United States Department of Agriculture

Soil Conservation Service

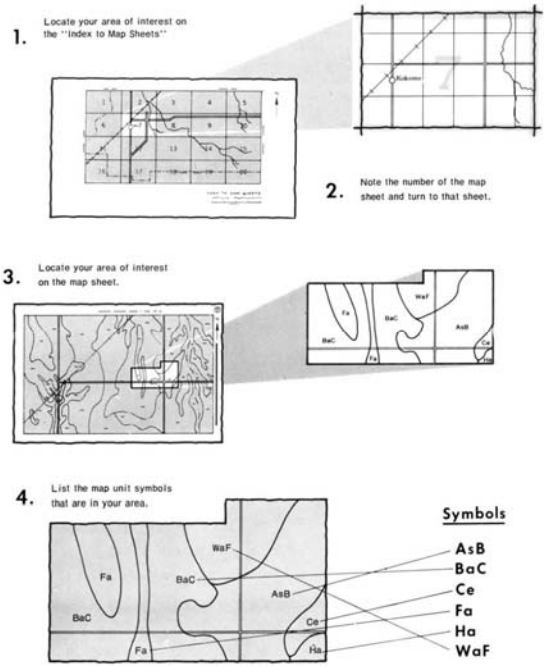
In cooperation with Texas Agricultural Experiment Station

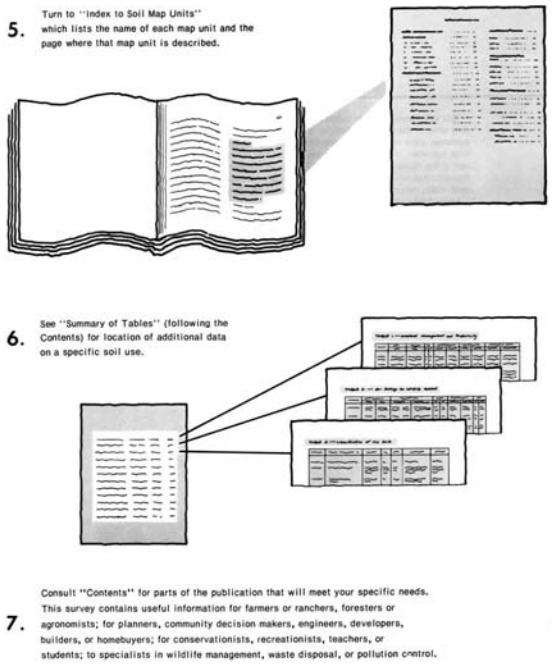
Soil Survey of Dimmit and Zavala Counties, Texas

ELECTRONIC VERSION

This soil survey is an electronic version of the original printed copy, dated November 1985. It has been formatted for electronic delivery. Additional and updated information may be available from the Web Soil Survey. In Web Soil Survey, identify an Area of Interest (AOI) and navigate through the AOI Properties panel to learn what soil data is available.

How To Use This Soil Survey





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 completed in 1981. Soil names and descriptions were approved in 1982. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981. 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 Dimmit County Soil and Water Conservation District and the Winter Garden 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: Irrigated spinach to be canned is being harvested by machine on Uvalde silty clay loam, 0 to 1 percent slopes.

Contents

Soil Series

Issued November 1985

Index to Map Units

Summary of Tables

Foreword

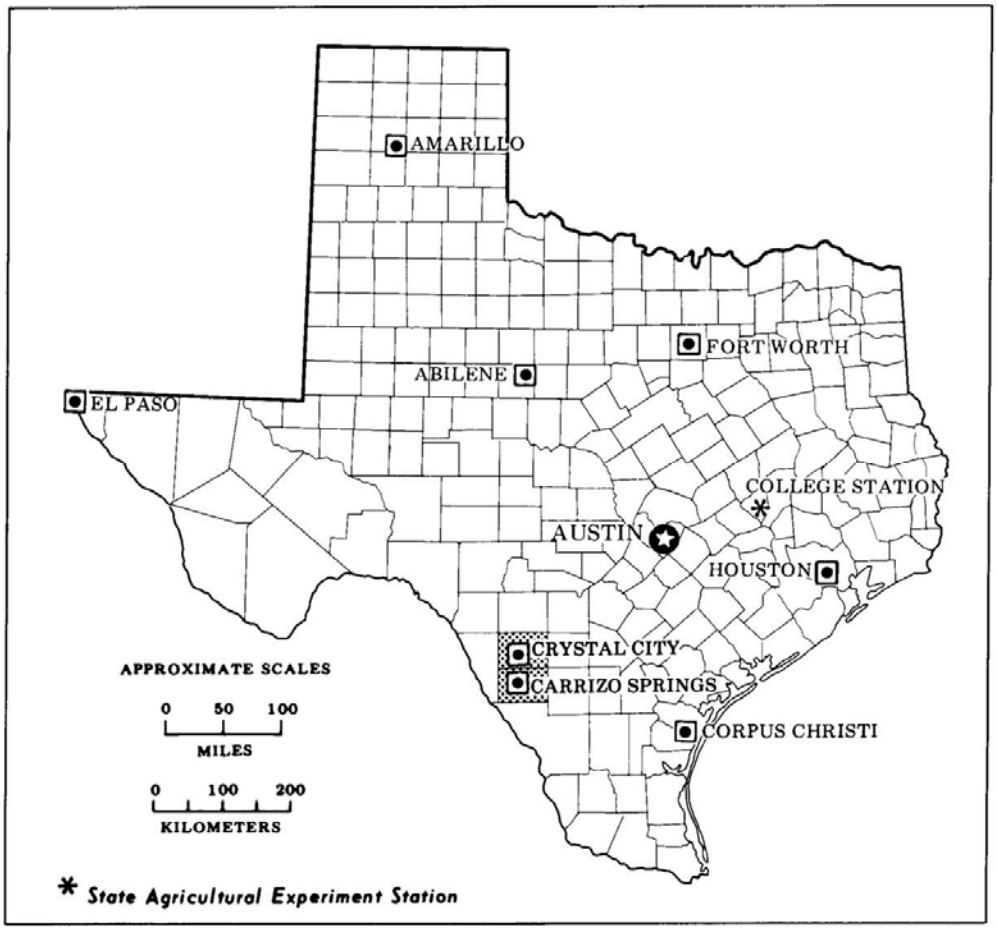
This soil survey contains information that can be used in land-planning programs in Dimmit and Zavala Counties. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and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

Billy C. Griffin
State Conservationist
Soil Conservation Service



Location of Dimmit and Zavala Counties in Texas.

Soil Survey of Dimmit and Zavala Counties, Texas

By Jack W. Stevens and Daniel Arriaga,
Soil Conservation Service
United States Department of Agriculture,
Soil Conservation Service
in cooperation with
Texas Agricultural Experiment Station

Dimmit and Zavala counties are in southwestern Texas. They are in the northwestern part of the Rio Grande Plain Land Resource Area.

The survey area is 2,636 square miles, or 1,687,040 acres. The surface is mostly nearly level to undulating; however, in a few places it is rolling. The survey area slopes gently from an elevation of about 830 feet in the northwestern part of Zavala County to an elevation of about 550 feet in the southeastern part of Dimmit County. Most of the water flows in a southeastern direction. The Nueces River is the major drainageway in the county. The Leona River flows through Zavala County, and a number of sizeable creeks drain the survey area.

Crystal City is the county seat of Zavala County, and Carrizo Springs is the county seat of Dimmit County. Ranching and irrigated farming are the major enterprises in the county. About 89 percent of the survey area is rangeland; slightly over 9 percent is used for crops, pasture, hay, and orchards; and slightly less than 2 percent is urban areas, roadways, farmsteads, and miscellaneous uses.

U.S. Highway 83 crosses the survey area from north to south. U.S. Highway 57 crosses Zavala County from west to east through La Pryor and Batesville, and U.S. Highway 277 crosses Dimmit County from the west to Carrizo Springs. Texas Highway 85 crosses Dimmit County from the east to Carrizo Springs. A large number of farm and ranch roads also are in the survey area.

The first soil survey of Dimmit County was published in 1943 *(6).* The first soil survey of Zavala County was published in 1940 *(5).* This soil survey updates these two soil surveys and provides additional information.

General Nature of the Survey Area

The settlement and population, agriculture, natural resources, and climate are discussed in this section.

Settlement and Population

Dimmit County was organized in 1880, and Zavala County in 1884. Before that time, a number of expeditions were made into and across the survey area. Based on the many observations of explorers in these early expeditions, apparently the vegetation on the uplands was primarily grass, interspersed with a small amount of scattered brush. Areas along creeks, however, were quite brushy and brushy thickets were on the flats near streams. The area abounded in wildlife.

Early settlers moved into the area during the 1860's and 1870's. The number of cattle and sheep rapidly increased. This increase caused the grasses to be severely overgrazed, so brush increased.

The estimated population of Dimmit County in 1977 was 11,000. Carrizo Springs, the county seat, had a population of 6,491. Smaller towns in Dimmit County are

Asherton, which had a population of 1,965, and Big Wells, which had a population of 1,116.

The estimated population of Zavala County in 1977 was 11,500. The county seat is Crystal City, which had a population of 8,075. Smaller towns or communities in the county are La Pryor and Batesville.

Agriculture

Livestock is the major agricultural enterprise in Dimmit and Zavala Counties. Beef cattle is the major type of livestock; however, a few goats and sheep are raised. Most ranches are cow-calf operations but some have stocker cattle. Ranch income is supplemented by hunting leases for deer, turkey, quail, and dove.

Irrigated farming is important to the economy of the area. The major irrigated crops are cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables. Irrigated acreage in the survey area has decreased slightly during the past 10 to 20 years. It has decreased considerably during this time in Dimmit County, but has slightly increased in Zavala County. Interest in pecan planting has increased considerably in recent years.

Natural Resources

Soil is one of the most important natural resources in the two-county survey area. The production of food and fiber is the major source of livelihood for the people. Because the soils in the area are varied, the types of agricultural production are diverse.

Deep and shallow wells provide a good supply of irrigation water. The Nueces River also furnishes irrigation water. The major sources of underground irrigation water are the Carrizo Sand Aquifer, which is several hundred feet below ground surface, and the Leona Gravel Aquifer, which is shallower and usually 50 to 100 feet below ground surface *(10).* The depth to the Carrizo Sand Aquifer increases from La Pryor in Zavala County to the southeastern part of Dimmit County. The quality of the water in the Carrizo Sand Aquifer decreases as the depth to water increases. The decrease in quality is caused mainly by higher amounts of totally dissolved solids and a higher sodium content.

Oil and gas production is considerable. It is scattered throughout the two-county area. Oil and gas are a major resource. Producers explore, drill, and process oil and gas. Lignite and coal are in the area.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Crystal City, Texas, in the period 1951 to 1978. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 55 degrees F, and the average daily minimum temperature is 43 degrees. The lowest temperature on record, which occurred at Crystal City on January 12, 1962, is 11 degrees. In summer the average temperature is 85 degrees, and the average daily maximum temperature is 97 degrees. The highest recorded temperature, which occurred at Crystal City July 29, 1954, is 109 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 21.54 inches. Of this, 14 inches, or 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 10 inches. The heaviest 1-day rainfall during the period of record was 6.83 inches at Crystal City on October 4, 1959. Thunderstorms occur on about 45 days each year, and most occur in spring.

Snowfall is rare. In 90 percent of the winters, there is no measurable snowfall. In 10 percent, the snowfall, usually of short duration, is more than 2 inches. The heaviest 1-day snowfall on record was more than 2 inches.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 80 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the southeast. Average wind speed is highest, 11 miles per hours, in spring.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another resulting in gradual changes in characteristics. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavioral different enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation to precisely define and locate the soil is needed to plan for intensive uses in small areas.

General Soil Map Units

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. Uvalde-Bookout-Montell

Deep, nearly level to gently sloping and gently undulating, moderately permeable to very slowly permeable, loamy and clayey soils; on uplands

These smooth soils are in broad areas on old terraces. Slopes are dominantly less than 1 percent but range to 5 percent. The Montell soils are slightly lower on the landscape than the Uvalde and Bookout soils (fig. 1).

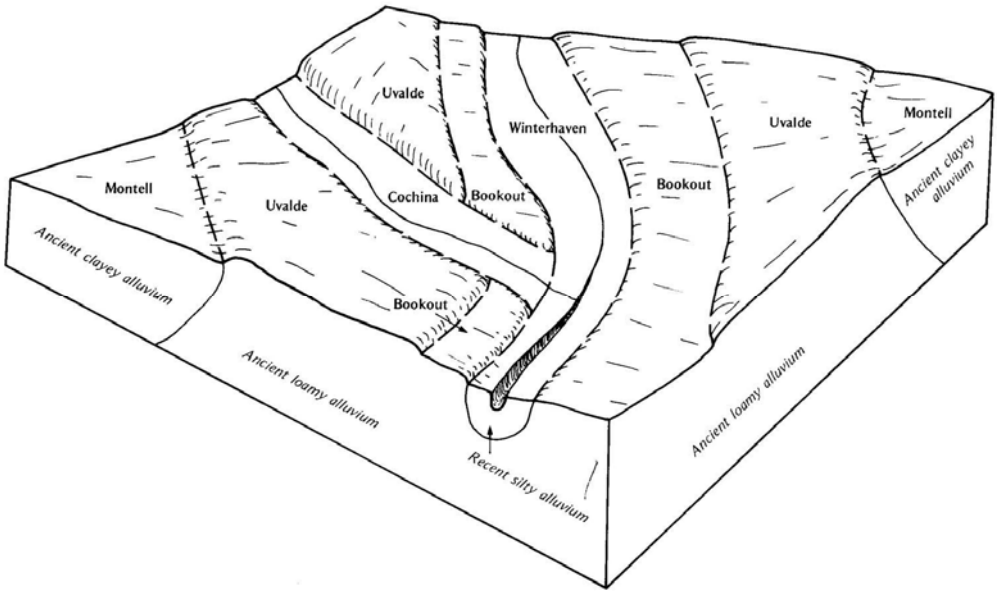


Figure 1.—Pattern of soils and underlying materials of the Uvalde-Bookout-Montell unit and the Cochina-Winterhaven unit.

This unit makes up about 21 percent, or about 360,000 acres, of the survey area. It is about 32 percent Uvalde soils, about 16 percent Bookout soils, and about 15 percent Montell soils. The remaining 37 percent is soils of minor extent.

Typically, the surface layer of the Uvalde soils is dark grayish brown, friable silty clay loam about 17 inches thick. The subsoil is about 33 inches thick. The upper 17 inches is brown, firm silty clay loam. The lower 16 inches is very pale brown, friable silty clay loam and has many small, hard masses of calcium carbonate. The

underlying material is very pale brown silty clay loam that has a few small masses of calcium carbonate. These soils are calcareous and moderately alkaline throughout.

Typically, the surface layer of the Bookout soils is pale brown, friable clay loam about 14 inches thick. The subsoil is pale brown, friable clay loam from 14 to 24 inches. It is very pale brown, friable to firm clay and silty clay from 24 and 64 inches. It has many soft masses and concretions of calcium carbonate. The subsoil is pink silty clay to a depth of 80 inches. These soils are moderately alkaline and calcareous throughout.

Typically, the surface layer of the Montell soils is gray, very firm clay about 19 inches thick. The subsoil is grayish brown, very firm clay about 21 inches thick. The underlying material is very pale brawn clay that has by volume about 5 percent visible calcium carbonate and gypsum. These soils are moderately alkaline and calcareous throughout.

Of minor extent are Batesville, Caid, Chacon, Cochina, Cotulla, Olmos, Pryor, Tonio, and Valco soils, Batesville, Caid, Chacon, Cotulla, Pryor, and Tonio soils are on old terraces. Cochina soils are in lower positions adjacent to the drainageways. Olmos and Valco soils are on the ridges.

This unit is used mainly as rangeland and for wildlife habitat. Large areas of the Uvalde and Bookout soils and smaller areas of the Cotulla soils are used as irrigated cropland. The main irrigated crops are grain sorghum, corn, cotton, and a variety of truck crops. This unit is generally suited to nonirrigated farming. Because of the climatic limitations of low rainfall and high evaporation, however, very little is dryfarmed. A great percentage of these soils could be irrigated in areas where an adequate water supply is available.

These soils range from moderately well suited to poorly suited to most urban uses. Shrinking and swelling with changes in soil moisture, low strength, and corrosivity of uncoated steel are the major limiting features for most urban uses.

These soils are moderately well suited to wildlife habitat. The wildlife species mostly include deer, javelina, scaled quail, bobwhite quail, and mourning dove. They are plentiful in most years.

2. Duval-Webb-Brystal

Deep, nearly level to gently sloping and gently undulating, moderately permeable and moderately slowly permeable, loamy soils; on uplands

These soils are in broad areas. Slopes range from 0 to 3 percent but dominantly are 1 to 3 percent. The Duval and Brystal soils are slightly higher on the landscape than the Webb soils (fig. 2).

This unit makes up about 19 percent, or about 320,000 acres, of the survey area. It is about 30 percent Duval soils, about 15 percent Webb soils, and about 14 percent Brystal soils. The remaining 41 percent is soils of minor extent.

