on ped faces; few chert pebbles; neutral; abrupt wavy boundary.

**R**—14 to 22 inches; fractured limestone bedrock with hardness of 3 or more on Mohs' scale; few coatings of calcium carbonate in fractures.

Solum ranges from 14 to 20 inches in thickness. Reaction is neutral or mildly alkaline. Coarse fragments range from a few to about 15 percent.

The A horizon ranges from 6 to 9 inches in thickness. It is very dark grayish brown, dark grayish brown, dark brown, or dark reddish brown.

The Bt horizon ranges from 6 to 11 inches in thickness. It is dark reddish brown, dusky red, or reddish brown. Clay content ranges from about 40 to 60 percent.

The R horizon is fractured limestone bedrock with a hardness of 3 or more on Mohs' scale.

### Tarrant series

The Tarrant series consists of very shallow to shallow, gently sloping to steep, well drained, very cobbly, clayey soils on uplands. These soils formed in residuum weathered from limestone. Slopes range from 1 to 50 percent.

Typical pedon of Tarrant very cobbly clay in an area of Tarrant soils, undulating; from Kimble County Courthouse, 2.7 miles southeast on U.S. Highway 290 to the access with Interstate 10, 1.7 miles southeast to access road, and west 100 feet in rangeland:

**A11**—0 to 7 inches; dark grayish brown (10YR 4/2) very cobbly clay, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; very hard, firm; many roots and pores; about 35 percent limestone cobbles and 15 percent gravel by volume; the undersides of fragments are coated with secondary calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

**A12ca**—7 to 16 inches; dark brown (7.5YR 4/2) very cobbly clay, dark brown (7.5YR 3/2) moist; moderate medium granular and subangular blocky structure; very hard, firm; about 75 percent by volume limestone cobbles that have calcium carbonate coatings and pendants on the undersides; calcareous; moderately alkaline; abrupt wavy boundary.

**R**—16 to 22 inches; fractured, weakly cemented to strongly cemented, platy limestone bedrock; calcium carbonate coating on the limestone bedrock; about 2 percent by volume brown clay in horizontal and vertical crevices and cracks.

The solum ranges from 6 to 20 inches in thickness. Content of coarse fragments ranges from 20 to 70 percent by volume in the A11 horizon and 60 to 90 percent by volume in the A12 horizon. The solum contains 35 to 85 percent coarse fragments.

The A horizon ranges from 6 to 19 inches in thickness. It is very dark grayish brown, very dark brown, dark grayish brown, or dark brown. Texture of the fine earth fraction is clay or silty clay and has 40 to 60 percent clay.

The fractured limestone bedrock has narrow cracks and crevices filled with clay and a few fine plant roots. Some pedons contain pulverulent lime interbedded with the bedrock.

### Valera series

The Valera series consists of moderately deep, well drained, clayey soils on uplands. These soils formed in limestone and marl. Slopes range from 1 to 3 percent.

Typical pedon of Valera clay, 1 to 3 percent slopes; from Kimble County Courthouse, 20 miles southeast on U.S. Highway 290 and Interstate 10, 2 miles east on U.S.

Highway 290, 2 miles southeast on private ranch road, and 250 feet north in rangeland:

- A11—0 to 12 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; very hard, very firm; few very fine limestone fragments; calcareous; moderately alkaline; gradual wavy boundary.
- A12—12 to 23 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate fine blocky structure with irregularly shaped peds; very hard, very firm; few very fine limestone fragments; calcareous; moderately alkaline; gradual wavy boundary.
- B—23 to 28 inches; brown (7.5YR 5/2) clay, brown (7.5YR 4/2) moist; moderate fine blocky structure; very hard, very firm; few very fine limestone fragments; few concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; abrupt irregular boundary.
- Ccam—28 to 33 inches; pinkish white (7.5YR 8/2), pink (7.5YR 7/4) moist; weakly cemented calcium carbonate in upper 2 inches, but strongly cemented

calcium carbonate below with imbedded limestone fragments; calcareous; abrupt boundary.

- R—33 to 36 inches; pinkish white (7.5YR 8/2) fractured, indurated limestone bedrock; soft calcium carbonate in fractures and cracks.

The solum ranges from 21 to 40 inches in thickness. Limestone fragments range from few to 15 percent by volume. When dry, the soil has cracks ranging from 1 centimeter to 2.5 centimeters in width and 15 to 25 inches in depth. COLE is less than 0.07 in all horizons. The A and B horizons have 40 to 55 percent clay.

The A horizon ranges from 21 to 25 inches in thickness. It is very dark grayish brown, dark grayish brown, or dark brown. The B horizon is not present in some pedons. If present, it is as much as 13 inches thick.

The Ccam horizon ranges from 1 inch to 12 inches in thickness. It ranges from strongly cemented to indurated, laminated calcium carbonate. In some pedons, there is 2 to 4 inches of soft calcium carbonate on top of the cemented calcium carbonate. The R horizon ranges from indurated limestone to soft limestone with interbedded layers of marl.



# formation of the soils

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In this section the factors of soils formation are discussed and related to the formation of soils in Kimble County.

Soil is formed by the action of soil-forming processes on material deposited or accumulated by geologic agencies. The characteristics of a soil at any given point depend on the physical and mineral composition of the parent material; the climate under which the soil material has accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil development have acted on the soil material.

All five of these factors are important in the genesis of every soil. Some of the factors have had more influence than others in different locations. These factors are discussed in the following subsections.

## parent material

Parent material is the unconsolidated material from which a soil is formed. The kind of parent material determines the rate of profile formation, the kind of profiles that form, and the chemical and mineral composition of the soil. It also influences relief.

The soils of Kimble County have formed in material weathered from the rock of three geologic systems. From the oldest to the youngest, these systems are Ordovician, Cretaceous, and Quaternary.

The Ordovician System is represented by Ellenberger Limestone. This rock is dolomitic and crops out across a few thousand acres in the northeastern part of the county along the sides of the Llano River where it flows into Mason County. This formation also crops out across a few hundred acres south of the James River where it flows into Mason County. Eckert soils are above Ellenberger Limestone. These soils are very shallow to shallow and very cobbly.

The majority of the soils in Kimble County formed over rocks of the Cretaceous System, which are spread over practically all of the county. The lowest and oldest soils are those that formed in loamy, reddish, or pinkish, limy sediment. These are the Menard, Oben, and Hext soils. Other soils that formed from rocks of the Cretaceous System are shallow and very shallow soils over hard limestone and interbedded marl. These are the Brackett, Eckrant, Kavett, Purves, Real, and Tarrant soils.