Typically, the surface layer of the Duval soils is reddish brown, slightly acid, very friable fine sandy loam about 15 inches thick. The next layer is red, slightly acid to neutral, friable sandy clay loam about 23 inches thick. The next 12 inches is yellowish red, mildly alkaline to moderately alkaline sandy clay loam. The underlying material below a depth of 50 inches is yellow, soft sandstone that has thin seams of calcium carbonate.

Typically, the surface layer of the Webb soils is reddish brown, very friable fine sandy loam about 10 inches thick. The subsoil is 30 inches thick. The upper 3 inches is reddish brown, friable sandy clay loam. The lower 27 inches is red, very firm sandy clay. The underlying material is yellowish red sandy clay loam that has many films and threads of calcium carbonate. It has a few sandstone fragments. The surface layer and subsoil are slightly acid, and the underlying material is calcareous and moderately alkaline.

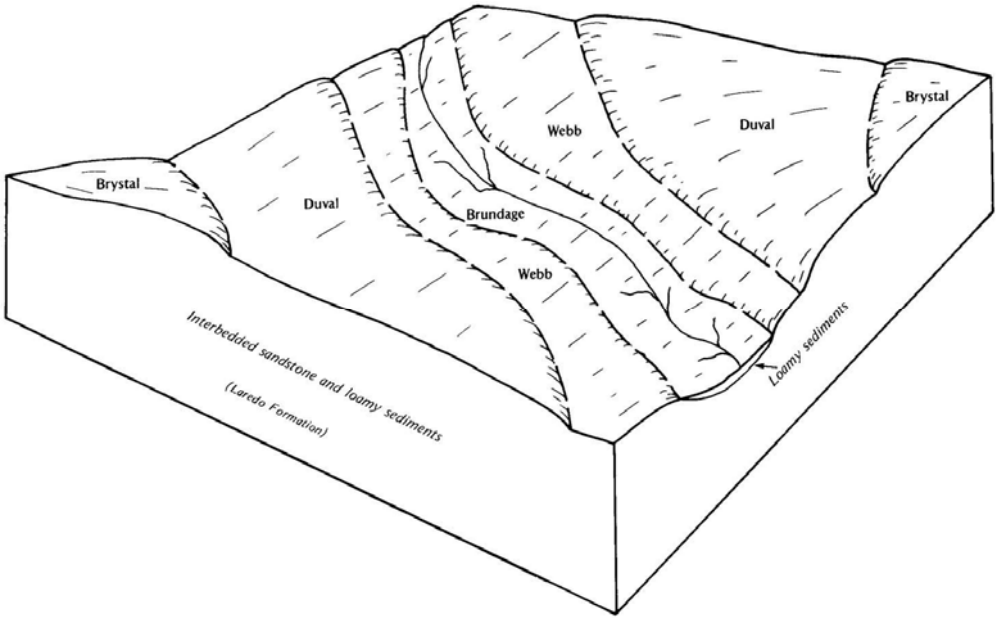


Figure 2.—Pattern of soils and underlying material of the Duval-Webb-Brystal unit and the Brundage unit.

Typically, the surface layer of the Brystal soils is brown, neutral, very friable fine sandy loam about 7 inches thick. The upper part of the subsoil is reddish brown, neutral, friable sandy clay loam from 7 to 24 inches. The middle part is yellowish red and reddish yellow, mildly alkaline, friable sandy clay loam from 24 to 44 inches. The lower part is very pale brown, moderately alkaline sandy clay loam to a depth of 72 inches. It is about 10 percent masses of calcium carbonate.

Of minor extent are Brundage, Caid, Dilley, Hindes, Poteet, Randado, Tiocano, Tonio, Yologo, and Zavco soils. Brundage, Poteet, and Zavco soils are in low positions close to drainageways. Tiocano soils are in ponded areas. Dilley, Hindes, Yologo, and Randado soils are on the higher parts of the landscape.

This unit is used almost exclusively as rangeland and for wildlife habitat. A few small areas are cropland and in pasture. Because of the low, variable, annual rainfall, these soils have only fair suitability for nonirrigated cropland and pasture. They are well suited to irrigated cropland and pasture where irrigation water is available.

These soils are moderately well suited to well suited to most urban uses. Corrosion of uncoated steel is a problem throughout the unit. Shrink-swell properties and low strength are problems on the soils that have a more clayey subsoil, such as the Webb soils.

These soils are well suited to wildlife habitat. Deer, javelina, scaled quail, bobwhite quail, and mourning dove are plentiful in good years.

3. Maverick-Catarina-Pryor

Moderately deep to deep, nearly level to gently undulating, slowly permeable and very slowly permeable, clayey and loamy soils; on uplands

These soils are in broad areas. Slopes range from 0 to 5 percent but dominantly are 1 to 5 percent. The Maverick soils are slightly higher on the landscape than the Pryor and Catarina soils. The Pryor soils are slightly higher than the Catarina soils (fig. 3).

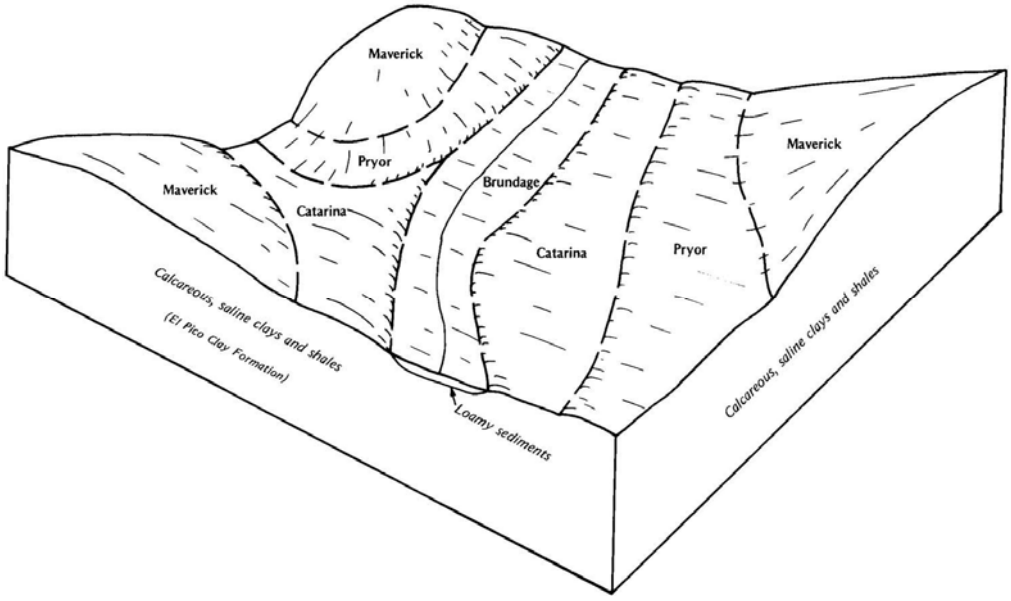


Figure 3.—Pattern of soils and underlying materials of the Maverick-Catarina-Pryor units and the Brundage unit.

This unit makes up about 12 percent, or 200,000 acres, of the survey area. It is about 40 percent Maverick soils, about 18 percent Catarina soils, and about 10 percent Pryor soils. The remaining 32 percent is soils of minor extent.

Typically, the surface layer of the Maverick soils is 6 inches of grayish brown, firm clay loam. The subsoil is 22 inches thick. It is very firm clay that is pale brown in the upper part and light yellowish brown in the lower part. Light yellowish brown shale is at a depth of 28 inches.

Typically, the surface layer of the Catarina soils is brown, very firm clay about 26 inches thick. The next layer is light yellowish brown, extremely firm clay about 32 inches thick. It has a few calcium carbonate masses and salt threads. The underlying material is yellow clay that has a few lime masses and a few gypsum crystals. The soils are moderately alkaline and calcareous throughout.

Typically, the surface layer of the Pryor soils is grayish brown, friable sandy clay loam about 9 inches thick. The upper part of the subsoil is firm clay from 9 to 32 inches. It is brown in the upper part and pale brown in the lower part. The lower part of the subsoil is light yellowish brown, firm clay from 32 to 46 inches. The underlying material is very pale brown, clayey shale. These soils are calcareous and moderately alkaline throughout.

Of minor extent are Brundage, Chacon, Cotulla, Montell, Olmos, Tonio, Uvalde, and Verick soils. Brundage and Montell soils are in the lower parts of the area. Brundage soils are mostly adjacent to drainageways. The Olmos and Verick soils are on the ridges.

This unit is used almost exclusively as rangeland and for wildlife habitat. A few very small areas are cropland or in pasture. These soils are poorly suited to nonirrigated cropland and pasture because of the climatic conditions of low rainfall and high evaporation. They are also poorly suited because of their salinity. The Pryor soils are moderately well suited where irrigation water is available.

These soils are poorly suited to most urban uses. Shrinking and swelling with changes in soil moisture, corrosivity of uncoated steel, low strength, and excess salts are the major limitations.

These soils are moderately well suited to wildlife habitat. Deer, javelina, scaled quail, bobwhite quail, and mourning dove are in this map unit, but they are more prevalent in other units that have deep soil.

4. Tonio-Pryor-Brystal

Deep, nearly level to gently sloping and gently undulating, moderately permeable to slowly permeable, loamy soils; on uplands

This unit consists of broad areas of mostly gently undulating soils. Slopes range from 0 to 3 percent but are dominantly 1 to 3 percent. These soils are in very similar positions on the landscape; however, Pryor soils are generally slightly lower than Tonio or Brystal soils (fig. 4).

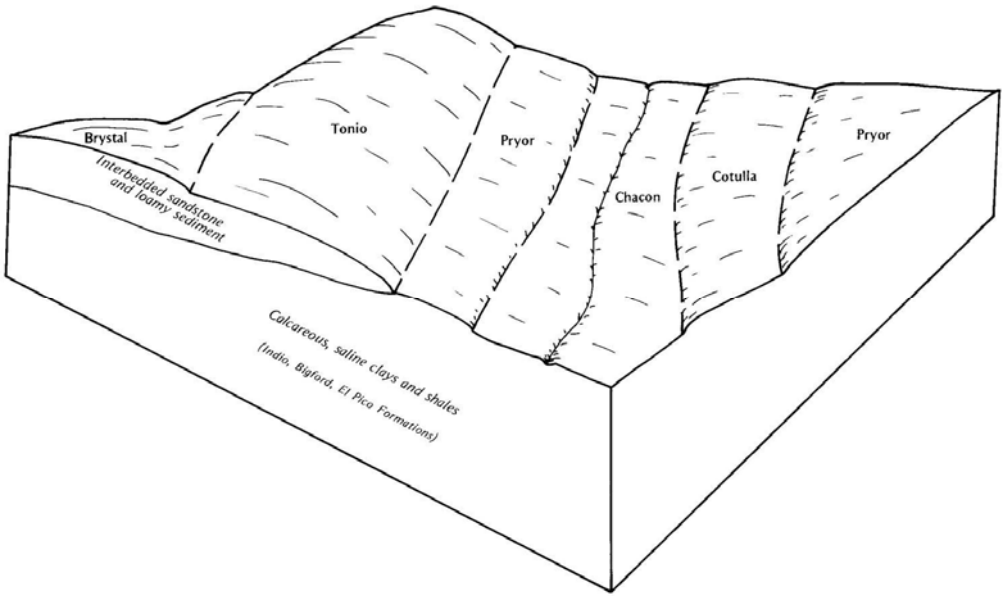


Figure 4.—Pattern and underlying materials in the Tonio-Pryor-Brystal unit and the Chacon-Cotulla-Pryor unit.

This unit makes up about 11 percent, or about 180,000 acres, of the survey area. Tonio soils make up about 38 percent, Pryor soils about 12 percent, and Brystal soils about 11 percent. The remaining 39 percent is soils of minor extent.

Typically, the surface layer of the Tonio soils is brown fine sandy loam about 10 inches thick. The subsoil is brown, friable sandy clay loam from 10 to 30 inches. It is sandy clay loam from 30 to 54 inches. This layer is light brown in the upper part and very pale brown in the lower part. The underlying material to a depth of 74 inches is weakly cemented sandstone.

Typically, the surface layer of the Pryor soils is grayish brown, friable sandy clay loam about 9 inches thick. The upper part of the subsoil is firm clay from 9 to 32 inches. This layer is brown in the upper part and pale brown in the lower part. The lower part of the subsoil is light yellowish brown, firm clay from 32 to 46 inches. The underlying material is very pale brown, clayey shale. These soils are calcareous and moderately alkaline throughout.

Typically, the surface layer of the Brystal soils is brown, neutral, very friable fine sandy loam about 7 inches thick. The subsoil is reddish brown, neutral, friable sandy clay loam from 7 to 24 inches. It is yellowish red and reddish yellow, mildly alkaline,

friable sandy clay loam from 24 to 44 inches. The lower part is very pale brown, moderately alkaline sandy clay loam to a depth of 72 inches. This part is about 10 percent masses of calcium carbonate.

Of minor extent are Brundage, Caid, Catarina, Chacon, Maverick, Montell, Olmos, Randado, Uvalde, and Verick soils. Brundage soils are adjacent to the drainageways. Caid, Catarina, Chacon, Montell, and Uvalde soils are in lower positions away from the drainageways. The Olmos, Randado, and Verick soils are on ridges.

This unit is used mostly as rangeland and for wildlife habitat. Only a few small areas are cropland or in pasture. Nonirrigated farming is questionable on these soils because of the low rainfall and the high evaporation. Where irrigation water is available, these soils would be moderately well suited to cropland or pasture.

The major limitations for most urban uses are the low strength of the soils and the corrosivity of uncoated steel.

These soils are well suited to wildlife habitat. Deer, javelina, scaled quail, bobwhite quail, and mourning dove are plentiful in most years.

5. Chacon-Cotulla-Pryor

Deep, nearly level to gently sloping and gently undulating, slowly permeable and very slowly permeable, loamy and clayey soils; on uplands

These soils are in broad areas. Slopes range from 0 to 3 percent but dominantly are 1 to 3 percent. The Chacon and Cotulla soils are in the lower parts of the landscape, and the Pryor soils are on slightly higher positions (see fig. 4).

This unit makes up about 9 percent, or 150,000 acres, of the survey area. It is about 35 percent Chacon soils, about 25 percent Cotulla soils, and 18 percent Pryor soils. The remaining 22 percent is soils of minor extent.

Typically, the surface layer of the Chacon soils is dark grayish brown, friable clay loam about 15 inches thick. The upper part of the subsoil is grayish brown, firm to very firm clay about 25 inches thick. The lower part is pale brown, very firm clay about 12 inches thick. The underlying material is very pale brown clay to a depth of about 66 inches. These soils are calcareous and moderately alkaline throughout.

Typically, the surface layer of the Cotulla soils is grayish brown, very firm clay about 20 inches thick. The soil is brown, very firm, saline clay from 20 to 32 inches. It is very firm, saline clay from 32 to 72 inches. This layer is light yellowish brown in the upper part, brownish yellow in the middle part, and very pale brown in the lower part. These soils are moderately alkaline and calcareous throughout.

Typically, the surface layer of the Pryor soils is grayish brown, friable sandy clay loam about 9 inches thick. The upper part of the subsoil is firm clay from 9 to 32 inches. This layer is brown in the upper part and pale brown in the lower part. The lower part of the subsoil is light yellowish brown, firm clay from 32 to 46 inches. The underlying material is very pale brown, clayey shale. These soils are calcareous and moderately alkaline throughout.

Of minor extent are Bookout, Brundage, Brystal, Caid, Maverick, Montell, Tonio, and Uvalde soils. Bookout, Caid, Montell, and Uvalde soils are in the lower parts of the landscape. Brundage soils also are in low areas adjacent to drainageways. Brystal and Maverick soils are on the higher parts.

This unit is used almost exclusively as rangeland and for wildlife habitat. A few small areas are cropland or in pasture. These soils are marginal for nonirrigated cropland because of the low rainfall and the high evaporation. These soils are moderately well suited to irrigated cropland and pasture.

These soils are limited for most urban uses because of shrinking and swelling with changes in soil moisture, low strength, and corrosivity of uncoated steel.

These soils are moderately well suited to wildlife habitat. Deer, javelina, scaled quail, bobwhite quail, and mourning dove are plentiful in most years.

6. Brundage

Deep, nearly level, very slowly permeable, loamy soils; in valleys

The major soil in the unit is in long, narrow areas adjacent to drainageways. Slopes range to 2 percent but are mostly less than 1 percent. Flooding ranges from occasional to frequent in the unit (see fig. 2 and fig. 3).

This unit makes up 8 percent, or 130,000 acres, of the survey area. The Brundage soils make up 85 percent of the unit. The remaining 15 percent is soils of minor extent.

Typically, the surface layer of the Brundage soils is brown, very friable fine sandy loam about 3 inches thick. The upper part of the subsoil is brown, firm sandy clay loam about 4 inches thick. It has columnar structure. Thin, light gray caps are on the columns. The middle part, about 19 inches thick, is light yellowish brown, firm sandy clay loam that has columnar structure. The lower part is very pale brown sandy loam about 16 inches thick. The underlying material is pale yellow sandy clay loam to a depth of 72 inches. It is about 10 percent masses of calcium carbonate. These soils are neutral in the surface layer and moderately alkaline below.

Of minor extent are Catarina, Chacon, Cochina, Cotulla, Montell, Pryor, and Tonio soils.

This unit is used as rangeland and for wildlife habitat. Most of the area is unsuitable for cropland and is poorly suited to pasture.

The major limitations for urban uses are flooding, shrinking and swelling with changes in soil moisture, low strength, and corrosivity of uncoated steel.

This soil is moderately well suited to wildlife habitat. Wildlife species include deer, javelina, scaled quail, bobwhite quail, and mourning dove.

7. Cochina-Winterhaven

Deep, nearly level, moderately permeable to very slowly permeable, clayey and loamy soils; on bottom lands

This unit consists of long, narrow areas of soils along the flood plain of the major drainageways. Slopes are less than 1 percent in a vast majority of the area. The Cochina soils are mostly along the large creeks. Winterhaven soils are along the river. Flooding ranges from rare to frequent in this map unit (see fig. 1).

This unit makes up 6 percent, or 105,000 acres, of the survey area. It is 45 percent Cochina soils and 40 percent Winterhaven soils. The remaining 15 percent is soils of minor extent.

Typically, the surface layer of the Cochina soils is grayish brown, very firm clay 34 inches thick. The soil is light brownish gray, very firm clay from 34 to 52 inches and is pale brown clay from 52 to 72 inches. The soil is moderately alkaline and calcareous throughout.

Typically, the surface layer of the Winterhaven soils is light brownish gray, friable silty clay loam 17 inches thick. The subsoil, about 19 inches thick, is pale brown, friable silty clay loam. The underlying material is very pale brown clay loam and loam to a depth of 72 inches. It has thin layers and pockets of darker silt loam, loam, and silty clay loam. These soils are calcareous and moderately alkaline throughout.

Of minor extent are Bookout, Brundage, Chacon, Conalb, Dev, and Divot soils. Bookout and Chacon soils are on the higher parts of the landscape. Brundage soils are along the smaller drainageways. Conalb and Dev soils are on flood plains along the river in the northern part of the survey area. Divot soils are also on flood plains.

This unit is used mostly as rangeland and for wildlife habitat. Large areas of the Winterhaven soils are irrigated cropland. Irrigated crops are mostly grain sorghum, corn, cotton, a variety of truck crops, and some pecan trees. The Cochina soils are

poorly suited to cropland but are moderately well suited to pasture. The Winterhaven soils are well suited to irrigated cropland or pasture.

These soils are poorly suited to moderately well suited to most urban uses. The major limiting features of these soils are flooding, shrinking and swelling with soil moisture changes, low strength, and corrosivity of uncoated steel.

These soils are moderately well suited to wildlife habitat. Deer, javelina, turkey, scaled quail, bobwhite quail, and mourning dove are plentiful in most years.

8. Yologo-Hindes-Maverick

Very shallow to moderately deep, gently undulating to undulating, moderately permeable to slowly permeable, very gravelly loamy soils; on uplands

These gently undulating to undulating soils are in broad areas on gravelly ridges separated by small drainageways. Slopes range from 1 to 8 percent. Yologo and Hindes soils are intermixed and are on caps and sides of the ridges. The Maverick soils are also on caps and sides of the gravelly ridges but are over a different type of geological formation.

This unit makes up about 5 percent, or 87,500 acres, of the survey area. It is 35 percent Yologo soils, 25 percent Hindes soils, and 15 percent Maverick soils. The remaining 25 percent is soils of minor extent.

Typically, the surface layer of the Yologo soils is reddish brown, friable, neutral very gravelly loam about 7 inches thick. The subsoil is 8 inches thick. It is reddish brown, friable, mildly alkaline, very gravelly sandy clay loam. The underlying material is whitish caliche that is indurated in the upper few inches.

Typically, the surface layer of the Hindes soils is reddish brown, friable, slightly acid very gravelly sandy clay loam about 9 inches thick. The subsoil layer is about 23 inches thick. It is reddish brown, firm, slightly acid very gravelly clay. The underlying material is pink, hard caliche.

Typically, the surface layer of the Maverick soils is brown, very gravelly, friable clay loam about 6 inches thick. The subsoil is about 22 inches thick. It is yellowish brown and light yellowish brown, firm clay. The underlying material is light gray shale. It is calcareous and moderately alkaline throughout.

Of minor extent are Brystal, Caid, Chacon, Dilley, Duval, Jimenez, Olmos, Poteet, Pryor, Randado, Uvalde, Valco, Verick, Webb, Zapata, and Zavco soils. The Jimenez and Verick soils are in the extreme southwestern part of the survey area. The other soils are mostly in the northeastern part of the survey area. Brystal, Caid, Chacon, Duval, Pryor, Uvalde, and Webb soils are along the foot slopes of the ridges or in the narrow valleys. Dilley, Olmos, Randado, and Valco soils are on the ridges. The Poteet and Zavco soils are along the drainageways.

This unit is used for rangeland and wildlife habitat. The soils are too shallow or too gravelly for cropland or pasture.

These soils are poorly suited to moderately well suited to most urban uses. The major limiting features in this unit are the gravelly surface, shallow depth, slope, shrink-swell characteristics, and corrosivity of uncoated steel. The Yologo and Hindes soils can be used as a source of caliche for construction purposes.

These soils are moderately well suited to wildlife habitat. Wildlife species include deer, javelina, scaled quail, bobwhite quail, and mourning dove.

9. Verick-Dilley-Randado

Shallow, gently undulating, moderately permeable, loamy soils; on uplands

These soils are on low hills. Slopes range from 1 to 5 percent. All of these soils are on the higher parts of the landscape (fig. 5). The Verick soils dominate the areas in the southwestern part of the survey area, and Dilley and Randado soils dominate the rest of the survey area.

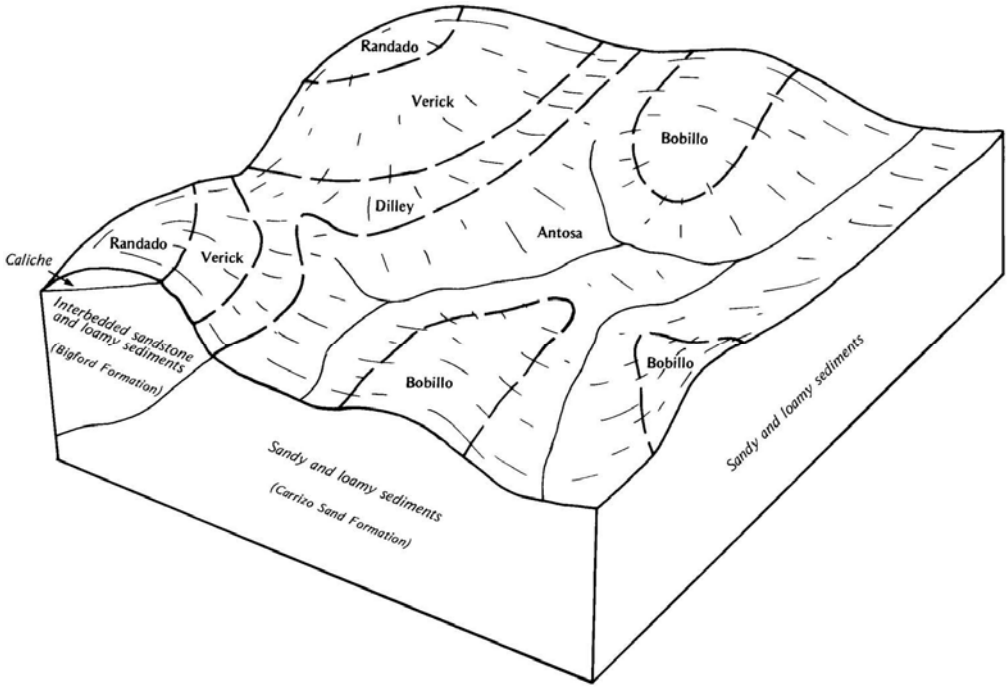


Figure 5.—Pattern of soils and underlying materials of the Verick-Dilley-Randado unit and the Antosa-Bobillo unit.

This unit makes up about 5 percent, or 87,500 acres, of the survey area. It is 40 percent Verick soils, 25 percent Dilley soils, and 20 percent Randado soils. The remaining 15 percent is soils of minor extent.

Typically, the surface layer of Verick soils is brown, very friable fine sandy loam 5 inches thick. The subsoil is pale brown, friable sandy clay loam about 12 inches thick. The underlying material is very pale brown, weakly cemented sandstone. These soils are calcareous and moderately alkaline throughout.

Typically, the surface layer of Dilley soils is yellowish red, neutral, very friable fine sandy loam about 5 inches thick. The subsoil is yellowish red and reddish yellow, friable fine sandy loam from 5 and 16 inches. It is neutral in the upper part and moderately alkaline in the lower part. The underlying material is weakly cemented sandstone.

Typically, the surface layer of Randado soils is yellowish red, very friable, mildly alkaline fine sandy loam about 7 inches thick. The subsoil is yellowish red, neutral sandy clay loam about 8 inches thick. The underlying material is caliche that is strongly cemented in the upper few inches.

Of minor extent are Brystal, Duval, Hindes, Jimenez, Maverick, Tonic, Valco, Webb, and Yologo soils. Brystal, Duval, Maverick, Tonic, and Webb soils are in the lower parts of the landscape, especially in the areas between the low hills. The Hindes, Yologo, and Jimenez soils are mainly on higher positions than the major soils. The Jimenez soils are mostly in the southwestern part of the survey area.

The soils of this unit are used as rangeland and for wildlife habitat. These soils are poorly suited to nonirrigated cropland or pasture. The Dilley and Randado soils are moderately well suited to irrigated cropland or pasture.

The most limiting feature for most urban uses is the shallow depth to sandstone or caliche. The Randado soils can be used as a source of caliche for construction purposes.

These soils are moderately well suited to wildlife habitat. Deer and javelina are in these areas, but they are more common in areas where soils are deeper. Scaled quail, bobwhite quail, and mourning dove also are in this map unit.

10. Antosa-Bobillo

Deep, gently undulating, moderately permeable and moderately slowly permeable, sandy soils; on uplands

These gently undulating soils are in broad areas or short narrow areas. Slopes range from 0 to 5 percent but dominantly are 2 or 3 percent. These two soils are very intermixed (see fig. 5).

This unit makes up about 4 percent, or 67,040 acres, of the survey area. It is about 55 percent Antosa soils and about 20 percent Bobillo soils. The remaining 25 percent is soils of minor extent.

Typically, the surface layer of the Antosa soils is pale brown and very pale brown, loose sand about 30 inches thick. The subsoil is light brownish gray, firm sandy clay from 30 to 38 inches. This upper part is mottled. The lower part to a depth of 72 inches is pale brown and very pale brown, firm sandy clay loam that is mottled. These soils are slightly acid in the upper part and mildly alkaline below.

Typically, the surface layer of the Bobillo soils is loose sand 58 inches thick. It is light yellowish brown in the upper part and very pale brown in the lower part. The subsoil to a depth of 80 inches is friable, mottled sandy clay loam. It is very pale brown in the upper part and grades to pale yellow. These soils are slightly acid to medium acid throughout.

Of minor extent are Brystal, Duval, and Poteet soils. The Brystal and Duval soils are in the lower part of the landscape, below the Antosa and Bobillo soils. If the Poteet soils are present, they are along the drainageways.

This unit is used mostly as rangeland and for wildlife habitat. A small acreage is presently in citrus orchards. The soils of this unit are poorly suited to cropland and pasture.

The sandy surface and wind erosion are the major limiting features for most urban uses.

These soils are moderately well suited to wildlife habitat. Deer are in these areas but in fewer numbers than on brushier sites. Scaled quail, bobwhite quail, and mourning dove also are in this unit.

Detailed Soil Map Units

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, Bookout clay loam, 0 to 1 percent slopes, is one of several phases in the Bookout 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. Dilley-Rock outcrop complex, 1 to 5 percent slopes, 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. Antosa-Bobillo association, gently undulating, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. A Dev soil, frequently flooded, is an undifferentiated group in this survey area.

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. Pits are an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 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

ABC—Antosa-Bobillo association, gently undulating. This association consists of deep, sandy soils on uplands. Slopes range from 0 to 5 percent but are mostly 2 to 3 percent. The areas are round to irregular in shape and are mainly 100 to 500 acres in size.

Antosa soils make up an average of 63 percent of the unit, but they range from 40 percent to as much as 80 percent of each mapped area. Bobillo soils average about 23 percent of the map unit but range from 10 to 60 percent. The rest of the area consists of Duval loamy fine sand, a sandy soil that has sandstone within 40 inches of the surface, and a sandy soil that has a reddish fine sandy loam subsoil. In most areas the soils could have been separated at the mapping scale used; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer of the Antosa soils is pale brown sand about 24 inches thick. The subsurface horizon is very pale brown, loose sand 6 inches thick. The upper part of the subsoil is 8 inches thick. It is light brownish gray sandy clay mottled in shades of red and yellow. The lower part is pale brown and very pale brown sandy clay loam to a depth of 72 inches. It is mottled in shades of red and

brown. These soils are slightly acid in the upper part, and they grade to mildly alkaline.

Typically, the upper layer of Bobillo soils is loose sand about 58 inches thick. It is light yellowish brown in the upper part and very pale brown in the lower part. The subsoil is sandy clay loam to a depth of 80 inches. It is very pale brown in the upper part and grades to pale yellow. The subsoil is mottled in shades of red, yellow, and gray. These soils are slightly acid to medium acid throughout.

The Antosa soil is moderately well drained, and the Bobillo soil is well drained. Surface runoff is very slow. Permeability is moderately slow in the Antosa soil and moderate in the Bobillo soil. Available water capacity is moderate in the Antosa soil and low in the Bobillo soil. Water erosion is a slight hazard, and wind erosion is a severe hazard.

The soils of this association are mostly used as rangeland and for wildlife habitat. A small acreage is in irrigated citrus orchards (fig. 6).

This association is poorly suited to cropland, pasture, and hay. The major limiting factors are the medium to low available water capacity, the hazard of wind erosion, and low rainfall. Citrus trees can be grown where the soils are irrigated, but they are subject to damage from periodic freeze.

In areas used as rangeland and for wildlife habitat, the potential plant community is open grassland of tall and mid grasses; a few, scattered mesquite trees; and infrequent live oak and bumelia or coma motts. Deer are in the area but are in lower numbers than in areas that have more brush. Only a few furbearing animals inhabit the areas. Scaled quail, bobwhite quail, mourning doves, and many songbirds are common. Various predators, such as the coyote, frequent the areas.

The sandy surface and soil blowing may present problems for some urban and recreational developments.

This soil is not assigned to a capability subclass. It is in the Sandy range site.

BAA—Batesville line sandy loam, nearly level. This moderately deep, loamy soil is on uplands. The surface is plane to slightly convex. Slope ranges from 0 to 1 percent. Areas of this soil are rounded and range from about 250 acres to more than 1,000 acres. There are only a few areas of this soil.

Batesville fine sandy loam and a Batesville soil that has a loam surface layer make up about 76 percent of the unit. The remaining 24 percent is mostly Randado fine sandy loam, Valco clay loam, and smaller amounts of Bookout, Brystal, and Uvalde soils. A few small areas that have slopes of more than 1 percent are on breaks to small drainageways. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of the soils.

Typically, the surface layer is dark brown, very friable fine sandy loam about 10 inches thick. The subsoil is about 18 inches thick. It is brown and light yellowish brown, friable sandy clay loam. The underlying material is caliche that is strongly cemented in the upper 4 inches and is softer with increasing depth. This soil is moderately alkaline and calcareous throughout.

This Batesville soil is well drained. Surface runoff is slow. Permeability is moderate above the caliche layer and slow in the caliche layer. Available water capacity is low. Rooting depth is limited by the caliche layer. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

This soil is mainly used as rangeland and for wildlife habitat.

This soil is moderately well suited to cropland, pasture, and hay. Management is similar to that of the Uvalde soils.

If this soil is used for rangeland and for wildlife habitat, the potential plant community is open grassland and occasional mesquite trees and woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer

and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit this map unit. Scaled quail, bobwhite quail, mourning dove, and many kinds of songbirds are in these areas. Predators, such as the coyote and bobcat, traverse the areas.

The major limiting features for most urban uses are shrinking and swelling of the soil with change in moisture; low strength, which affects roads and streets; a cemented pan; and corrosivity of uncoated steel. Recreational developments have no significant limitations.

This soil is not assigned to a capability subclass. It is in the Clay Loam range site.

Figure 6.—Irrigated citrus trees on Antosa-Bobillo association, gently undulating.

BkA—Bookout clay loam, 0 to 1 percent slopes. This deep, nearly level soil is

on uplands. The surface is plane to slightly convex. Areas of this soil are round to irregular in shape and range from about 50 acres to more than 500 acres in size.

Typically, the surface layer is pale brown, friable clay loam about 14 inches thick. The upper part of the subsoil is pale brown, friable clay loam from 14 to 24 inches. The middle part is very pale brown, friable to firm clay and silty clay from 24 and 64 inches. It has many soft masses and concretions of calcium carbonate. The lower part is pink silty clay to a depth of 80 inches. The soil is moderately alkaline and calcareous throughout.