Soils of the more recent Quaternary System that formed from alluvium are the Dev, Frio, Oakalla, and Rioconcho soils. These soils are along the flood plains of the Llano River and its tributaries and are the deepest in the county.

## climate

The climate of Kimble county is subhumid and fairly uniform. It has had a definite effect on soil formation. Rainfall, evaporation, temperature, and wind are some of the influential characteristics of climate. The limited rainfall has not been adequate to leach the minerals from the soils. As a result, most of the soils have a layer in which calcium carbonate has accumulated. The deep soils are seldom wet below the root zone. Average annual rainfall is about 24 inches. Summer temperatures are high, and winter temperatures are usually moderate. The high temperatures and low rainfall have limited the accumulation of organic matter in the soils.

## plant and animal life

Plants, micro-organisms, earthworms, insects, animals, and even man have contributed to the development of soils. Gains or losses of organic matter, nitrogen, and plant nutrients and changes in soil structure and porosity are some of the changes caused by living organisms.

Plants have played a major role in soil development in Kimble County. The fibrous root system of grasses contributed large amounts of organic matter to the soils. Roots of grasses, shrubs, and trees have decayed and left pores and holes that serve as passageways for water. Tree roots have loosened the stones beneath the surface and have made it possible for grass roots to penetrate to greater depths.

Earthworms, insects, rodents, and other animals have worked and mixed the soils to a great degree. Worms hasten the decay of organic matter, and wormcasts improve the soil structure to aid in the movement of water and the growth of plant roots. Fungi, bacteria, and other micro-organisms help to decay organic matter and improve fertility.

The activities of man also have affected soil development. By fencing in rangeland and allowing it to be overgrazed, man has changed the character of the vegetation. The grasses have become shorter, thinner, and weaker and they return less organic matter to the soils. Tillage and other uses of soils have affected soil

development. Construction and excavation activities are also likely to alter soil development.

#### **relief**

Relief is influenced by geology, climate, and time. Relief influences soil formation through its effect on drainage, runoff, and erosion. The hilly or undulating Brackett, Cho, Eckert, Eckrant, Real, and Tarrant soils lose much rainfall through runoff. All of these soils are very shallow to shallow because little moisture is available for living organisms and because nearly as fast as the soil forms, it is lost through water erosion. The nearly level Frio, Menard, Nuvalde, and Oakalla soils are deep because they absorb much moisture. They receive runoff from higher soils. Kavett, Oben, Purves, and Speck soils are intermediate in depth and absorb a moderate amount of moisture.

#### **time**

A long time is required for the formation of soils that have distinct horizons. The differences in length of time that parent materials have been in place are commonly reflected in the degree of development of the soil profile.

The soils in Kimble County range from young to old. The younger soils have little profile development, and the older soils have well expressed horizons. Some of the soils along the Llano River are examples of young soils; they are the Dev, Frio, and Oakalla soils. These bottom land soils are still receiving sediment when the river overflows and they are flooded.

Some soils, such as Nuvalde and Shep soils, are older than the flood plain soils. These soils developed in older alluvium washed from higher lying uplands. These soils have calcium carbonate accumulations in the form of soft masses or concretions that have leached from the upper horizons to the lower horizons. Still older soils, such as Cho and Kavett soils, have calcium carbonate accumulations that have become cemented or indurated. These cemented horizons require a long time for development, possibly millions of years.

Another stage of development occurs in even older soils. After the carbonates have been leached from the solum, clay particles begin to move downward by translocation to form clay accumulations in the subsoil. Some of these older soils in Kimble County are the Menard, Oben, and Speck soils.

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## glossary

**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	<i>Inches</i>
Very low.....	0 to 3
Low.....	3 to 6
Moderate.....	6 to 9
High.....	9 to 12
Very high.....	More than 12

**Base saturation.** The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bottom land.** The normal flood plain of a stream, subject to flooding.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Caliche.** A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is 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 texture

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 oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

**Climax vegetation.** The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

**Coarse fragments.** If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

**Cobblestone (or cobble).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

**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 map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds 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 when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Corrosive.** High risk of corrosion to uncoated steel or deterioration of concrete.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Decreasers.** The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

**Deferred grazing.** Postponing grazing or arresting grazing for a prescribed period.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, 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 classes of natural soil drainage are recognized:

*Excessively drained.*—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained.*—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well drained.*—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained.*—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but

periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

*Somewhat poorly drained.*—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained.*—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained.*—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

**Excess lime** (in tables). Excess carbonates in the soil that restrict the growth of some plants.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Forb.** Any herbaceous plant not a grass or a sedge.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Gravel.** Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

*O horizon.*—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

*C horizon.*—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

*R layer.*—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Increasesers.** Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasesers commonly are the shorter plants and the less palatable to livestock.

**Large stones** (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil:

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Low strength.** The soil is not strong enough to support loads.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Munsell notation.** A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Nutrient, plant.** Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition.

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called "a soil."

A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percs slowly** (in tables). The slow movement of water through the soil adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow.....	less than 0.06 inch
Slow.....	0.06 to 0.20 inch
Moderately slow.....	0.2 to 0.6 inch
Moderate.....	0.6 inch to 2.0 inches
Moderately rapid.....	2.0 to 6.0 inches
Rapid.....	6.0 to 20 inches
Very rapid.....	more than 20 inches

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Piping** (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Rangeland.** Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

**Range condition.** The present composition of the plant community on a range site in relation to the potential natural plant community for that site.

Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

**Range site.** An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	<i>pH</i>
Extremely acid.....	Below 4.5
Very strongly acid.....	4.5 to 5.0
Strongly acid.....	5.1 to 5.5
Medium acid.....	5.6 to 6.0
Slightly acid.....	6.1 to 6.5
Neutral.....	6.6 to 7.3
Mildly alkaline.....	7.4 to 7.8
Moderately alkaline.....	7.9 to 8.4
Strongly alkaline.....	8.5 to 9.0
Very strongly alkaline.....	9.1 and higher

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rooting depth** (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

**Root zone.** The part of the soil that can be penetrated by plant roots.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-size particles.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Slickensides.** Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

**Slow intake** (in tables). The slow movement of water into the soil.

**Small stones** (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

**Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	<i>Millimeters</i>
Very coarse sand.....	2.0 to 1.0
Coarse sand.....	1.0 to 0.5
Medium sand.....	0.5 to 0.25
Fine sand.....	0.25 to 0.10
Very fine sand.....	0.10 to 0.05
Silt.....	0.05 to 0.002
Clay.....	less than 0.002

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of 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 plant and animal activities are largely confined to the solum.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

**Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. 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 either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Trace elements.** Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Wilting point (or permanent wilting point).** The moisture content of soil, on an oven-dry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.