This Bookout soil is well drained. Surface runoff is slow. Permeability is moderate. Available water capacity is high. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

Included with this soil in mapping are small areas of Caid, Tonio, Uvalde, and Valco soils. These soils have a darker surface layer than the Bookout soil. The Tonio and Valco soils are in slightly higher positions on the landscape. Also included are small areas of gently sloping Bookout soils. The included soils make up less than 15 percent of a mapped area.

This soil is used mostly as irrigated cropland. Small areas are used for nonirrigated crops and for irrigated and nonirrigated pasture and hay. Some areas are rangeland and in wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated land. Where the soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. The lime in the soil might cause chlorosis, the yellowing of leaves of plants, in some crops. Amendments of iron can be used to control chlorosis. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited to irrigated pasture and hay. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are numerous where cover is adequate. A few furbearing animals inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. Bobwhite quail and mourning dove frequently are along field borders and in grain fields.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational developments have no significant limitations.

This soil is in capability subclass IIIc, nonirrigated, and capability class I, irrigated. It is in the Clay Loam range site.

BkB—Bookout clay loam, 1 to 3 percent slopes. This deep, gently sloping soil is on uplands. The surface is convex. Areas of this soil are irregular to round in shape and range from about 25 to 300 acres in size.

Typically, the surface layer is pale brown, very friable clay loam about 5 inches

thick. The soil is pale brown, friable clay from 5 and 14 inches. The subsoil is very pale brown, friable clay from 14 to 64 inches. A few masses of calcium carbonate are in the lower part. The soil is moderately alkaline and calcareous throughout.

This Bookout soil is well drained. Surface runoff is medium. Permeability is moderate. Available water capacity is high. The hazards of water erosion and wind erosion are moderate.

Included with this soil in mapping are small areas of Caid, Tonio, Uvalde, and Valco soils. These soils have a darker surface layer than the Bookout soil. Also included are small areas of nearly level Bookout soils and areas of Bookout soils where slopes are more than 3 percent. The included soils make up less than 15 percent of a mapped area.

This soil is used mostly as irrigated cropland. Small areas are used for nonirrigated crops and for irrigated and nonirrigated pasture and hay. Some areas are rangeland and in wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland.

In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory from nonirrigated cropland. Low rainfall limits yields from nonirrigated cropland. If the soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, and pecan trees are grown successfully. The lime content might cause chlorosis, the yellowing of leaves of plants, in some crops. This can be controlled with amendments of iron. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. Terraces, contour farming, and grassed waterways help control water erosion. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited to irrigated pasture and hay. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful in brushy areas. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational developments have no significant limitations.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Clay Loam range site.

BkC—Bookout clay loam, 3 to 5 percent slopes. This deep, gently sloping soil is on uplands. The surface is convex. Areas of this soil are irregular to round in shape and range from about 20 to 150 acres in size.

Typically, the surface layer is grayish brown, friable clay loam about 10 inches thick. The upper part of the subsoil is pale brown, friable clay loam from 10 to 26 inches. The lower part is very pale brown, friable clay from 26 to 60 inches. A few masses of calcium carbonate are in the lower part. The soil is moderately alkaline

and calcareous throughout.

This Bookout soil is well drained. Surface runoff is medium. Permeability is moderate. Available water capacity is high. Water erosion is a severe hazard, and wind erosion is a moderate hazard.

Included with this soil in mapping are small areas of Bookout soils that have slopes of less than 3 percent. Also included are small areas of Caid and Tonio soils. The included soils make up less than 10 percent of a mapped area.

This soil is used mostly as cropland or is in pasture and hay. A few small areas are used as rangeland and for wildlife habitat.

This soil is poorly suited to irrigated and nonirrigated cropland. Wheat or other cool-season forage crops, grain sorghum, and forage sorghum are the major irrigated and nonirrigated crops. Low rainfall limits yields from nonirrigated cropland. The lime content may cause chlorosis, the yellowing of the leaves of the plant. This can be controlled by application of amendments of iron. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on or near the surface. Terraces, contour farming, and grassed waterways help control water erosion. If this soil is irrigated, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to pasture and hay. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning doves, and many songbirds are in these areas.

The main limiting features for most urban uses are shrinking and swelling with changes in soil moisture and corrosivity of uncoated steel. Recreational developments have no significant limitations.

This soil is in capability subclass IVe, nonirrigated, and IIIe, irrigated. It is in the Clay Loam range site.

BOB—Bookout clay loam, gently undulating. This deep, loamy soil is on uplands. The surface is plane to convex. Slopes range from 0 to 5 percent but are mostly 0 to about 2 percent. Areas of this soil are irregular to round in shape and range from about 100 acres to over 1,000 acres in size.

Bookout clay loam, 0 to 1 percent slopes, makes up about 50 percent of the map unit. Bookout clay loam, 1 to 3 percent slopes, makes up about 30 percent, and Bookout clay loam, 3 to 5 percent slopes, makes up about 5 percent. The remaining 15 percent is made up of Caid, Pryor, Tonio, Uvalde, and Valco soils. Caid and Uvalde soils are darker in color. Pryor, Tonio, and Valco soils are on slightly higher positions. Pryor soils are more clayey than the Bookout soils, and Tonio soils are more sandy. Valco soils are shallow over caliche. The composition of this map unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer is brown clay loam about 12 inches thick. The upper part of the subsoil is light yellowish brown clay from 12 to 26 inches. The subsoil is very pale brown clay from 26 to 40 inches. The lower part is very pale brown clay to a depth of 64 inches. It is about 10 percent soft masses and concretions of calcium carbonate. The soil is moderately alkaline and calcareous throughout.

This Bookout soil is well drained. Surface runoff is slow to medium. Available water capacity is high. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

The soil is used mostly as rangeland and for wildlife habitat.

The potential plant community is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational developments have no significant limitations.

This soil is not assigned to a capability subclass. It is in the Clay Loam range site.

Br—Brundage fine sandy loam, occasionally flooded. This deep, nearly level, loamy soil is on terraces adjacent to small creeks. The surface is mainly concave to plane, but there are a few convex knolls. Slopes average about 0.5 percent and range from 0 to 1 percent. Areas are mainly long and narrow and parallel the small creeks. They range from about 50 to 500 acres. This soil is occasionally inundated by large overflow from the small creeks after heavy, short rains. The water remains on the soil for only a few hours after rainfall ceases.

Typically, the surface layer is yellowish brown, slightly acid, very friable fine sandy loam about 4 inches thick. The upper part of the subsoil is yellowish brown and light yellowish brown, moderately alkaline, firm sandy clay loam from 4 to 26 inches. The middle part is yellow, calcareous, firm sandy clay loam from 26 to 34 inches. The lower part is yellow, calcareous sandy clay loam to a depth of 62 inches. It has a few, soft masses of calcium carbonate.

This Brundage soil is moderately well drained. Permeability is very slow. Surface runoff is slow. Available water capacity is low. The subsoil is moderately affected to strongly affected by salts and sodium. This affects the available water capacity; therefore, this soil is droughty. Surface crusting and the tight subsoil caused by the high sodium, limit movement of water in these soils. Because of their low position in the landscape, this soil receives runoff from the surrounding uplands. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

Included with this soil in mapping are a few areas of Chacon, Pryor, and Tonio soils, which generally are on slightly higher parts of the landscape. A few areas of the frequently flooded Brundage soil also are included. The A few areas of the frequently flooded Brundage soil also are included. The included soils make up less than 15 percent of a mapped area.

This soil is mostly used as rangeland and for wildlife habitat. A few small areas are in nonirrigated pasture and hay, and a few small areas are irrigated cropland or in pasture and hay.

This soil is not suited as nonirrigated cropland because of low rainfall and salinity. It is poorly suited to irrigated cropland. Cotton, corn, grain sorghum, wheat, and truck crops have been grown under irrigation. A cropping system that provides cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. This is done by keeping crop residue on or near the soil surface. A well designed irrigation system and proper management of irrigation water help control soil and water losses and help minimize the hazard of salt accumulation in the soil. Leaching of the soil is needed where salt builds up. Applications of gypsum increase water movement in the soil and improve

irrigation efficiency.

This soil is poorly suited to pasture and hay. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is grassland of mid and short grasses and a few woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are common. A few furbearing animals inhabit these areas. Scaled quail, bobwhite quail, mourning doves, and many songbirds are in these areas. A few predators, such as the coyote and bobcat, frequent the areas.

The main limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Excess sodium and salt in the soil are limiting features that affect recreational developments.

This soil is in capability subclass VIs, nonirrigated, and IIIs, irrigated. It is in the Claypan Prairie range site.

Bu—Brundage fine sandy loam, frequently flooded. This is a deep, nearly level, loamy soil on low terraces adjacent to small creeks. The surface is mostly concave to plane, but there are a few, convex knolls. Areas are long and narrow and range from about 100 acres to more than 1,000 acres. Slopes average about 0.5 percent but range from 0 to 1 percent. Most small creeks that transect this soil have several, meandering, narrow, shallow channels. Areas of soil that are crusted over are common between the channels. This soil is frequently flooded from the small creeks after rainstorms. The water remains on the soil for several hours after rainfall ceases.

Typically, the surface layer is brown, very friable fine sandy loam about 3 inches thick. The upper part of the subsoil is brown, firm sandy clay loam from 3 to 7 inches. It has columnar structure. Thin, light gray caps are on the columns. The subsoil is light yellowish brown sandy clay loam from 7 to 26 inches. It also has columnar structure. The middle part is very pale brown, calcareous sandy clay loam from 26 to 42 inches. The lower part is pale yellow sandy clay loam to a depth of 72 inches. It has about 10 percent masses of calcium carbonate. This soil is neutral in the surface layer and moderately alkaline below.

This Brundage soil is moderately well drained. Permeability is very slow. Surface runoff is slow. Available water capacity is low. The subsoil is moderately affected to strongly affected by salts and sodium, which affect the available water capacity and cause the soil to be droughty. Surface crusting and the tight, very slowly permeable subsoil limit water movement in the soil. Because of their low position, these soils receive extra water as runoff from the surrounding uplands. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

Included with this soil in mapping are a few areas of Chacon, Pryor, and Tonio soils, which are generally on slightly higher parts of the landscape, and small areas of Montell soils, which are in low spots. These included soils make up less than 15 percent of a mapped area.

This soil is used mostly as rangeland and for wildlife habitat. This soil is not suited to use as cropland because of frequent flooding.

This soil is moderately well suited to nonirrigated pasture and hay. The principal grasses are improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass. The major limiting features, besides the frequent flooding, are very slow permeability, low available water capacity, and salinity. Proper management of

pasture and hay includes fertilization, weed control, controlled grazing, and proper

timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is grassland of mid and short grasses and a few woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are common. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning doves, and many songbirds are in the areas. A few predators, such as the coyote and bobcat, frequent the areas.

The main limiting features for most urban uses are flooding; shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. The major limiting features affecting recreational developments are excess sodium and salt in the soil.

This soil is in capability subclass Vw, nonirrigated, and the Claypan Prairie range site.

BxB—Brystal fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping soil is on uplands. The surface is convex. Mapped areas of this soil are round to irregular in shape and are mainly less than 50 acres in size.

Typically, the surface layer is brown, neutral, very friable fine sandy loam about 7 inches thick. The upper part of the subsoil is reddish brown, neutral, friable sandy clay loam from 7 to 24 inches. The middle part is yellowish red and reddish yellow, mildly alkaline, friable sandy clay loam from 24 to 44 inches. The lower part is reddish yellow, moderately alkaline sandy clay loam to a depth of 72 inches. It is about 10 percent masses of calcium carbonate.

This Brystal soil is well drained. Permeability is moderate, and surface runoff is medium. Available water capacity is moderate. Water erosion and wind erosion are moderate hazards.

Included with this soil in mapping are small areas of nearly level Brystal soils. Also included are small areas of Duval and Tonio soils. The Duval soils and this Brystal soil are in similar positions on the uplands. The Tonio soils are on slightly higher parts of the landscape. These included soils make up less than 15 percent of a mapped area.

This soil is mostly used as irrigated cropland. Small areas are used as nonirrigated cropland and rangeland or for pasture and hay.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum forage sorghum, sorghum, and wheat and other cool-season crops generally are satisfactory from nonirrigated cropland. Where the soil is irrigated, cotton, corn, grain sorghum, wheat, truck crops, especially winter vegetables, and some citrus and peanuts are grown successfully. A cropping system that provides cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on or near the surface. Terraces, contour farming, and grassed waterways may be needed in some areas. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited if irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland dominated by mid grasses and some forbs and woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are found where cover is adequate. A few furbearing animals, such as

opossum and raccoon, inhabit these areas. Bobwhite quail and morning dove are plentiful along field borders and in and around grain fields.

The major limiting features for most urban uses are low strength, which affects roads and streets, and corrosivity of uncoated steel. Recreational developments have no significant limitations.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Sandy Loam range site.

BYB—Brystal fine sandy loam, gently undulating. This deep, loamy soil is on uplands. The surface is convex. Slopes range from 0 to 3 percent. Areas of this soil are round to irregular in shape and range from about 75 acres to as much as 500 acres in size.

This unit is made up of about 60 percent Brystal soils that have slopes of 1 to 3 percent and about 13 percent a Brystal soil that has slopes of 0 to 1 percent. Duval soils make up about 23 percent of the unit. The remaining 4 percent is made up of such soils as Randado and Tonio. The Randado soils and the Tonio soils are mainly on the highest parts of the landscape. The composition of this association is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer is reddish brown, neutral, very friable fine sandy loam about 8 inches thick. The subsoil is reddish brown, neutral, friable sandy clay loam from 8 to 17 inches. The middle part is yellowish red and reddish yellow, friable sandy clay loam from 17 to 38 inches. It is mildly alkaline in the upper part and moderately alkaline in the lower part. The lower part of the subsoil is yellow, moderately alkaline sandy clay loam. It is about 25 percent by volume soft masses and concretions of calcium carbonate.

This Brystal soil is well drained. Permeability is moderate. Surface runoff is slow to medium. Available water capacity is moderate. Water erosion is a slight to moderate hazard, and wind erosion is a moderate hazard.

This soil is used mainly as rangeland and for wildlife habitat.

The potential plant community for rangeland and wildlife habitat is open grassland dominated by mid grasses and some forbs and woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Quail, mourning dove, and many songbirds are in these areas. Various predators, such as the coyote and bobcat, are also in the area.

The major limitations for most urban uses are low strength, which affects roads and streets, and corrosivity of uncoated steel. Recreational developments have no significant limitations.

This soil is not assigned to a capability subclass. It is in the Sandy Loam range site.

CaA—Caid sandy clay loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on uplands. The surface is mostly plane. Areas of this soil are round to irregular in shape and range from 15 to 200 acres in size.

Typically, the surface layer is brown, friable sandy clay loam about 12 inches thick. The upper part of the subsoil is yellowish brown, friable sandy clay loam from 12 to 28 inches. The lower part is very pale brown sandy clay loam to a depth of 64 inches. It has reddish yellow mottles and is about 10 percent by volume soft masses and concretions of calcium carbonate. This soil is moderately alkaline and calcareous throughout.

This Caid soil is well drained. Permeability is moderate, and surface runoff is slow. Available water capacity is moderate. Erosion is a slight hazard.

Included with this soil in mapping are a few small areas of gently sloping Caid soils, a few small areas of soil that is similar to the Caid soil but is more clayey

throughout, and another soil that is not calcareous throughout. Small pockets of Chacon and Uvalde soils in the lower parts of the landscape are also included. The included soils make up less than 15 percent of a mapped area.

This soil is used mainly as irrigated cropland. Small areas are used for nonirrigated cropland, rangeland and wildlife habitat, and pasture and hay.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated cropland. Where the soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on or near the soil surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated (fig. 7). Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

Figure 7.—Small grain, used for grazing, is irrigated by a sprinkler system. The soil is Caid sandy clay loam, 0 to 1 percent slopes.

The potential plant community for rangeland and wildlife habitat is open grassland

and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Javelina and deer are present. Several furbearing animals inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. Bobwhite quail and mourning dove are mostly along field borders and in grain fields.

The main limiting features of this soil for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Most recreational developments have only slight limitations.

This soil is in capability subclass IIIc, nonirrigated, and capability class I, irrigated. It is in the Clay Loam range site.

CaB—Caid sandy clay loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on uplands. The surface is convex. Slopes are mainly 1 to 2 percent. Areas of this soil are round or irregular in shape and are 10 to 100 acres in size.

Typically, the surface layer is brown, friable sandy clay loam about 10 inches thick. The upper part of the subsoil is light yellowish brown, friable sandy clay loam from 10 to 46 inches. The lower part to a depth of 64 inches is very pale brown sandy clay loam that has reddish yellow mottles. This soil is moderately alkaline and calcareous throughout.

This Caid soil is well drained. Permeability is moderate, and surface runoff is medium. Available water capacity is moderate. Water erosion is a moderate hazard.

Included with this soil in mapping are a few areas of nearly level Caid soils and a soil which is similar to Caid soils but is more clayey throughout. Small pockets of Brystal, Pryor, and Tonio soils are on slightly higher parts of the landscape. The included soils make up less than 15 percent of a mapped area.

This soil is mainly used as irrigated cropland. Small areas are used for nonirrigated cropland, pasture, hay, rangeland, and wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated cropland. Where the soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil is protected by keeping crop residue on and near the surface. Terraces, contour farming, and grassed waterways help control erosion in some areas. In irrigated areas, a well designed irrigation system and proper management of irrigation help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Javelina, deer, and several other furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and songbirds are in the areas. Bobwhite quail and mourning doves are plentiful along field borders and in and around grain fields. Various predators, such as the coyote, bobcat, and hawk, frequent the areas.

The main limiting features of this soil for most urban uses are shrinking and

swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Most recreational development has only slight limitations.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Clay Loam range site.

CDB—Caid sandy clay loam, gently undulating. This deep, loamy soil is on uplands. The surface is convex. Slopes range from 0 to 3 percent. Areas of this soil are irregular in shape and range from about 50 acres to more than 500 acres in size.

This unit is made up of about 50 percent Caid soils that have 1 to 3 percent slopes and about 20 percent Caid soils that have 0 to 1 percent slopes. Pryor soils make up about 10 percent of the unit. The remaining 20 percent is made up of Brystal, Maverick, and Tonio soils and a soil similar to this Caid soil except it has sandstone within 40 inches of the surface. All of these soils are on higher positions of the landscape. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer is dark brown, friable sandy clay loam about 12 inches thick. The upper part of the subsoil is brown, friable sandy clay loam from 12 to 29 inches. The middle part is light yellowish brown, friable sandy clay loam from 29 to 39 inches. It is about 10 percent accumulation of calcium carbonate. The lower part to a depth of 72 inches is light brown and light yellowish brown sandy clay loam. It is about 5 to 15 percent accumulation of calcium carbonate. The underlying material is brownish yellow, soft sandstone. This soil is moderately alkaline and calcareous throughout.

This soil is well drained. Permeability is moderate. Surface runoff is slow to medium. Available water capacity is moderate. Water erosion is a slight to moderate hazard.

This soil is used mostly as rangeland and for wildlife habitat.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. Various predators, such as the coyote and bobcat, frequent the areas.

The main limiting features of this soil for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Most recreational development has slight limitations.

This soil is not assigned to a capability subclass. It is in the Clay Loam range site.

Cf—Catarina clay, frequently flooded. This deep, nearly level, clayey soil is on uplands. It is in weakly depressed drainageways. The surface is slightly concave to plane. Slopes are 0 to 1 percent. The areas are long and narrow and parallel the small drainageways. The areas range from about 200 to 800 acres or more.

Typically, this soil is grayish brown, very firm clay about 30 inches thick. The next layer is light yellowish brown, very firm clay about 15 inches thick. The underlying material to a depth of 72 inches is olive yellow clay. It has a few calcium carbonate masses and gypsum crystals.

This Catarina soil is moderately well drained. Permeability is very slow. Surface runoff is slow. Available water capacity is low. These soils are moderately affected to strongly affected by salts, especially in the layers between 2 and 4 feet, which affect the available water capacity and cause the soil to be droughty. This soil is frequently flooded for very brief periods following heavy rains mostly during the spring and fall months. It is flooded at least 1 out of every 2 years and, in some cases, 2 or 3 times

a year. The flood waters usually last for only a few hours. Water erosion is a slight to moderate hazard.

Included in some of the mapped areas of this soil are small areas of occasionally flooded Catarina clay. Small areas of Brundage and Cochina soils are also included. The included soils make up less than 15 percent of a mapped area.

All of this soil is used as rangeland or for wildlife habitat.

This soil is poorly suited to cropland and pasture because of excess salt in the soil and because of the flooding hazard.

The potential plant community for rangeland and wildlife habitat is grassland of mid and short grasses and a few woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are common in the areas. Several furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and songbirds are in these areas. Predators, such as the coyote and bobcat, also are in the areas.

The major limiting features for most urban uses are flooding; shrinking and swelling of the soil with changes in moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Significant limitations for recreational development are flooding, high clay content, and salinity of the soil.

This soil is in capability subclass VIw, nonirrigated, and the Saline Clay range site.

CGB—Catarina clay, nearly level. This deep, clayey soil is on uplands. The surface is plane to convex. Slopes range from 0 to 3 percent. Areas of this soil are mostly irregular in shape and mostly more than 250 acres in size.

This map unit is made up of about 40 percent Catarina clay that has slopes of 0 to 1 percent and about 40 percent Catarina clay that has slopes of 1 to 3 percent.

The remaining 20 percent is Chacon, Maverick, Montell, and Pryor soils. There are a few small areas of a soil that has slopes of more than 3 percent. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of the soils.

Typically, the surface layer is brown, very firm clay about 26 inches thick. The soil is light yellowish brown, extremely firm clay from 26 to 58 inches. It has a few calcium carbonate masses and salt threads. The underlying material is light yellowish brown clay to a depth of 64 inches. It has a few masses of calcium carbonate and a few gypsum crystals (fig. 8). The soil is moderately alkaline and calcareous throughout.

The Catarina soil is moderately well drained. Permeability is very slow. Surface runoff is slow to medium. Available water capacity is low. The available water capacity is affected by the salt content of the soil: the higher the salt content the lower the available water. This soil is moderately affected to strongly affected by salts, especially in the layer between 2 and 4 feet. The soil is droughty. Water erosion is a moderate hazard.

Most areas of this soil are used as rangeland and for wildlife habitat. A few areas are in cropland or pasture. Generally, this soil is poorly suited to these uses.

The potential plant community for rangeland and wildlife habitat is grassland of mid and short grasses and a few woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are common. Furbearing animals, such as opossum and raccoon, are occasionally in these areas. Scaled quail, bobwhite quail, mourning doves, and some songbirds also are in these areas. Predators, such as the coyote and bobcat, frequent the areas. The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and

corrosivity of uncoated steel and excess salt. The very slow permeability, the clayey

surface, and excess salts are limiting features affecting recreational development.

This soil is not assigned to a capability subclass. It is in the Saline Clay range site.

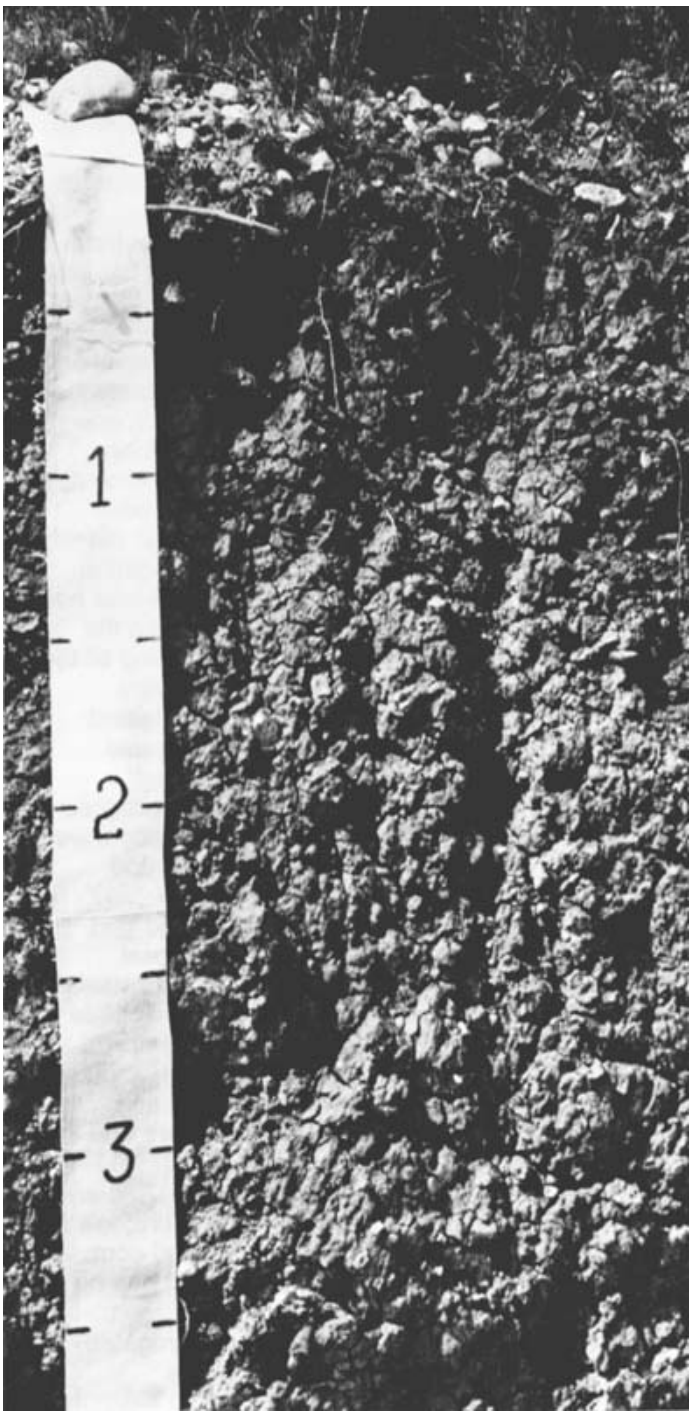


Figure 8.—Profile of Catarina clay, nearly level. This soil is dense clay and has blocky structure throughout.

ChA—Chacon clay loam, 0 to 1 percent slopes. This deep, nearly level soil is

on uplands. The surface is plane. Areas of this soil are round to irregular in shape and are mostly about 50 acres in size.

Typically, the surface layer is dark grayish brown, friable clay loam about 17 inches thick. The subsoil is 52 inches thick. It is grayish brown, firm clay. The underlying material is light brownish gray clay and has a few concretions of calcium carbonate. It is moderately alkaline and calcareous throughout.

This Chacon soil is well drained. It is slowly permeable. Surface runoff is slow. Available water capacity is moderate. Water erosion is a slight hazard.

Slight to moderate salinity is within 48 inches of the surface.

Included with this soil in mapping are small areas of Montell, Pryor, and Uvalde soils. The Pryor and Uvalde soils are on small knolls and along the outer margins of the mapped areas. The Montell soils are in slightly lower parts of the landscape. These included soils make up less than 15 percent of a mapped area.

Most areas of this soil are in cropland. Some areas are in rangeland or in pasture.

This soil is poorly suited to nonirrigated cropland but is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. Where this soil is irrigated, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. In addition, moderate salinity in some areas hinders the yields for some crops. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. This soil can be protected by keeping crop residue on and near the surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses and help minimize the hazard of salt accumulation in the soil. Leaching of the soil may be needed where salt has accumulated.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are common. Scaled quail, bobwhite quail, mourning doves, and many songbirds are in these areas. Bobwhite quail and mourning dove are plentiful along field borders and in and around grain fields.

The major limiting features for most urban uses are shrinking and swelling with changes in moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass IVc, nonirrigated, and IIs, irrigated. It is in the Clay Loam range site.

ChB—Chacon clay loam, 1 to 3 percent slopes. This deep, gently sloping soil is on uplands. The surface is convex. Areas of this soil are round to irregular in shape and are mostly 30 acres in size.

Typically, the surface layer is dark grayish brown, friable clay loam about 14 inches thick. The subsoil is 36 inches thick. It is grayish brown and brown, firm clay. The underlying material is yellowish brown clay to a depth of 72 inches. The soil is moderately alkaline and calcareous throughout.

This Chacon soil is well drained. Permeability is slow. Surface runoff is medium, and available water capacity is moderate. Water erosion is a moderate hazard. Slight to moderate salinity is within 48 inches of the surface.

Included with this soil in mapping are small areas of the nearly level Chacon clay

loam and small areas of Pryor and Uvalde soils. The Pryor soils are light spots on slightly higher parts of the landscape. The Uvalde soils also are on slightly higher positions. The included soils make up less than 15 percent of a mapped area.

Most areas of this soil are in cropland. A few areas are used for rangeland or are in pasture.

This soil is poorly suited to nonirrigated cropland but is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. If this soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. Also, moderate salinity in some areas hinders the yields of some crops. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. Terraces, contouring, and grassed waterways help control erosion in places. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses and help minimize the hazard of salt accumulation in the soil. Leaching of the soil may be needed where salt has accumulated.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited to these uses where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are common. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning doves, and many songbirds are in these areas. Bobwhite quail and mourning dove are plentiful along field borders and in and around grain fields.

The major limiting features for most urban uses are shrinking and swelling with changes in moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass IVe, nonirrigated, and IIIe, irrigated. It is in the Clay Loam range site.

CKB—Chacon clay loam, gently undulating. This deep, loamy soil is on uplands. The surface is plane to convex. Slopes range from 0 to 3 percent but are mostly 1 to 3 percent. The areas of this soil are round to irregular in shape and range from about 75 acres to as much as 500 acres in size.

This unit is made up of about 50 percent Chacon soils that have slopes of 1 to 3 percent and 25 percent Chacon soils that have slopes of 0 to 1 percent. The remaining 25 percent consists of Cotulla, Maverick, Montell, and Pryor soils. Maverick and Pryor soils are on slightly higher positions than the Chacon soils. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer is dark grayish brown, friable clay loam about 15 inches thick. The subsoil is grayish brown, firm to very firm clay from 15 to 40 inches. It is pale brown, very firm clay from 40 to 52 inches. The underlying material is very pale brown clay to a depth of about 66 inches. This soil is calcareous and moderately alkaline throughout.

The Chacon soil is well drained. It is slowly permeable. Surface runoff is slow to

medium. Available water capacity is moderate. Water erosion is a low to moderate hazard. Slight to moderate salinity is within a depth of 48 inches.

Most areas of this soil are used as rangeland and for wildlife habitat.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are common. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. Various predators, such as the coyote and bobcat, frequent the areas.

The main limiting features of this soil for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is not assigned to capability subclass. It is in the Clay Loam range site.

Cm—Cochina clay, occasionally flooded. This deep, nearly level soil is on bottom land. The surface is plane to slightly concave. Slopes range from 0 to 1 percent. Areas are mostly long and narrow and parallel the drainageways. They range from about 50 to 500 acres.

Typically, this soil has a surface layer of grayish brown, very firm clay about 24 inches thick. The soil is pale brown, very firm clay from 24 to 46 inches and is light yellowish brown clay from 46 to 62 inches. The soil is moderately alkaline and calcareous throughout.

This Cochina soil is moderately well drained. Surface runoff is slow. Permeability is very slow, and available water capacity is moderate. The rooting zone is deep. The high clay content tends to impede the movement of air, water, and roots, and the soil becomes difficult to till at most levels of moisture content. Water erosion is a slight hazard. This soil is occasionally flooded for very brief to brief periods following heavy rains. It is flooded mostly during the spring and fall months. Flooding occurs at intervals of about 2 to 10 years and lasts for several hours to as long as 7 days.

Included in some areas of this soil are small areas of soils that are frequently flooded and small areas of Brundage, Divot, and Montell soils. The included soils make up less than 10 percent of a mapped area.

Most areas of this soil are used as rangeland and for wildlife habitat. A few small areas are in improved pasture.

This soil is poorly suited to nonirrigated cropland but is moderately well suited to irrigated cropland. The flooding may be harmful or beneficial depending on the kind of crop and stage of growth. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, wheat, and other cool-season crops generally are satisfactory from nonirrigated cropland. In irrigated areas, cotton, corn, grain sorghum, and wheat are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil is protected by keeping crop residue on and near the soil surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is poorly suited to nonirrigated pasture and hay and is moderately well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is a mixture of trees, shrubs, grasses, and forbs. Deer and javelina are plentiful. Wild turkeys are in areas where larger trees furnish roosting places. A few furbearing animals, such as

opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are common. Predators, such as the coyote and bobcat, frequent the area.

The major limiting features for most urban uses are occasional flooding; shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Significant limitations for recreational development are flooding, the clayey surface, and very slow permeability.

This soil is in capability subclass IVw, nonirrigated, and IVw, irrigated. It is in the Clayey Bottomland range site.

Cn—Cochina clay, frequently flooded. This deep, nearly level soil is on bottom land. The surface is slightly concave to plane. Slopes range from 0 to 1 percent. Areas are mostly long and narrow and parallel the drainageways. These areas range from 100 acres to more than 1,000 acres.

Typically, the upper layer of this soil is grayish brown, very firm clay 34 inches thick. The soil is light brownish gray, very firm clay from 34 to 52 inches and is pale brown clay from 52 to 72 inches. The soil is moderately alkaline and calcareous throughout.

This Cochina soil is moderately well drained. Surface runoff is slow. Permeability is very slow, and available water capacity is moderate. The rooting zone is deep. High clay content tends to impede the movement of air, water, and roots, and the soil becomes difficult to till at most moisture levels. Water erosion is a slight hazard. This soil is frequently flooded. It is flooded at least 1 year out of every 2 years after heavy rains. Flooding occurs mostly during the spring and fall months. It lasts from several hours to long periods of 7 to 30 days.

Included in some areas of this soil are small areas of Cochina clay, occasionally flooded, and small areas of Brundage, Divot, and Montell soils. The included soils make up less than 10 percent of a mapped area.

Most areas of this soil are used as rangeland and for wildlife habitat.