# tables

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TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1910-1968]

Month	Temperature			Precipitation
	Average daily maximum	Average daily minimum	Average daily	Average Monthly
	<u>OF</u>	<u>OF</u>	<u>OF</u>	<u>In</u>
January-----	59.3	30.8	45.0	1.13
February-----	61.4	38.5	49.9	1.14
March-----	73.7	38.6	56.1	1.40
April-----	75.2	49.6	62.4	2.54
May-----	86.5	61.9	74.2	3.54
June-----	91.2	67.5	79.3	2.78
July-----	96.5	71.1	83.8	2.36
August-----	97.0	68.4	82.7	1.98
September-----	85.9	67.9	76.9	3.03
October-----	73.4	54.5	63.9	2.25
November-----	69.9	41.0	55.4	1.43
December-----	60.1	29.7	44.9	1.18
Year-----	---	---	---	24.76

TABLE 2.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
CoC	Cho gravelly loam, 1 to 8 percent slopes-----	2,713	0.3
De	Dev very gravelly loam, frequently flooded-----	15,237	1.9
EcE	Eckert soils, rolling-----	5,994	0.7
EtC	Eckrant-Tarrant complex, undulating-----	4,380	0.5
Fr	Frio silty clay loam, occasionally flooded-----	8,845	1.1
HtD	Hext-Latom complex, undulating-----	15,004	1.8
KTB	Kavett-Tarrant association, gently undulating-----	27,092	3.3
MnB	Menard fine sandy loam, 1 to 3 percent slopes-----	25,854	3.2
NuA	Nuvalde clay loam, 0 to 1 percent slopes-----	4,952	0.6
NuB	Nuvalde clay loam, 1 to 3 percent slopes-----	39,264	4.8
Oa	Oakalla silty clay loam-----	2,814	0.4
OhC	Oben-Hext complex, 1 to 5 percent slopes-----	5,420	0.7
PTB	Purves-Tarrant association, gently undulating-----	12,373	1.5
RbF	Real-Brackett complex, hilly-----	25,191	3.1
Ro	Rioconcho clay, occasionally flooded-----	3,547	0.4
ShC	Shep clay loam, 1 to 5 percent slopes-----	9,860	1.2
SpB	Speck clay loam, 0 to 3 percent slopes-----	860	0.1
TaC	Tarrant soils, undulating-----	529,779	65.0
TrG	Tarrant-Rock outcrop complex, steep-----	68,248	8.4
VaB	Valera clay, 1 to 3 percent slopes-----	7,933	1.0
	Total-----	815,360	100.0

TABLE 3.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Grain sorghum		Wheat		Grazing sorghum		Grazing small grain		Native pecans		Improved pecans	
	N Bu	I Bu	N Bu	I Bu	N AUM	I AUM	N AUM	I AUM	N Cwt	I Cwt	N Cwt	I Cwt
CoC----- Cho	---	---	10	---	---	---	---	---	---	---	---	---
De----- Dev	---	---	---	---	---	---	---	---	200	---	800	---
EcE----- Eckert	---	---	---	---	---	---	---	---	---	---	---	---
EtC----- Eckrant-Tarrant	---	---	---	---	---	---	---	---	---	---	---	---
Fr----- Frio	75	---	---	---	3	---	2	---	300	---	1,000	---
HtD----- Hext-Latom	---	---	---	---	---	---	---	---	---	---	---	---
KTB*: Kavett----- Tarrant-----	---	---	15	---	2	---	1	---	---	---	---	---
MnB----- Menard	30	---	---	---	4	---	2	---	---	---	---	---
NuA----- Nuvalde	40	---	20	---	3	---	2	---	250	---	900	---
NuB----- Nuvalde	35	---	20	---	3	---	2	---	250	---	900	---
Oa----- Oakalla	65	---	25	---	---	---	---	---	300	---	1,000	---
OhC----- Oben-Hext	---	---	---	---	2	---	1	---	---	---	---	---
PTB*: Purves----- Tarrant-----	25	---	20	---	2	---	1	---	---	---	---	---
RbF----- Real-Brackett	---	---	---	---	---	---	---	---	---	---	---	---
Ro----- Rioconcho	30	---	---	---	3	---	2	---	300	---	1,000	---
ShC----- Shep	30	---	15	---	2	---	1	---	---	---	---	---
SpB----- Speck	---	---	15	---	2	---	1	---	---	---	---	---
TaC----- Tarrant	---	---	---	---	---	---	---	---	---	---	---	---
TrG----- Tarrant-Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
VaB----- Valera	35	---	20	---	3	---	2	---	---	---	---	---

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 4.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (N)	---	---	---	---	---
I (I)	20,158	---	---	---	---
II (N)	84,364	73,051	2,814	---	8,499
II (I)	73,051	73,051	---	---	---
III (N)	27,866	27,866	---	---	---
III (I)	9,860	9,860	---	---	---
IV (N)	15,280	15,280	---	---	---
IV (I)	---	---	---	---	---
V (N)	---	---	---	---	---
VI (N)	25,452	7,502	15,237	2,713	---
VII (N)	638,709	---	---	638,709	---

TABLE 5.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation are listed]