This soil is poorly suited to cropland because of frequent flooding; however, it is moderately well suited to pasture and hay. Coastal bermudagrass, kleingrass, introduced bluestem, and blue panicum are the major grasses grown. Proper management of the grasses includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is a mixture of trees, shrubs, grasses, and forbs. Deer and javelina are plentiful. Wild turkeys are along the stream channels, especially where large trees furnish roosting places. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. The most common predator is the coyote.

The major limiting features for most urban uses are frequent flooding; shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Significant limitations for recreational developments are flooding, the clayey surface, and very slow permeability.

This soil is in capability subclass Vw, nonirrigated, and the Clayey Bottomland range site.

Co—Conalb loam, occasionally flooded. This deep, nearly level soil is on bottom land. The slopes range from 0 to 2 percent. The surface is plane. Areas of this soil are mostly long and narrow and parallel the river. These areas are 10 acres to about 100 acres.

Typically, the surface layer is pale brown loam about 14 inches thick. The subsoil is very pale brown loam about 14 inches thick. The underlying material is very pale brown loam and stratified thin bands of fine sandy loam, silt loam, and silty clay loam to a depth of 80 inches. The soil is moderately alkaline and calcareous throughout.

This Conalb soil is well drained. Permeability is moderate, and surface runoff is slow. The available water capacity is moderate. Occasional flooding occurs 1 year out of every 10 to 15 years and lasts from a few hours to a few days. Erosion is a slight hazard.

Included with this soil in mapping are a few small areas of Conalb loam that has slopes of more than 2 percent. Also included are small pockets of Dev and Winterhaven soils. The Dev soils are in lower positions near the river. The included soils make up less than about 15 percent of a mapped area.

Most areas of this soil are used as rangeland and for wildlife habitat. A few small areas, however, are in cropland or in pasture and hay.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat or other cool-season crops are satisfactory from nonirrigated cropland. If the soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is a mixture of trees, shrubs, grasses, and forbs. The vegetation varies depending on the frequency and amount of overflow and the position on the bottom land. The trees and shrubs are generally in the lower parts of the landscape. Deer and javelina are plentiful. Wild turkeys are common, especially where large trees furnish roosting places. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features of most urban uses are occasional flooding; low strength, which affects roads and streets; and corrosivity of uncoated steel. The major limitation affecting recreational development is the occasional flooding.

This soil is in capability subclass IIIc, nonirrigated, and IIw, irrigated. It is in the Loamy Bottomland range site.

CtA—Cotulla clay, 0 to 1 percent slopes. This deep, nearly level, clayey soil is on uplands. The surface is plane to slightly convex. Areas of this soil are round to irregular in shape and range from about 25 to 250 acres in size.

Typically, the surface layer is grayish brown, very firm clay about 20 inches thick. The soil is brown, very firm, saline clay from 20 to 32 inches. It is very firm, saline clay from 32 and 72 inches. This layer is light yellowish brown in the upper part, brownish yellow in the middle part, and very pale brown in the lower part. This soil is moderately alkaline and calcareous throughout.

This Cotulla soil is moderately well drained. Surface runoff is slow. Permeability is very slow. Available water capacity is low. The rooting zone is deep. High clay content and excess salts tend to impede the movement of air, water, and roots and cause droughtiness. This soil is difficult to till at most moisture levels because of the high clay content. Water erosion is a slight hazard.

Included with this soil in mapping are small areas of Chacon and Montell soils that are a darker gray and in pockets in the landscape. The included soils make up less than 10 percent of a mapped area.

This soil is used mostly as irrigated cropland. Small areas are used for nonirrigated cropland, pasture, and hay; as rangeland; and for wildlife habitat.

This soil is poorly suited to nonirrigated cropland but is moderately well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. If this soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully.

Salinity hinders the yields of some crops. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. This soil can be protected by keeping crop residue on and near the surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses and help minimize the hazard of salt accumulation in the soil. Leaching of the soil may be needed where salt has accumulated.

This soil is poorly suited to nonirrigated pasture and hay and is moderately well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is grassland of mid and short grasses and a few woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Significant limitations affecting recreational development are the very slow permeability, the high clay content, and salinity.

This soil is in capability subclass IVs, nonirrigated, and IIIs, irrigated. It is in the Saline Clay range site.

CtB—Cotulla clay, 1 to 3 percent slopes. This deep, gently sloping, clayey soil is on uplands. The surface is convex. Areas of this soil are round to irregular in shape and range from about 40 to 300 acres in size.

Typically, the surface layer is grayish brown, very firm clay about 20 inches thick. The soil is brown, very firm, saline clay from 20 to 30 inches and is very firm, saline clay from 30 to 62 inches. It is light yellowish brown in the upper part and brownish yellow in the lower part. This soil is moderately alkaline and calcareous throughout.

This Cotulla soil is moderately well drained. Surface runoff is medium. Permeability is very slow. Available water capacity is low. The rooting zone is deep. High clay content and excess salts tend to impede the movement of air, water, and roots, and cause droughtiness. Water erosion is a moderate hazard.

Included with this soil in mapping are small areas of Chacon, Maverick, Montell, and Pryor soils. The Chacon and Montell soils are darker gray and are in spots and patches in the lower parts of the landscape. The Maverick and Pryor soils are on the higher parts of the landscape. The included soils make up less than 10 percent of a mapped area.

This soil is mostly irrigated cropland. Small areas are used for nonirrigated cropland, pasture, and hayland; as rangeland; and for wildlife habitat.

This soil is poorly suited to nonirrigated cropland but is moderately suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. Where the soil

is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully.

Salinity hinders the yields of some crops. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil is protected by keeping crop residue on and near the soil surface. Terraces, contour farming, and grassed waterways help control erosion in places. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses and help minimize the hazard of salt accumulation in the soil. Leaching of the soil may be needed where salt has accumulated.

This soil is poorly suited to nonirrigated pasture and hay but is moderately well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is grassland of mid and short grasses and a few woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are shrinking and swelling of the soil with changes in moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Significant limitations for recreational development are the very slow permeability, the high clay content, and salinity.

This soil is in capability subclass IVe, nonirrigated, and IVe, irrigated. It is in the Saline Clay range site.

CUB—Cotulla clay, gently undulating. This deep, clayey soil is on uplands. The surface is plane to convex. Slopes range from 0 to 3 percent. The areas are round to irregular in shape and range from about 40 to 500 acres in size.

This unit is made up of 45 percent Cotulla clay, 1 to 3 percent slopes, and 35 percent Cotulla clay, 0 to 1 percent slopes. The remaining 20 percent is Chacon, Maverick, Montell, and Pryor soils. Catarina and Maverick soils are on slightly higher parts of the landscape and are lighter in color. Chacon and Montell soils have a grayer surface layer. Pryor soils are on slightly higher parts of the landscape and have a surface layer that is less clayey than this Cotulla soil. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer of the Cotulla soil is grayish brown, very firm clay about 20 inches thick. The soil is brown, very firm, saline clay from 20 to 32 inches. It is very firm, saline clay from 32 to 72 inches. It is light yellowish brown in the upper part, brownish yellow in the middle part, and very pale brown in the lower part. It is moderately alkaline and calcareous throughout.

This Cotulla soil is moderately well drained. Surface runoff is slow to medium. Permeability is very slow. Available water capacity is low. The rooting zone is deep. Clay content and excess salts tend to impede the movement of air, water, and roots. Water erosion is a slight hazard.

This soil is used mainly as rangeland and for wildlife habitat.

The potential plant community for rangeland and wildlife habitat is grassland of mid and short grasses and a few woody plants. Salinity in the soil causes it to be droughty. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. Several furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail,

mourning dove, and many songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the area.

The major limiting features for most urban uses are shrinking and swelling of the soil with changes in moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Significant limitations for recreational development are very slow permeability, high clay content, and salinity.

This soil is not assigned to a capability subclass. It is in the Saline Clay range site.

DA—Dev soils, frequently flooded. These deep, nearly level, very gravelly and loamy soils are on flood plains. This soil is immediately adjacent to the stream channel and is only a few feet higher than the channel floor. Slopes range from 0 to 2 percent. Areas are long and narrow in shape and range from about 40 to 150 acres in size. There are only a few areas of this soil. These areas are in the north-central part of the survey area.

This unit is made up of about 80 percent Dev soils and 20 percent of a soil very similar to Dev soils but lighter in color. The texture of the surface layer varies from very gravelly sandy loam, loam, or clay loam through gravelly sandy loam, loam, or clay loam. The composition of this association is more variable than that of other map units in the county; however, mapping has been controlled well enough for anticipated use of the soils.

Typically, the surface layer is dark grayish brown, very friable, very gravelly loam about 28 inches thick. The underlying material is brown to pale brown, very gravelly loam to a depth of 72 inches. The soil is moderately alkaline and calcareous throughout.

The Dev soils are well drained. Surface runoff is slow to medium. Permeability is moderately rapid. Available water capacity is low. Water erosion is a slight hazard. These soils are flooded at least 1 year out of every 2 years, mostly in the spring and fall months. Flooding lasts for a few hours to a few days following heavy rains.

These soils are used as rangeland and for wildlife habitat.

These soils are not suited to cropland, pasture, and hay. The hazard of flooding, very gravelly texture throughout, and low available water capacity are the main limiting features of this soil.

The potential plant community for rangeland and wildlife habitat is a mixture of trees, shrubs, grasses, and forbs. The vegetation varies depending on the frequency and amount of overflow and the position on the bottom land. The high gravel content causes the soils to be droughty. Deer and javelina are plentiful. Wild turkeys roost in the larger trees. Furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in the areas. Various predators, such as the coyote and bobcat, frequent the areas.

The major limitations affecting this soil for urban uses and recreational development are the hazard of flooding and the high content of gravel in the soil.

This soil is not assigned to a capability subclass. It is in the Loamy Bottomland range site.

DcC—Dilley-Rock outcrop complex, 1 to 5 percent slopes. This complex consists of shallow, gently sloping fine sandy loam and sandstone outcrops on uplands. The surface is convex. The areas are mostly irregular in shape and range from about 15 to 300 acres in size. There are only a few areas of this soil complex. The complex is in the north-central part of the survey area.

This complex is about 50 percent Dilley soils, 25 percent Rock outcrop, 10 percent soils similar to Dilley soils, and 15 percent other soils, such as Verick and Webb soils. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of the soils.

Typically, the surface layer of the Dilley soil is light yellowish brown, neutral, very friable fine sandy loam about 5 inches thick. The subsoil is brown, neutral, friable sandy clay loam from 5 to 12 inches. The underlying material is weakly cemented sandstone.

Rock outcrop is exposed sandstone bedrock and areas that have less than 2 inches of soil material on the bedrock.

The Dilley soils are well drained and moderately permeable. Surface runoff is medium to high. Available water capacity is very low. Rooting depth is shallow. These soils are very droughty. Water erosion is a severe hazard.

This soil is used as rangeland and for wildlife habitat.

The soil is not suited to cropland, pasture, and hay because of the Rock outcrop, the very low available water capacity, and the shallow rooting depth.

The potential plant community for rangeland and wildlife habitat is open grassland and a variety of scattered woody plants and perennial forbs. Few species of wildlife are in these areas because of a scarcity of food and cover.

The major limiting features of this soil for most urban uses and recreational development are the many sandstone outcrops and the shallow depth to rock.

This soil is in capability subclass VIs, nonirrigated, and the Shallow Sandy Loam range site.

DFC—Dilley fine sandy loam, gently undulating. This shallow, loamy soil is on uplands. The surface is convex. Slopes range from 1 to 5 percent but are mostly 1 to 3 percent. Areas of this soil are round to irregular in shape and range from about 15 to 75 acres in size.

This unit is made up of 75 percent Dilley soils; 15 percent soils very similar to Dilley soil but that have sandstone between depths of 20 and 40 inches; and 10 percent other soils, such as Batesville, Brystal, Duval, Randado, Verick, and Webb soils. Brystal, Duval, and Webb soils are at slightly lower positions on the landscape. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer is yellowish red, neutral, very friable fine sandy loam about 5 inches thick. The subsoil is yellowish red and reddish yellow, friable fine sandy loam from 5 and 16 inches. It is neutral in upper part and moderately alkaline in lower part. The underlying material is weakly cemented sandstone.

The Dilley soil is well drained. Permeability is moderate. Surface runoff is medium. Available water capacity is very low. Water erosion and wind erosion are moderate hazards.

This soil is used mostly as rangeland and for wildlife habitat. A few areas are in pasture or are irrigated cropland.

The potential plant community for rangeland and wildlife habitat is open grassland, a few scattered woody plants, and a wide variety of forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are less common in these areas than in areas where the soils are deeper. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, and mourning dove are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The most limiting feature for most urban uses and for recreational development is the depth of the soil to sandstone.

This soil is not assigned to a capability subclass. It is in the Shallow Sandy Loam range site.

Dt—Divot silty clay, occasionally flooded. This deep, nearly level, clayey soil is on bottom land. The surface is plane. Areas of this soil are mainly long and narrow

and parallel streams. They range from 10 acres to about 200 acres. Slopes range from 0 to 1 percent but are mostly less than 0.5 percent.

Typically, the surface layer is grayish brown, friable to firm silty clay about 24 inches thick. The subsoil is light brownish gray, firm silty clay from 24 to 38 inches. It is pale brown, firm silty clay loam from 38 to 50 inches. The underlying layer is very pale brown silty clay loam to a depth of 64 inches. The soil is moderately alkaline and calcareous throughout.

This Divot soil is well drained. Permeability is moderately slow. Available water capacity is high. Surface runoff is slow. Most areas of this soil receive floodwater about 1 year out of every 5 to 20 years. Flooding lasts for less than 24 hours. Erosion is a slight hazard.

Included with this soil in mapping are small areas of a Divot soil that has a clay surface layer and a Divot soil that has a silty clay loam surface layer. Areas of Winterhaven soils are also included. The Winterhaven soils have a lighter colored surface layer. The included soils make up less than 15 percent of a mapped area.

This soil is used mainly as irrigated cropland. Small areas are used for pasture and hay; as rangeland; and for wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average to above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated land. Where the soil is irrigated, cotton, corn, grain sorghum, pecan trees, wheat, and truck crops, especially winter vegetables, are grown successfully. The periodic flooding can be either harmful or beneficial to crops depending on the kind and stage of growth. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the soil surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is a mixture of trees, shrubs, grasses, and forbs. The vegetation varies depending on the frequency and amount of overflow and the position on the landscape. Deer and javelina are plentiful. Wild turkeys are common. They use the many large trees for roosting. Scaled quail, bobwhite quail, mourning dove, and many songbirds are in these areas. Bobwhite quail and mourning dove are plentiful along field borders and in and around grain fields. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are flooding; shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Limitations that affect recreational development are the periodic flooding and the silty clay surface.

This soil is in capability subclass IIc, nonirrigated, and capability class I, irrigated. It is in the Loamy Bottomland range site.

DuB—Duval loamy fine sand, 0 to 3 percent slopes. This deep, nearly level to gently sloping, sandy soil is on uplands. The surface is convex. Areas of this soil are round to irregular in shape and range from about 20 to 100 acres in size.

Typically, the surface layer is brown, slightly acid, and very friable loamy fine sand about 17 inches thick. The upper part of the subsoil is reddish brown, slightly acid to neutral, and friable sandy clay loam from 17 to 36 inches. The lower part is

yellowish red to reddish yellow, neutral to mildly alkaline and friable sandy clay loam from 36 to 58 inches. The underlying material is sandstone with seams of caliche.

This Duval soil is well drained. Permeability is moderate. Surface runoff is slow to medium. Available water capacity is moderate. Because of the sandy surface layer, water erosion is a slight hazard, and wind erosion is a severe hazard.

Included with this soil in mapping are small areas of Duval fine sandy loam and Brystal and Webb soils. These soils are on lower landforms. The included soils make up less than 15 percent of a mapped area.

This soil is used mostly as rangeland and for wildlife habitat. Small areas are in irrigated cropland or are in pasture and hay.

This soil is moderately well suited to nonirrigated and irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, wheat and other cool-season crops generally are satisfactory on nonirrigated land. Where the soil is irrigated, cotton, corn, grain sorghum, wheat, some citrus, peanuts, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the soil surface. Stripcropping to protect against soil blowing is generally needed for row crops. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to pasture and hay. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and a few mesquite trees. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are few. Scaled quail, bobwhite quail, mourning dove, and some songbirds are in these areas. Sometimes there are predators, such as the coyote and bobcat.

The major limiting feature for most urban uses is corrosivity of uncoated steel. A significant limitation for recreational development is the sandy surface.

This soil is in capability subclass IIIe, nonirrigated, and IIIe, irrigated. It is in the Loamy Sand range site.

DvB—Duval fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on uplands. The surface is convex. Areas of this soil are round to irregular in shape and range from about 10 to 75 acres in size.

Typically, the surface layer is reddish brown and yellowish red, slightly acid, very friable fine sandy loam about 14 inches thick. The upper part of the subsoil is red, friable, neutral sandy clay loam from 14 to 38 inches. The lower part is yellowish red sandy clay loam from 38 to 48 inches. It has a few threads and small masses of calcium carbonate. The underlying material is reddish yellow, soft sandstone and seams of calcium carbonate.

This Duval soil is well drained. Permeability is moderate. Surface runoff is medium, and available water capacity is moderate. Water erosion and wind erosion are moderate hazards.

Included with this soil in mapping are small areas of nearly level Duval fine sandy loam and small areas of Brystal, Dilley, and Webb soils. Also included are small spots of a soil which is similar to Duval soil but which has sandstone between 20 and 40 inches. The Dilley soils are on higher parts of the landscape in the map unit, and the Webb soils are on lower parts. The included soils make up less than 15 percent of a mapped area.

This soil is used mostly as irrigated cropland or for pasture and hay. Small areas are used as rangeland and for wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated cropland. Where the soil is irrigated, cotton, corn, grain sorghum, wheat, some citrus, peanuts, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. Terrace, contour farming, and grassed waterways help control erosion in some areas. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated and irrigated pasture and hay. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland dominated by mid grasses and some forbs and woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning dove are plentiful along field borders and in and around grain fields. Predators, such as the coyote and bobcat, frequent the area.

The major limiting feature for most urban uses is corrosivity to uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Sandy Loam range site.

DYB—Duval fine sandy loam, gently undulating. This deep, loamy soil is on uplands. The surface is plane to convex. Slopes range from 0 to 3 percent. The areas are round to irregular in shape and range from about 100 acres to more than 1,000 acres in size.

This unit is made up of 70 percent Duval soils; of which 25 percent has slopes of 0 to 1 percent and 45 percent has slopes of 1 to 3 percent; 15 percent Brystal soils; and 15 percent other soils. The other soils include small areas of a soil which is similar to Duval soil but has sandstone between depths of 20 to 40 inches, a soil which is similar to Duval soil but has sandier subsoil, and Dilley soils. Dilley soils are mainly on the higher parts of the landscape. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, this soil has a surface layer of reddish brown, slightly acid, very friable fine sandy loam about 15 inches thick. The upper part of the subsoil is red, slightly acid to neutral, friable sandy clay loam from 15 to 38 inches. The lower part is yellowish red, mildly alkaline to moderately alkaline sandy clay loam from 38 to 50 inches. The underlying material is yellow, soft sandstone and thin seams of calcium carbonate.

This Duval soil is well drained. Permeability is moderate. Surface runoff is slow to medium. Available water capacity is moderate. Water erosion is a slight to moderate hazard, and wind erosion is a moderate hazard.

This soil is mainly used as rangeland and for wildlife habitat.

The potential plant community for rangeland and wildlife habitat is open grassland dominated by mid grasses and some forbs and woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and some songbirds are in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting feature for most urban areas is corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is not assigned to a capability subclass. It is in the Sandy Loam range site.

JED—Jimenez very gravelly loam, rolling. This very shallow to shallow, very gravelly soil is on uplands. The surface is convex. Slopes range from 1 to 12 percent but average about 7 percent. The areas of this soil are round to irregular in shape and are several hundred acres in size.

Jimenez soils make up about 70 percent of this unit. The remaining 30 percent consists mostly of a soil which is similar to the Jimenez soil but which is redder and is neutral in reaction. This similar soil is on the caps of the rolling hills, and Jimenez soils are mainly on the steeper side slopes. Other soils in the association are Olmos, Verick, and Zapata soils and a few areas of rock outcrop. The soils are mainly on the side slopes. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of the soils.

Typically, the surface layer of the Jimenez soil is dark grayish brown, very friable very gravelly loam about 12 inches thick. It is underlain by a thick bed of caliche that is strongly cemented in the upper few inches (fig. 9).

Jimenez soil is well drained. Surface runoff is medium to rapid. Permeability is moderate. Available water capacity is very low. The rooting zone is very shallow to shallow. This soil is very droughty. Water erosion is a moderate to severe hazard.

This soil is used as rangeland and for wildlife habitat. The substratum is a source of caliche for construction purposes.

This soil is not suited to cropland, pasture, and hay. The very gravelly texture, very shallow to shallow rooting depth, very low available water capacity, and the hazard of erosion are the major limiting features of this soil.

The potential plant community for rangeland and wildlife habitat is open grassland and a variety of scattered, woody shrubs and perennial forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, a few mourning doves, and a few songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban and recreational uses are the very gravelly texture, very shallow to shallow depth to a cemented pan, slope, and corrosivity of uncoated steel.

This soil is not assigned to a capability subclass. It is in the Gravelly Ridge range site.

MAC—Maverick very gravelly clay loam, gently undulating. This moderately deep, very gravelly soil is on uplands. Slopes are convex and range from 1 to 5 percent. Most areas of this soil are oval but some are round or irregular in shape. The areas range from about 25 acres to 300 acres.

Maverick very gravelly clay loam and a Maverick soil that has a very gravelly clay surface layer make up about 80 percent of this unit. About 10 percent is a Maverick soil that has a clay surface layer, and the remaining 10 percent is made up of

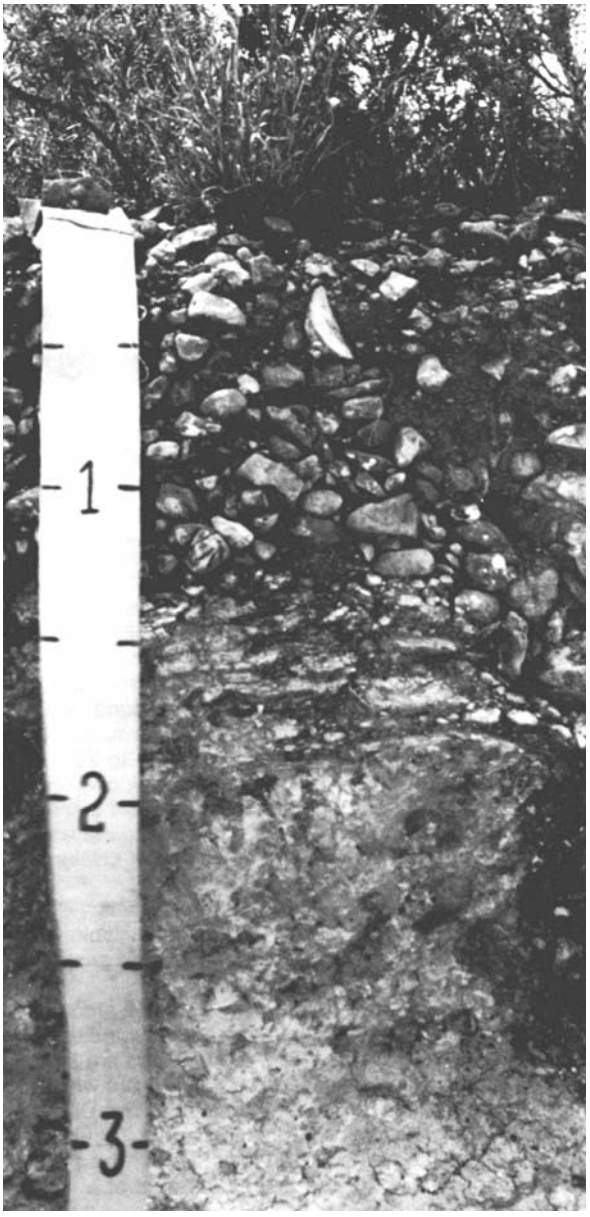


Figure 9.—Profile of Jimenez very gravelly loam, rolling, which has a gravelly layer over a bed of caliche.

Catarina, Chacon, Cotulla, Pryor, and Verick soils. Catarina, Chacon, Cotulla, and Pryor soils are in low parts of the landscape and along small drainageways. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of these soils.

Typically, the surface layer of the Maverick soils is brown, friable very gravelly clay loam about 6 inches thick. The subsoil is about 22 inches thick. It is yellowish brown and light yellowish brown, firm clay. The underlying material is light gray shale (fig. 10). It is calcareous and moderately alkaline throughout.

These Maverick soils are well drained. Permeability is slow. Surface runoff is medium to rapid. Available water capacity is very low. The amount of salts in the soil

affects its available water capacity. The higher the salt content is the lower the available water. These soils are moderately affected by salts below the surface layer. Water erosion is a moderate hazard.

Figure 10.—Profile of Maverick very gravelly clay loam, gently undulating. This soil has a very gravelly layer over a clayey subsoil.

This soil is used as rangeland and for wildlife habitat. It is not suited to cropland or pasture.

The potential plant community is open grassland and a variety of scattered woody shrubs and perennial forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are common. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and a few songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Significant limitations for recreational development are the very gravelly surface layer and slow permeability.

This soil is not assigned to a capability subclass. It is in the Gravelly Ridge range site.

MKC—Maverick clay loam, gently undulating. This moderately deep, loamy soil is on uplands. The surface is convex. Slopes range from 1 to 5 percent. Areas of this soil are mostly oval, but some areas are round or irregular in shape. The areas range from 20 to 500 acres.

Maverick clay loam and a Maverick soil that has a clay surface layer make up about 83 percent of this unit. The remaining 17 percent consists of a soil which is similar to this Maverick soil but is less than 20 inches deep to shale and small areas of Catarina, Pryor, and Verick soils. Pryor and Verick soils are on the higher parts of the landscape. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of these soils.

Typically, the surface layer is grayish brown, firm clay loam 6 inches thick. The subsoil is 22 inches thick. It is very firm clay that is pale brown in the upper part and light yellowish brown in the lower part. The underlying material is light yellowish brown shale.

This Maverick soil is well drained. Permeability is slow. Surface runoff is medium to rapid. Available water capacity is very low. The amount of salts in the soil affects the available water capacity. This soil is moderately to strongly affected by salts below the surface layer. The higher the salt content is the lower the available water. Water erosion is a moderate hazard.

This soil is used mostly as rangeland and for wildlife habitat. A few small areas are within larger areas of better soils that are used as cropland.

The potential plant community for rangeland and wildlife habitat is open grassland and a scattering of low brush, after years of heavy grazing; most areas have been invaded with variable amounts of brush. Deer and javelina are common. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and a few songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Significant limitations for recreational development are the clayey surface and slow permeability.

This soil is not assigned to a capability subclass. It is in the Rolling Hardland range site.

MnA—Montell clay, 0 to 1 percent slopes. This deep, nearly level, clayey soil is on uplands. The surface is plane to slightly convex. Slopes are mostly less than 0.5 percent. Areas are mostly irregular in shape and less than 100 acres in size.

Typically, this soil has a surface layer of gray, very firm clay about 19 inches thick. The soil is grayish brown, very firm clay from 19 to 40 inches. The underlying material is very pale brown clay to a depth of 64 inches. It is about 5 percent, by volume, visible calcium carbonate and gypsum. This soil is moderately alkaline and calcareous throughout.

This Montell soil is moderately well drained. Surface runoff and permeability are very slow. Available water capacity is low. When the soil is dry and cracked, water enters rapidly. When the soil is wet and the cracks are closed, water enters very slowly. The rooting zone is deep, but the high clay content tends to impede the movement of air, water, and roots. This soil is slightly to moderately affected by salts in some parts of the upper 24 inches of the soil. It is moderately to strongly affected below 24 inches. The salt affects the available water capacity and causes the soil to be droughty. The hazard of erosion is slight.

Included in some mapped areas of this soil are small areas of Chacon, Cotulla, and Uvalde soils. The Chacon and Uvalde soils have a loamy surface layer and are on slightly higher parts of the landscape. The Cotulla soils are on landforms similar to those of the Montell soils. They have a similar profile but are browner. The included soils make up less than about 10 percent of a mapped area.

Most areas of this soil are in irrigated cropland or are in pasture and hay. Some areas are used as rangeland and for wildlife habitat.

This soil is poorly suited to nonirrigated cropland but is moderately well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. Where the soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. In addition, moderate salinity hinders the yields of some crops. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil is protected by keeping crop residue on and

near the soil surface. This soil is difficult to till at most moisture levels because of the high clay content. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses and help minimize the hazard of salt accumulation in the soil. Leaching of the soil may be needed where salt has accumulated.

This soil is poorly suited to nonirrigated pasture and hay and is moderately well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit the areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning dove are plentiful along the borders of fields and in and around grain fields.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; slow strength, which affects roads and streets; and corrosivity of uncoated steel. Significant limitations for recreational developments are the clayey surface, very slow permeability, and excess salts.

This soil is in capability subclass IVs, nonirrigated, and IIIs, irrigated. This soil is in the Clay Flat range site.

MOA—Montell clay, nearly level. This deep, clayey soil is on uplands. The surface is plane to slightly convex. Slopes are mostly less than 0.5 percent. Areas are mostly large and irregular in shape. Most areas are more than 150 acres, and many areas are more than 1,000 acres.

Montell soils comprise about 80 percent of this unit. The remaining 20 percent is Chacon, Cotulla, and Uvalde soils. The Chacon and Uvalde soils have a loamy surface layer and are on slightly higher parts of the landscape. The Cotulla soils are in positions similar to that of the Montell soil but are browner. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of these soils.

Typically, this soil has a surface layer of gray, very firm clay about 30 inches thick. The soil is brown, very firm clay from 30 to 38 inches. The underlying material is very pale brown clay and about 10 percent by volume visible calcium carbonate and gypsum. This soil is moderately alkaline and calcareous throughout.

This Montell soil is moderately well drained. Surface runoff is very slow. Permeability is very slow. Available water capacity is low. Water enters the soil rapidly when the soil is dry and cracked, but it enters very slowly when the soil is wet and the cracks are closed. The soil is slightly affected to moderately affected by salts in some parts of the upper 24 inches of the soil. It is moderately affected to strongly affected below a depth of 24 inches. The salt affects the available water capacity and causes the soil to be droughty. The hazard of erosion is low.

This soil is used mostly as rangeland and for wildlife habitat. A few areas are in cropland or are used for pasture.

The potential plant community for rangeland and wildlife habitat is open grassland. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, are in these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and

corrosivity of uncoated steel. Significant limitations for recreational development are the clayey surface, very slow permeability, and excess salts.

This soil is not assigned to a capability subclass. It is in the Clay Flat range site.

OMD—Olmos very gravelly loam, undulating. This very shallow to shallow, very gravelly soil is on uplands. The surface is convex. The areas are irregular in shape and are 10 acres to several hundred acres in size. Slopes range from 1 to 8 percent but are more commonly 2 to 5 percent.

Olmos soils make up about 75 percent of this unit. The remaining 25 percent is made up of other soils, such as Batesville, Jimenez, Valco, Randado, Zapata soils, and a soil which is similar to this Olmos soil but is redder and has only a few coarse fragments of caliche. Most of these soils commonly are on the caps of the hills. The Jimenez and Zapata soils also are on the side slopes. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of the soils.

Typically, the surface layer of the Olmos soil is dark grayish brown, friable very gravelly loam about 14 inches thick. Below this is a thick bed of caliche that is strongly cemented or indurated in the upper few inches. The soil is calcareous and moderately alkaline throughout.

This Olmos soil is well drained. Surface runoff is medium. Permeability is moderate above the caliche layer. Available water capacity is very low. The rooting zone is very shallow to shallow. Water erosion is a moderate to severe hazard.

This soil is used as rangeland and for wildlife habitat. The caliche can be used for construction.

This soil is not suited to cropland, pasture, or hay. The major limiting features of this soil are the very gravelly surface layer, the very shallow to shallow depth of the soil, the very low available water capacity, and the hazard of erosion.

The potential plant community for rangeland and wildlife habitat is open grassland and a variety of scattered woody plants and perennial forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. The very shallow and shallow depth and the large amount of gravel cause the soil to be droughty. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, a few mourning dove, and a few songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban and recreational developments are the very gravelly surface layer, the very shallow to shallow depth to a cemented pan, and the corrosivity of uncoated steel.

This soil is not assigned to a capability subclass. It is in the Shallow Ridge Range site.

Pa—Pits. Pits are areas that have been excavated for mining. They range from 2 acres to as much as 50 acres in size and from 5 to 20 feet in depth. In these areas, caliche, gravel, and sandstone have been removed for use in construction.

Pits have limited potential for most uses. Some areas can be developed for wildlife habitat, for recreation areas, as a source of water for livestock, and for limited grazing.

This unit is not assigned to a capability subclass or to a range site.

Po—Poteet fine sandy loam, frequently flooded. This deep, nearly level, loamy soil is in weakly depressional drainageways. The surface is slightly concave or plane. Slopes are 0 to 1 percent. The areas are long and narrow and parallel the small drainageways. They range from 75 to 500 acres.

Typically, the surface layer is very friable, dark brown fine sandy loam about 16 inches thick. The soil is reddish brown fine sandy loam from 16 to 24 inches. The

subsoil is sandy clay loam to a depth of 64 inches. It is yellowish brown in the upper part, brown and light brown in the middle part, and reddish yellow in the lower part. This soil is slightly acid in the upper part and grades to moderately alkaline in the lower part.

The Poteet soils are moderately well drained. Surface runoff and permeability are slow. Available water capacity is moderate. This soil is flooded at least 1 year out of every 2 years and in some areas as often as 2 or 3 times a year. The flooding is characterized by shallow, relatively slow moving water that lasts only a few hours after rains. The hazard of water erosion is slight.