Soil name and map symbol	Range site name	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
CoC----- Cho	Very Shallow-----	1,800	1,300	800
De----- Dev	Loamy Bottomland-----	4,500	3,700	2,500
EcE#----- Eckert	Stony Loam-----	3,000	2,200	1,400
EtC#: Eokrant-----	Low Stony Hill-----	3,000	2,200	1,500
Tarrant-----	Low Stony Hill-----	3,000	2,200	1,500
Fr----- Frio	Loamy Bottomland-----	5,000	4,000	3,000
HtD#: Hext-----	Shallow (Central Basin)-----	2,000	1,500	1,000
Latom-----	Shallow (Central Basin)-----	2,000	1,500	1,000
KTB#: Kavett-----	Shallow (Edwards Plateau)-----	3,500	2,500	1,500
Tarrant-----	Low Stony Hill-----	3,000	2,200	1,500
MnB----- Menard	Sandy Loam-----	3,800	3,000	2,200
NuA, NuB----- Nuvalde	Clay Loam-----	4,000	3,000	1,900
Oa----- Oakalla	Loamy Bottomland-----	4,500	3,700	2,500
OhC#: Oben-----	Shallow (Central Basin)-----	2,000	1,500	1,000
Hext-----	Shallow (Central Basin)-----	2,000	1,500	1,000
PTB#: Purves-----	Shallow (Edwards Plateau)-----	3,500	2,200	1,500
Tarrant-----	Low Stony Hill-----	3,000	2,200	1,500
RbF#: Real-----	Steep Adobe-----	1,800	1,300	800
Brackett-----	Steep Adobe-----	1,500	1,300	800
Ro----- Rioconcho	Clayey Bottomland-----	4,500	3,000	2,500
ShC----- Shep	Hardland Slopes-----	2,800	1,900	1,200
SpB----- Speck	Redland-----	3,000	2,000	1,000
TaC#----- Tarrant	Low Stony Hill-----	3,000	2,200	1,500
TrG#: Tarrant-----	Steep Rocky-----	2,500	1,800	1,000

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site name	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
TrG*: Rock outcrop.				
VaB----- Valera	Clay Loam-----	4,000	3,000	2,000

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
CoC----- Cho	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Slight-----	Severe: thin layer.
De----- Dev	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones, flooding.	Severe: small stones.	Severe: small stones, droughty, flooding
EcE*----- Eckert	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, depth to rock.	Severe: large stones.	Severe: large stones, thin layer.
EtC*: Eckrant-----	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones.	Severe: large stones, thin layer.
Tarrant-----	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, small stones.	Severe: large stones.	Severe: large stones, thin layer.
Fr----- Frio	Severe: flooding.	Severe: too clayey.	Severe: too clayey.	Moderate: too clayey.	Severe: too clayey.
HtD*: Hext-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Moderate: thin layer.
Latom-----	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight-----	Severe: thin layer.
KTB*: Kavett-----	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: too clayey, depth to rock, cemented pan.	Moderate: too clayey.	Severe: thin layer, too clayey.
Tarrant-----	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, small stones.	Severe: large stones.	Severe: large stones, thin layer.
MnB----- Menard	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
NuA----- Nuvalde	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
NuB----- Nuvalde	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Oa----- Oakalla	Severe: flooding.	Moderate: too clayey.	Moderate: dusty.	Moderate: dusty.	Moderate: excess lime.
OhC*: Oben-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----	Severe: thin layer.
Hext-----	Slight-----	Slight-----	Moderate: slope, small stones, depth to rock.	Slight-----	Moderate: thin layer.

See footnote at end of table.

TABLE 6.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
PTB#: Purves-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: too clayey.	Severe: thin layer, too clayey.
Tarrant-----	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, small stones.	Severe: large stones.	Severe: large stones, thin layer.
RbF#: Real-----	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.	Severe: small stones, slope, thin layer.
Brackett-----	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.	Severe: slope, thin layer.
Ro----- Rioconcho	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
ShC----- Shep	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Slight.
SpB----- Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----	Severe: thin layer.
TaC#----- Tarrant	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, small stones.	Severe: large stones.	Severe: large stones, thin layer.
TrG#: Tarrant-----	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones, slope.	Severe: large stones, slope, thin layer.
Rock outcrop.					
VaB----- Valera	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, small stones, too clayey.	Moderate: too clayey.	Severe: too clayey.

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements				Potential as habitat for--	
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Openland wildlife	Rangeland wildlife
CoC----- Cho	Fair	Poor	Poor	Poor	Poor	Poor.
De----- Dev	Poor	Poor	Fair	Fair	Poor	Good.
EcE*----- Eckert	Very poor	Very poor	Good	Good	Very poor	Good.
EtC*: Eckrant-----	Very poor	Very poor	Good	Good	Poor	Good.
Tarrant-----	Very poor	Very poor	Good	Good	Poor	Good.
Fr----- Frio	Good	Good	Fair	Good	Good	Good.
HtD*: Hext-----	Poor	Fair	Good	Good	Fair	Good.
Latom-----	Very poor	Very poor	Fair	Fair	Poor	Fair.
KTB*: Kavett-----	Fair	Fair	Fair	Poor	Fair	Poor.
Tarrant-----	Very poor	Very poor	Good	Good	Poor	Good.
MnB----- Menard	Good	Good	Good	Good	Good	Good.
NuA, NuB----- Nuvalde	Good	Good	Fair	Fair	Good	Fair.
Oa----- Oakalla	Good	Good	Good	Good	Good	Good.
OhC*: Oben-----	Fair	Good	Fair	Fair	Fair	Fair.
Hext-----	Fair	Good	Good	Good	Good	Good.
PTB*: Purves-----	Fair	Good	Poor	Fair	Fair	Poor.
Tarrant-----	Very poor	Very poor	Good	Good	Poor	Good.
RbF*: Real-----	Very poor	Very poor	Poor	Fair	Very poor	Poor.
Brackett-----	Very poor	Very poor	Fair	Fair	Very poor	Fair.
Ro----- Rioconcho	Good	Good	Fair	Good	Good	Good.
ShC----- Shep	Fair	Good	Good	Fair	Good	Fair.
SpB----- Speck	Fair	Fair	Fair	Fair	Fair	Fair.
TaC*----- Tarrant	Very poor	Very poor	Good	Good	Poor	Good.

See footnote at end of table.

TABLE 7.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements				Potential as habitat for--	
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Openland wildlife	Rangeland wildlife
TrG*: Tarrant----- Rock outcrop.	Very poor	Very poor	Good	Good	Poor	Good.
VaB----- Valera	Good	Good	Fair	Fair	Good	Fair.

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
CoC----- Cho	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan.	Moderate: cemented pan.	Severe: thin layer.
De----- Dev	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: small stones, droughty, flooding.
EcE#----- Eckert	Depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.
EtC#: Eckrant-----	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, thin layer.
Tarrant-----	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: large stones, thin layer.
Fr----- Frio	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: too clayey.
HtD#: Hext-----	Moderate: depth to rock.	Slight-----	Moderate: depth to rock.	Moderate: slope.	Slight-----	Moderate: thin layer.
Latom-----	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
KTB#: Kavett-----	Severe: depth to rock, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, cemented pan, shrink-swell.	Severe: thin layer, too clayey.
Tarrant-----	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: large stones, thin layer.
MnB----- Menard	Slight-----	Slight-----	Slight-----	Slight-----	Moderate: low strength.	Slight.
NuA, NuB----- Nuvalde	Slight-----	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Oa----- Oakalla	Slight-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Moderate: excess lime.
OhC#: Oben-----	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
Hext-----	Moderate: depth to rock.	Slight-----	Moderate: depth to rock.	Slight-----	Slight-----	Moderate: thin layer.
PTB#: Purves-----	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer, too clayey.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
PTB#: Tarrant-----	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: large stones, thin layer.
RbF#: Real-----	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: small stones, slope, thin layer.
Brackett-----	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope, thin layer.
Ro----- Rioconcho	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: too clayey.
ShC----- Shep	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: low strength.	Slight.
SpB----- Speck	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: thin layer.
TaC#----- Tarrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: large stones, thin layer.
TrG#: Tarrant-----	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, low strength, slope.	Severe: large stones, slope, thin layer.
Rock outcrop.						
VaB----- Valera	Severe: depth to rock, cemented pan.	Severe: shrink-swell.	Severe: depth to rock, cemented pan, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
CoC----- Cho	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: area reclaim.
De----- Dev	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding.	Severe: flooding, seepage.	Poor: small stones.
EcE*----- Eckert	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
EtC*: Eckrant-----	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones, thin layer.
Tarrant-----	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Fr----- Frio	Severe: flooding, percs slowly.	Slight-----	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
HtD*: Hext-----	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Latom-----	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
KTB*: Kavett-----	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, too clayey.	Severe: depth to rock, cemented pan.	Poor: thin layer, too clayey, area reclaim.
Tarrant-----	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
MnB----- Menard	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
NuA----- Nuvalde	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey, hard to pack.
NuB----- Nuvalde	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey, hard to pack.
Oa----- Oakalla	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
OhC*: Oben-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----	Poor: area reclaim, thin layer.
Hext-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
PTB*: Purves-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Tarrant-----	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
RbF*: Real-----	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Brackett-----	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Ro----- Rioconcho	Severe: flooding.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey.
ShC----- Shep	Slight-----	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
SpB----- Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
TaC*----- Tarrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
TrG*: Tarrant-----	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
Rock outcrop.					
VaB----- Valera	Severe: depth to rock, cemented pan, percs slowly.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, too clayey.	Severe: depth to rock, cemented pan.	Poor: area reclaim, too clayey, hard to pack.

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
CoC----- Cho	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
De----- Dev	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
EcE*----- Eckert	Poor: area reclaim, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
EtC*: Eckrant-----	Poor: area reclaim, thin layer, large stones.	Improbable: excess fines, thin layer, large stones.	Improbable: excess fines, thin layer, large stones.	Poor: area reclaim, large stones, thin layer.
Tarrant-----	Poor: area reclaim, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, too clayey, large stones.
Fr----- Frio	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
HtD*: Hext-----	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Latom-----	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
KTB*: Kavett-----	Poor: thin layer, low strength.	Improbable: excess fines, thin layer.	Improbable: excess fines.	Poor: too clayey, area reclaim, thin layer.
Tarrant-----	Poor: area reclaim, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, too clayey, large stones.
MnB----- Menard	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair.
NuA, NuB----- Nuvalde	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Oa----- Oakalla	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, excess lime.
OhC*: Oben-----	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Hext-----	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
PTB#: Purves-----	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey, small stones.
Tarrant-----	Poor: area reclaim, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, too clayey, large stones.
RbF#: Real-----	Poor: area reclaim, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, small stones, thin layer.
Brackett-----	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Ro----- Rioconcho	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
ShC----- Shep	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
SpB----- Speck	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
TaC#----- Tarrant	Poor: area reclaim, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, too clayey, large stones.
TrG#: Tarrant-----	Poor: area reclaim, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, too clayey, large stones.
Rock outcrop.				
VaB----- Valera	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes and levees	Irrigation	Terraces and diversions	Grassed waterways
CoC----- Cho	Severe: cemented pan, seepage.	Severe: thin layer.	Cemented pan, slope.	Cemented pan----	Droughty, cemented pan.
De----- Dev	Severe: seepage.	Slight-----	Droughty, flooding.	Favorable-----	Droughty.
EcE*----- Eckert	Severe: depth to rock.	Severe: thin layer, large stones.	Large stones, droughty, depth to rock.	Slope, depth to rock, large stones.	Large stones, slope, depth to rock.
EtC*: Eckrant-----	Severe: depth to rock, seepage.	Severe: thin layer, large stones.	Large stones, droughty, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.
Tarrant-----	Severe: depth to rock.	Severe: thin layer, hard to pack, large stones.	Large stones, slow intake, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.
Fr----- Frio	Slight-----	Moderate: hard to pack.	Slow intake, flooding.	Favorable-----	Favorable.
HtD*: Hext-----	Moderate: seepage, depth to rock.	Severe: piping.	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
Latom-----	Severe: depth to rock.	Severe: thin layer.	Depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
KTB*: Kavett-----	Severe: depth to rock, cemented pan, seepage.	Severe: thin layer.	Slow intake, depth to rock, cemented pan.	Depth to rock, cemented pan.	Rooting depth, depth to rock, cemented pan.
Tarrant-----	Severe: depth to rock.	Severe: thin layer, hard to pack, large stones.	Large stones, slow intake, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.
MnB----- Menard	Severe: seepage.	Slight-----	Soil blowing, erodes easily.	Erodes easily, soil blowing.	Erodes easily.
NuA, NuB----- Nuvalde	Severe: seepage.	Moderate: piping.	Favorable-----	Favorable-----	Favorable.
Oa----- Oakalla	Moderate: seepage.	Moderate: hard to pack.	Excess lime-----	Favorable-----	Favorable.
OhC*: Oben-----	Severe: depth to rock.	Severe: thin layer.	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
Hext-----	Moderate: seepage, depth to rock.	Severe: piping.	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--	
	Pond reservoir areas	Embankments, dikes and levees	Irrigation	Terraces and diversions	Grassed waterways
PTB*: Purves-----	Severe: depth to rock.	Severe: thin layer.	Slow intake, depth to rock, slope.	Depth to rock----	Depth to rock.
Tarrant-----	Severe: depth to rock.	Severe: thin layer, hard to pack, large stones.	Large stones, slow intake, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.
RbF*: Real-----	Severe: depth to rock, slope, seepage.	Severe: thin layer, seepage.	Droughty, depth to rock, excess lime.	Slope, depth to rock.	Slope, depth to rock.
Brackett-----	Severe: depth to rock, slope.	Severe: thin layer.	Depth to rock, slope.	Large stones, slope, depth to rock.	Large stones, slope, depth to rock.
Ro----- Rioconcho	Slight-----	Moderate: hard to pack.	Slow intake, percs slowly, flooding.	Percs slowly----	Percs slowly.
ShC----- Shep	Moderate: seepage, slope.	Moderate: piping.	Slope-----	Favorable-----	Favorable.
SpB----- Speck	Severe: depth to rock.	Severe: thin layer.	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
TaC*----- Tarrant	Severe: depth to rock.	Severe: thin layer, hard to pack, large stones.	Large stones, slow intake, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.
TrG*: Tarrant-----	Severe: depth to rock, slope.	Severe: thin layer, hard to pack, large stones.	Large stones, slow intake, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Rock outcrop.					
VaB----- Valera	Moderate: depth to rock, cemented pan.	Severe: thin layer, hard to pack.	Slow intake, depth to rock, cemented pan.	Depth to rock, cemented pan.	Depth to rock, cemented pan.

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
CoC----- Cho	0-12	Gravelly loam----	CL, SC	A-4, A-6, A-7-6	0-5	60-95	55-95	50-80	45-70	25-44	8-22
	12-22	Cemented-----	---	---	---	---	---	---	---	---	---
	22-78	Variable-----	---	---	---	---	---	---	---	---	---
De----- Dev	0-72	Very gravelly loam.	GC, GP-GC, SC, SP-SC	A-2-4, A-2-6, A-7, A-6	0-10	10-78	5-65	5-50	5-42	28-47	9-24
EcE*----- Eckert	0-10	Very cobbly loam-	ML, CL-ML	A-4	25-70	75-95	75-95	75-95	60-80	<30	NP-7
	10-18	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
EtC*: Eckrant-----	0-12	Cobbly clay, very cobbly clay.	GC, SC, CH	A-7-6, A-2-7	25-75	45-100	40-100	35-97	30-94	47-76	26-54
	12-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tarrant-----	0-9	Cobbly silty clay	CH, GC, SC	A-7-6, A-7-5	33-77	55-100	51-100	48-99	36-95	51-75	25-44
	9-80	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
Fr----- Frio	0-32	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0-2	80-100	80-100	70-100	60-95	35-52	20-34
	32-80	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0-5	80-100	80-100	70-100	60-95	30-52	18-34
HtD*: Hext-----	0-11	Fine sandy loam	SM, SM-SC, SC, CL-ML	A-4	0-2	85-100	80-100	60-90	40-70	<25	NP-8
	11-24	Fine sandy loam, loam, sandy clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-2-4	0-2	75-100	70-100	50-90	30-70	<30	NP-10
	24-35	Weathered bedrock	---	---	---	---	---	---	---	---	---
Latom-----	0-8	Gravelly fine sandy loam.	SM, SM-SC	A-4, A-2-4	0-5	90-100	75-95	60-80	30-50	<25	NP-7
	8-19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
KTB*: Kavett-----	0-11	Silty clay-----	CH	A-7-6	0-2	90-100	80-100	75-100	70-96	51-66	25-40
	11-20	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tarrant-----	0-9	Very cobbly silty clay.	CH, GC, SC	A-7-6, A-7-5	33-77	55-100	51-100	48-99	36-95	51-75	25-44
	9-17	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
MnB----- Menard	0-9	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-2-4, A-4	0	95-100	95-100	75-100	30-60	<25	NP-7
	9-33	Sandy clay loam, clay loam.	SC, CL	A-4, A-6	0	95-100	95-100	70-100	36-70	26-40	10-22
	33-70	Sandy clay loam, clay loam, sandy loam.	SC, CL	A-4, A-6	0-5	80-100	75-100	65-97	36-60	20-35	8-20

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
NuA----- Nuvalde	0-16	Clay loam-----	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	80-96	38-60	20-38
	16-40	Clay loam, clay, silty clay.	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	70-98	38-58	20-36
	40-80	Clay loam, silty clay loam, clay.	CL	A-6, A-7-6	0	85-100	80-100	70-98	65-90	30-50	14-30
NuB----- Nuvalde	0-15	Clay loam-----	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	80-96	38-60	20-38
	15-50	Clay loam, clay, silty clay.	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	70-98	38-58	20-36
	50-74	Clay loam, silty clay loam, clay.	CL	A-6, A-7-6	0	85-100	80-100	70-98	65-90	30-50	14-30
Oa----- Oakalla	0-78	Silty clay loam	CL, CH	A-6, A-7-6	0-2	85-100	80-100	70-100	65-95	35-54	18-36
OhC*: Oben-----	0-6	Fine sandy loam	SC, CL, SM-SC, CL-ML	A-4	0-5	90-100	90-100	70-85	40-55	<25	NP-10
	6-19	Fine sandy loam, sandy clay loam.	SC, CL	A-4, A-6	0-5	90-100	90-100	80-95	45-75	26-36	8-15
	19-25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Hext-----	0-12	Fine sandy loam	SM, SM-SC, SC, CL-ML	A-4	0-2	85-100	80-100	60-90	40-70	<25	NP-8
	12-28	Fine sandy loam, loam, sandy clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-2-4	0-2	75-100	70-100	50-90	30-70	<30	NP-10
	28-36	Weathered bedrock	---	---	---	---	---	---	---	---	---
PTB*: Purves-----	0-11	Clay-----	CH	A-7-6	0-5	90-100	80-100	80-95	70-95	51-65	30-40
	11-14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tarrant-----	0-9	Very cobbly clay	CH, GC, SC	A-7-6, A-7-5	33-77	55-100	51-100	48-99	36-95	51-75	25-44
	9-15	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
RbF*: Real-----	0-16	Gravelly clay loam, very gravelly clay loam.	GC, SC, GP-GC, SP-SC	A-2-6, A-2-4	1-10	25-75	10-50	10-45	10-35	25-35	8-15
	16-80	Variable, weathered bedrock.	---	---	---	---	---	---	---	---	---
Brackett-----	0-17	Loam, gravelly loam, clay loam.	CL, SC, GC	A-6, A-4, A-7-6	0-20	70-100	60-100	54-95	40-85	28-45	9-26
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ro----- Rioconcho	0-80	Clay-----	CL, CH	A-6, A-7-6	0-10	85-100	83-100	75-100	70-97	39-62	20-38
ShC----- Shep	0-24	Clay loam-----	CL, SC	A-4, A-6	0-2	85-100	80-100	75-95	40-75	25-40	9-21
	24-80	Loam, clay loam, sandy clay loam.	CL, SC	A-4, A-6	0-2	85-100	80-100	70-95	40-75	25-40	9-21

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
SpB----- Speck	0-7	Clay loam-----	CL	A-6, A-7-6	0	90-100	90-100	80-95	70-90	30-45	15-25
	7-14	Clay, clay loam	CL, CH	A-7-6	0	85-100	80-100	70-100	55-95	45-65	25-40
	14-22	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
TaC*----- Tarrant	0-16	Very cobbly clay	CH, GC, SC	A-7-6, A-7-5	33-77	55-100	51-100	48-99	36-95	51-75	25-44
	16-22	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
TrG*: Tarrant-----	0-12	Very cobbly clay	CH, GC, SC	A-7-6, A-7-5	33-77	55-100	51-100	48-99	36-95	51-75	25-44
	12-20	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
VaB----- Valera	0-28	Clay-----	CL, CH	A-7-6	0-2	85-100	75-100	75-95	75-90	41-62	20-38
	28-33	Cemented-----	---	---	---	---	---	---	---	---	---
	33-36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth In	Clay <2mm Pct	Moist bulk density G/cm <sup>3</sup>	Permeability In/hr	Available water capacity In/in	Soil reaction pH	Shrink-swell potential	Erosion factors		Wind erodi- bility group	Organic matter Pct
								K	T		
CoC----- Cho	0-12 12-22 22-78	20-35 --- ---	--- --- ---	0.6-2.0 --- ---	0.10-0.15 --- ---	7.9-8.4 --- ---	Low----- ----- -----	0.28 --- ---	1 --- ---	4L --- ---	1-2 --- ---
De----- Dev	0-72	18-35	---	2.0-6.0	0.03-0.10	7.9-8.4	Very low----	0.10	5	8	1-3
EcE*----- Eckert	0-10 10-18	15-27 ---	--- ---	0.6-2.0 ---	0.10-0.15 ---	6.6-8.4 ---	Low----- -----	0.10 ---	1 ---	8 ---	1-3 ---
EtC*: Eckrant-----	0-12 12-20	35-60 ---	--- ---	0.2-0.6 ---	0.05-0.12 ---	6.6-8.4 ---	Moderate-----	0.10	1	8	1-3
Tarrant-----	0-9 9-80	40-60 ---	--- ---	0.2-0.6 ---	0.10-0.17 ---	7.9-8.4 ---	Moderate-----	0.20	1	8	2-7
Fr----- Frio	0-32 32-80	35-50 35-50	--- ---	0.2-0.6 0.2-0.6	0.15-0.22 0.11-0.22	7.9-8.4 7.9-8.4	Moderate----- Moderate-----	0.32 0.32	5	4	1-4
HtD*: Hext-----	0-11 11-24 24-35	10-25 10-25 ---	--- --- ---	0.6-2.0 0.6-2.0 ---	0.11-0.18 0.11-0.18 ---	7.4-8.4 7.9-8.4 ---	Low----- Low----- -----	0.24 0.24 ---	1 ---	3 ---	<1 ---
Latom-----	0-8 8-19	5-18 ---	--- ---	0.6-2.0 ---	0.10-0.15 ---	7.9-8.4 ---	Low----- -----	0.24 ---	1 ---	8 ---	<1 ---
KTB*: Kavett-----	0-11 11-20	35-50 ---	--- ---	0.2-0.6 ---	0.15-0.20 ---	7.9-8.4 ---	High----- -----	0.32 ---	1 ---	4 ---	1-3 ---
Tarrant-----	0-9 9-17	40-60 ---	--- ---	0.2-0.6 ---	0.10-0.17 ---	7.9-8.4 ---	Moderate-----	0.20	1	8	2-7
MnB----- Menard	0-9 9-33 33-70	8-20 20-35 15-30	--- --- ---	2.0-6.0 0.6-2.0 2.0-6.0	0.11-0.17 0.15-0.19 0.11-0.17	6.6-7.8 6.1-7.8 7.9-8.4	Low----- Low----- Low-----	0.43 0.49 0.49	5	3	<1
NuA----- Nuvalde	0-16 16-40 40-80	35-50 35-50 28-45	--- --- ---	0.6-2.0 0.6-2.0 0.6-2.0	0.14-0.20 0.12-0.18 0.12-0.18	7.9-8.4 7.9-8.4 7.9-8.4	High----- High----- Moderate-----	0.28 0.28 0.32	5	4L	1-3
NuB----- Nuvalde	0-15 15-50 50-74	35-50 35-50 28-45	--- --- ---	0.6-2.0 0.6-2.0 0.6-2.0	0.14-0.20 0.12-0.18 0.12-0.18	7.9-8.4 7.9-8.4 7.9-8.4	High----- High----- Moderate-----	0.28 0.28 0.32	5	4L	1-3
Oa----- Oakalla	0-78	25-40	---	0.6-2.0	0.12-0.19	7.9-8.4	Moderate-----	0.32	5	4L	1-3
OhC*: Oben-----	0-6 6-19 19-25	8-18 16-25 ---	--- --- ---	0.6-2.0 0.6-2.0 ---	0.10-0.16 0.11-0.17 ---	6.1-7.3 6.1-7.3 ---	Low----- Low----- -----	0.24 0.32 ---	1 ---	3 ---	<1 ---
Hext-----	0-12 12-28 28-36	10-25 10-25 ---	--- --- ---	0.6-2.0 0.6-2.0 ---	0.11-0.18 0.11-0.18 ---	7.4-8.4 7.9-8.4 ---	Low----- Low----- -----	0.24 0.24 ---	1 ---	3 ---	<1 ---

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth		Clay <2mm Pct	Moist bulk density G/cm <sup>3</sup>	Permeability In/hr	Available water capacity In/in	Soil reaction pH	Shrink-swell potential		Erosion factors		Wind erodibility group	Organic matter Pct
	In	Pct						K	T				
PTB#:													
Purves-----	0-11 11-14	35-55 ---	---	0.2-0.6 ---	0.12-0.18 ---	7.9-8.4 ---	High-----	0.32	1	4	1-3		
Tarrant-----	0-9 9-15	40-60 ---	---	0.2-0.6 ---	0.10-0.17 ---	7.9-8.4 ---	Moderate-----	0.20	1	8	2-7		
RbF#:													
Real-----	0-16 16-80	18-35 ---	---	0.6-2.0 ---	0.05-0.10 ---	7.9-8.4 ---	Low-----	0.10	1	8	1-4		
Brackett-----	0-17 17-60	15-35 ---	---	0.2-0.6 ---	0.10-0.20 ---	7.9-8.4 ---	Low-----	0.32	2	4L	<1		
Ro-----	0-80	35-55	---	0.06-0.2	0.15-0.20	7.4-8.4	High-----	0.32	5	4	1-4		
Rioconcho													
ShC-----	0-24 24-80	18-35 18-35	---	0.6-2.0 0.6-2.0	0.15-0.19 0.13-0.17	7.9-8.4 7.9-8.4	Low----- Low-----	0.28 0.28	5	4L	<1		
Shep													
SpB-----	0-7 7-14 14-22	20-39 35-60 ---	---	0.2-0.6 0.06-0.2 ---	0.15-0.20 0.12-0.18 ---	6.1-7.8 6.1-7.8 ---	Moderate----- High-----	0.32 0.32	1	6	1-3		
Speck													
TaC*-----	0-16 16-22	40-60 ---	---	0.2-0.6 ---	0.10-0.17 ---	7.9-8.4 ---	Moderate-----	0.20	1	8	2-7		
Tarrant													
TrG#:													
Tarrant-----	0-12 12-20	40-60 ---	---	0.2-0.6 ---	0.10-0.17 ---	7.9-8.4 ---	Moderate-----	0.20	1	8	2-7		
Rock outcrop.													
VaB-----	0-28 28-33 33-36	40-55 ---	---	0.2-0.6 ---	0.15-0.20 ---	7.9-8.4 ---	High-----	0.32	2	4	1-5		
Valera													

\* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
CoC----- Cho	C	None-----	---	---	In >60	---	In 8-20	Thin	High----	Low.
De----- Dev	A	Frequent----	Brief-----	Apr-Jun	>60	---	---	---	Moderate	Low.
EcE*----- Eckert	D	None-----	---	---	4-14	Hard	---	---	Low-----	Low.
EtC*: Eckrant-----	D	None-----	---	---	8-20	Hard	---	---	High----	Low.
Tarrant-----	D	None-----	---	---	6-20	Hard	---	---	High----	Low.
Fr----- Frio	B	Occasional	Brief-----	Oct-May	>60	---	---	---	High----	Low.
HtD*: Hext-----	B	None-----	---	---	20-40	Soft	---	---	Moderate	Low.
Latom-----	D	None-----	---	---	4-20	Hard	---	---	Moderate	Moderate.
KTB*: Kavett-----	D	None-----	---	---	11-26	Hard	10-20	Thick	High----	Low.
Tarrant-----	D	None-----	---	---	6-20	Hard	---	---	High----	Low.
MnB----- Menard	B	None-----	---	---	>60	---	---	---	Moderate	Low.
NuA, NuB----- Nuvalde	B	None-----	---	---	>60	---	---	---	High----	Low.
Oa----- Oakalla	B	Rare-----	---	---	>60	---	---	---	Moderate	Low.
OhC*: Oben-----	C	None-----	---	---	9-20	Soft	---	---	Low-----	Low.
Hext-----	B	None-----	---	---	20-40	Soft	---	---	Moderate	Low.
PTB*: Purves-----	D	None-----	---	---	8-20	Hard	---	---	High----	Low.
Tarrant-----	D	None-----	---	---	6-20	Hard	---	---	High----	Low.
RbF*: Real-----	D	None-----	---	---	8-20	Soft	---	---	High----	Low.
Brackett-----	C	None-----	---	---	10-20	Soft	---	---	High----	Low.
Ro----- Rioconcho	C	Occasional	Very brief to brief.	Apr-Jun	>60	---	---	---	High----	Low.
ShC----- Shep	B	None-----	---	---	>60	---	---	---	Moderate	Low.
SpB----- Speck	D	None-----	---	---	14-20	Hard	---	---	High----	Low.
TaC*----- Tarrant	D	None-----	---	---	6-20	Hard	---	---	High----	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
					<u>In</u>		<u>In</u>			
TrG#: Tarrant----- Rock outcrop.	D	None-----	---	---	6-20	Hard	---	---	High-----	Low.
VaB----- Valera	C	None-----	---	---	21-52	Hard	20-40	Thick	High-----	Low.

\* See description of the map unit for composition and behavior characteristics of the map unit.



TABLE 16.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Brackett-----	Loamy, carbonatic, thermic, shallow Typic Ustochrepts
Cho-----	Loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls
Dev-----	Loamy-skeletal, carbonatic, thermic Cumulic Haplustolls
Eckert-----	Loamy-skeletal, mixed, thermic Lithic Haplustolls
Eckrant-----	Clayey-skeletal, montmorillonitic, thermic Lithic Haplustolls
Frio-----	Fine, mixed, thermic Cumulic Haplustolls
Hext-----	Coarse-loamy, mixed, thermic Typic Ustochrepts
Kavett-----	Clayey, montmorillonitic, thermic, shallow Petrocalcic Calciustolls
Latom-----	Loamy, mixed (calcareous), thermic Lithic Ustic Torriorthents
Menard-----	Fine-loamy, mixed, thermic Typic Haplustalfs
Nuvalde-----	Fine-silty, mixed, thermic Typic Calciustolls
Oakalla-----	Fine-loamy, carbonatic, thermic Cumulic Haplustolls
*Oben-----	Loamy, mixed, thermic, shallow Udic Haplustalfs
Purves-----	Clayey, montmorillonitic, thermic Lithic Calciustolls
Real-----	Loamy-skeletal, carbonatic, thermic, shallow Typic Calciustolls
Rioconcho-----	Fine, mixed, thermic Vertic Haplustolls
Shep-----	Fine-loamy, mixed, thermic Typic Ustochrepts
Speck-----	Clayey, mixed, thermic Lithic Argiustolls
Tarrant-----	Clayey-skeletal, montmorillonitic, thermic Lithic Calciustolls
Valera-----	Fine, montmorillonitic, thermic Petrocalcic Calciustolls



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