Included with this soil in mapping are small areas of a soil which is similar to this Poteet soil but has a more clayey subsoil and other areas where the soil has a sandy clay loam or clay loam surface layer. Also included are small areas of Brundage, Chacon, Cochina, Montell, and Zavco soils. The included soils make up as much as 15 percent of some mapped areas.

Most areas of this soil are used as rangeland and for wildlife habitat. A few areas are in pasture and hay, and a few areas are used for small grain and forage sorghum.

This soil is poorly suited to cropland because of frequent flooding. It is moderately well suited to pasture and hay; however, flooding can be damaging at times. Proper management of pasture and hay includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential community for rangeland and wildlife habitat is open grassland and scattered woody plants and some forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are frequent flooding; low strength, which affects roads and streets; and corrosivity of uncoated steel. The significant limitation for recreational development is flooding.

This soil is in capability subclass Vw, nonirrigated. It is in the Tight Sandy Loam range site.

PrA—Pryor sandy clay loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on uplands. The surface is plane to slightly convex. The areas are irregular in shape and average about 50 acres in size.

Typically, the surface layer is a grayish brown, friable sandy clay loam about 12 inches thick. The upper part of the subsoil is light olive brown, firm clay from 12 to 22 inches. The middle part is light yellowish brown, firm clay from 22 to 28 inches. The lower part is yellow clay loam from 28 to 42 inches. It has a few concretions of calcium carbonate. The underlying material is pale yellow shale. This soil is calcareous and moderately alkaline.

This Pryor soil is well drained. Surface runoff and permeability are slow. The salinity of the soil is slight to moderate. The available water capacity is moderate. Where the soil has a higher salinity level, it correspondingly has a lower available water capacity and is more droughty. The hazard of erosion is slight.

Included in some mapped areas of this soil are small areas of Chacon, Maverick, and Tonio soils. The Chacon soils are in the lower parts of the landscape and are darker in color. The Maverick and Tonio soils are on slightly higher parts of the landscape. The included soils make up less than 15 percent of a mapped area.

Most areas of this soil are used as irrigated cropland or for pasture and hay. Small areas are used as rangeland and for wildlife habitat.

This soil is poorly suited to nonirrigated cropland but is moderately well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. Where the soil

is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully (fig. 11). Moderate salinity hinders the yields of some crops. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses and help minimize the hazard of salt accumulation in the soil. Leaching of the soil may be needed where salt has accumulated.

Figure 11.—Irrigated onions being harvested. This soil is Pryor sandy clay loam, 0 to 1 percent slopes.

This soil is poorly suited to nonirrigated pasture and hay but is moderately well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass IVc, nonirrigated, and IIs, irrigated. It is in the Clay Loam range site.

PrB—Pryor sandy clay loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on uplands. The surface is convex. Areas are irregular in shape and average about 50 acres in size.

Typically, the surface layer of this soil is grayish brown, friable sandy clay loam 10 inches thick. The upper part of the subsoil is light yellowish brown, firm clay loam from 10 to 24 inches. It has many soft masses of lime. The lower part of the subsoil is pale yellow, very firm clay from 24 to 46 inches. It has many soft masses of calcium carbonate. The underlying material is pale yellow shale clay. This soil is calcareous and moderately alkaline throughout.

This Pryor soil is well drained. Surface runoff is medium. Permeability is slow. Available water capacity is moderate. Salinity ranges from slight to moderate. Where the soil has higher salinity, it correspondingly has lower available water capacity and is more droughty. The hazard of water erosion is moderate.

Included with this soil in mapping are small areas of Chacon, Maverick, and Tonio soils. The Chacon soils are on the lower parts of the landscape and are darker in color. The Maverick and Tonio soils are on the higher parts. The included soils make up less than 15 percent of a mapped area.

Most areas of this Pryor soil are used for irrigated cropland or are in pasture and hay. Small areas are used as rangeland and for wildlife habitat.

This soil is poorly suited to nonirrigated cropland but is moderately well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. Where the soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. In addition, moderate salinity hinders the yields of some crops. Cropping systems that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. Terraces, contour farming, and grassed waterways are needed in some areas. In irrigated areas, a well designed irrigation system and proper management of irrigation water helps control soil and water losses and helps minimize the hazard of salt accumulation in the soil. Leaching of the soil may be needed where salt has accumulated.

This soil is poorly suited to nonirrigated pasture and hay and is moderately well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning dove are plentiful along field borders and in and around grain fields.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass IVe, nonirrigated, and IIe, irrigated. It is in the Clay Loam range site.

PYB—Pryor sandy clay loam, gently undulating. This deep, loamy soil is on uplands. The surface is convex to plane. Slopes are mostly 1 to 3 percent but range from 0 to 3 percent. Areas are irregular in shape and range from about 100 acres to more than 1,000 acres in size.

Pryor soils make up about 70 percent of this unit. Of this 70 percent, about 15 percent is Pryor sandy clay loam, 0 to 1 percent slopes, and 25 percent is Pryor sandy clay loam, 1 to 3 percent slopes. Ten percent is a Pryor soil that has a clay loam surface layer and slopes of 0 to 1 percent and 20 percent is a Pryor clay loam that has slopes of 1 to 3 percent. The remaining 30 percent is made up of Brundage, Chacon, Maverick, Montell, and Tonio soils. Brundage soils are along the small drainageways. Chacon and Montell soils are in low positions just above the drainageways. Maverick and Tonio soils are on the higher parts of the landscape. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of these soils.

Typically, the surface layer of the Pryor soil is grayish brown, friable sandy clay loam about 9 inches thick. The upper part of the subsoil is firm clay from 9 to 32 inches. It is brown in the upper part and pale brown in the lower part. The lower part of the subsoil is light yellowish brown, firm clay from 32 to 46 inches. The underlying material is very pale brown clayey shale. This soil is calcareous and moderately alkaline throughout.

These Pryor soils are well drained. Surface runoff is slow to medium. Permeability is slow. Salinity is slight to moderate. The available water capacity is generally moderate. Where the soils have higher salinity levels, they have low available water capacity and are more droughty. The hazard of water erosion is slight to moderate.

This soil is used mostly as rangeland and for wildlife habitat. A few areas are used for cropland or are in pasture.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded by variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Predators, such the coyote and bobcat, frequent the area.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This map unit is not assigned to a capability subclass. It is in the Clay Loam range site.

RAC—Randado fine sandy loam, gently undulating. This shallow, loamy soil is on uplands. The surface is convex. Slopes range from 1 to 5 percent. Areas are round to irregular in shape and range from about 15 to 100 acres in size.

Randado soils make up about 70 percent of this unit. The remaining 30 percent is made up of Brystal, Dilley, Duval, Tonio, and Verick soils and a soil which is similar to Randado soils but has caliche at a depth of 20 to 40 inches. The Brystal, Duval, and Tonio soils are in deeper pockets, mainly on the lower parts of the landscape. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer of Randado soils is yellowish red, very friable, mildly alkaline fine sandy loam about 7 inches thick. The subsoil is about 8 inches thick. It is yellowish red, neutral sandy clay loam. The underlying material is caliche that is strongly cemented in the upper few inches and weakly cemented below.

The Randado soils are well drained. Surface runoff is medium. Permeability above the caliche layer is moderate. Available water capacity is very low. The rooting depth is shallow. This soil is droughty. Water erosion is a moderate hazard.

This soil is used mostly as rangeland and for wildlife habitat. This soil can be mined for caliche for construction purposes.

The potential plant community for rangeland and wildlife habitat is open grassland and a few, scattered woody plants and a wide variety of forbs. After years of heavy grazing, most areas have been invaded by variable amounts of brush. Deer and javelina are in these areas but are less common than in areas where the soils are deeper. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and songbirds are in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The most limiting feature for most urban uses and for recreational development is the depth to the cemented caliche layer.

This soil is not assigned to a capability subclass. It is in the Shallow Sandy Loam range site.

Tc—Tiocano clay. This deep, nearly level, clayey soil is in slightly depressional, intermittent lakebeds. The surface is concave, and slopes are less than about 0.5 percent. The areas are round and most are 2 to 30 acres in size.

Typically, the surface layer is dark gray, very firm clay about 32 inches thick. It has many very fine reddish brown mottles in the upper part. The soil is gray, very firm clay from 32 to 52 inches. The underlying material is light brownish gray clay and has a few fine masses of calcium carbonate.

This soil is somewhat poorly drained. It is ponded or inundated after heavy rains and remains wet for several weeks. Permeability is very slow. Water enters the soil rapidly when the soil is dry and cracked, but it enters at a very slow rate when the soil is wet and the cracks are closed. Available water capacity is high. The hazard of erosion is slight.

Included with this soil in mapping are small areas of Cochina and Montell soils that are on the slightly higher outer edges of the lakebeds. Also included are small areas of a soil which is similar to this Tiocano soil but has a sandy surface layer more than 6 inches thick. The included soils make up less than 10 percent of a mapped area.

All of this soil is used as rangeland and for wildlife habitat.

The potential plant community for rangeland and wildlife habitat is open grassland that has varying degrees of wetness. These areas vary greatly in the types of wildlife that inhabit them. Some areas are so wet that sedges and rushes dominate. Deer inhabit these wetter areas during the winter and in dry periods. Furbearers inhabit the area heavily, especially when the soil is ponded. Feral, or wild domestic hogs, root and wallow here frequently. Quail feed on the many insects during the summer. When the soil is ponded, turkey and songbirds are in these areas.

The major limiting features for most urban uses are ponding; shrinking and swelling with changes in moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Ponding, very slow permeability, and the clayey surface limit recreational development.

This soil is in capability subclass VIw, nonirrigated, and the Lakebed range site.

TnA—Tonio fine sandy loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on uplands. The surface is plane to slightly convex. Areas of this soil are round to irregular in shape and range from about 10 to 80 acres in size.

Typically, the surface layer is brown, moderately alkaline, very friable fine sandy loam about 9 inches thick. The subsoil is moderately alkaline, friable sandy clay loam 47 inches thick. It is pale brown in the upper 22 inches, light yellowish brown in the middle 13 inches, and very pale brown in the lower 12 inches. The underlying material is very pale brown, soft sandstone and has seams of calcium carbonate.

This Tonio soil is well drained. Permeability is moderate. Surface runoff is slow. Available water capacity is moderate. Water erosion is a slight hazard, and wind erosion is a moderate hazard.

Included with this soil in mapping are small areas of gently sloping Tonio soils and small areas of Brystal, Cad, and Duval soils. The included soils make up less than about 15 percent of a mapped area.

This soil is used mostly as irrigated cropland, but small areas are in nonirrigated cropland and rangeland or are in pasture and hay.

This soil is poorly suited to nonirrigated cropland but is moderately well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. If the soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. A well designed irrigation system and proper management of irrigation water help control soil and water losses. Some crops might develop chlorosis, yellowing of the leaves, because of the lime. This problem can be treated by application of amendments of iron.

This soil is moderately well suited to irrigated pasture and hay. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and scattered woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas, Bobwhite quail and mourning dove are plentiful along field borders and in and around grain fields. Predators, such as the coyote and bobcat, frequent the areas.

The major limitations for most urban uses are low strength, which affects roads and streets, and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass IVc, nonirrigated, and IIs, irrigated. It is in the Gray Sandy Loam range site.

TnB—Tonio fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on uplands. The surface is convex. Areas of this soil are round to irregular in shape and range from about 10 to 200 acres in size.

Typically, the surface layer is brown, moderately alkaline, very friable fine sandy loam 8 inches thick. The subsoil is moderately alkaline, friable sandy clay loam 38 inches thick. It is light yellowish brown in the upper 14 inches, light brown in the middle 10 inches, and pink in the lower 14 inches. The underlying material is pink, soft sandstone and has seams of calcium carbonate.

This Tonio soil is well drained. Permeability and surface runoff are moderate. Available water capacity is moderate. Water erosion and wind erosion are moderate hazards.

Included with this soil in mapping are small areas of nearly level Tonio soils and areas of Brystal, Caid, and Duval soils. The included soils make up less than 15 percent of a mapped area.

This soil is used mostly as irrigated cropland. Small areas are in nonirrigated cropland and rangeland or are in pasture and hay.

This soil is poorly suited to nonirrigated cropland but is moderately well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. Where this soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. This soil can be protected by keeping

crop residue on and near the surface. Terraces, contour farming, and grassed waterways help control erosion in some areas. A well designed irrigation system and proper management of irrigation water help control soil and water losses. Some crops might develop chlorosis, a yellowing of the leaves, on this soil. Chlorosis can be treated with applications of amendments of iron.

This soil is moderately well suited to irrigated pasture and hay. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and scattered woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning dove are plentiful along field borders and in and around grain fields. Predators, such as the coyote and bobcat, frequent the areas.

The major limitations for most urban uses are low strength, which affects roads and streets, and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass IVe, nonirrigated, and IIe, irrigated. It is in the Gray Sandy Loam range site.

TOB—Tonio fine sandy loam, gently undulating. This deep, loamy soil is on uplands. Slopes range from 0 to 3 percent. The areas are round to irregular in shape and range from about 30 to 300 acres in size.

This map unit is made up of about 35 percent Tonio fine sandy loam, 1 to 3 percent slopes; 12 percent Tonio fine sandy loam, 0 to 1 percent slopes; 25 percent Tonio sandy clay loam, 1 to 3 percent slopes; and 8 percent Tonio sandy clay loam, 0 to 1 percent slopes. About 15 percent is a soil similar to Tonio soils but has sandstone at depths of less than 40 inches or more than 60 inches. The remaining 5 percent includes Brystal, Caid, Pryor, and Zavco soils. The Tonio fine sandy loam mainly is on the higher parts of the landscape. Soils in this map unit could have been separated by degree of slope but because the present use and management are very similar, the separation could not be justified.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The upper part of the subsoil is brown, friable sandy clay loam from 10 to 30 inches. The lower part is sandy clay loam from 30 to 54 inches. It is light brown in the upper part and very pale brown in the lower part. The underlying material is weekly cemented sandstone to a depth of 74 inches.

This Tonio soil is well drained. Permeability is moderate, Surface runoff is slow to medium. Available water capacity is moderate. Water erosion and wind erosion are moderate hazards.

This soil is used mainly as rangeland and for wildlife habitat.

The potential plant community for rangeland and wildlife habitat is open grassland and scattered woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limitations for most urban uses are low strength, which affects roads and streets, and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is not assigned to a capability subclass. It is in the Gray Sandy Loam range site.

UdA—Uvalde silty clay loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on uplands. The surface is plane. Slopes are mostly less than 0.5 percent. Most areas are irregular in shape and about 150 acres in size.

The surface layer is dark grayish brown, friable silty clay loam about 17 inches thick. The subsoil is about 33 inches thick. It is brown, firm silty clay loam in the upper part and very pale brown, friable silty clay loam in the lower part. The lower part has many small, hard masses of calcium carbonate. The underlying material is very pale brown silty clay loam and a few small masses of calcium carbonate. It is calcareous and moderately alkaline throughout.

This Uvalde soil is well drained. Surface runoff is slow. Permeability is moderate. Available water capacity is high. The hazard of erosion is slight.

Included in some mapped areas of this soil are small areas of Bookout, Caid, Chacon, Montell, and Tonio soils. The Bookout and Tonio soils are on the slightly higher parts of the landscape. They are along the outer margins of the mapped areas. The Chacon and Montell soils are generally on slightly lower parts of the landscape. The included soils make up as much as 15 percent of a mapped area.

Most areas of this soil are in irrigated cropland, pasture, and hay. Small areas are used for nonirrigated cropland, pasture, and hay; as rangeland; and for wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat, and other cool-season crops generally are satisfactory on nonirrigated cropland. If this soil is irrigated, cotton (fig. 12), corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops, helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful; A few furbearing animals inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning dove frequently are along field borders and in grain fields.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This map unit is in capability subclass IIIc, nonirrigated, and I, irrigated. It is in the Clay Loam range site.

UdB—Uvalde silty clay loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on uplands. The surface is convex. Slopes are mostly 1 to 2 percent but range to 3 percent. The areas are mostly long and narrow and follow the contours of the slope. They are above the drainageways. Some areas are irregular in shape and average about 75 acres in size.

Figure 12.—Harvesting irrigated cotton on Uvalde silty clay loam, 0 to 1 percent slopes.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 15 inches thick. The subsoil is about 31 inches thick. It is brown, firm silty clay loam in the upper 11 inches and very pale brown, firm silty clay loam in the lower 20 inches. The underlying material is very pale brown silty clay loam to a depth of 64 inches. It has many, small hard masses of calcium carbonate. This soil is calcareous and moderately alkaline throughout.

This Uvalde soil is well drained. Surface runoff is medium. Permeability is moderate. Available water capacity is high. Water erosion is a moderate hazard.

Included with this soil in mapping are small areas of Bookout, Caid, and Tonio soils and small areas of nearly level Uvalde soils. The included soils make up as much as 15 percent of a mapped area.

Most areas of this soil are in irrigated cropland, pasture, and hay. Small areas are used as nonirrigated cropland and rangeland and for wildlife habitat or for pasture and hay.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. Where this soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during

the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. Terraces, contour farming, and grassed waterways help control erosion in some areas. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

The soil is moderately well suited to nonirrigated pasture and hay and is well suited to pasture and hay where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning dove frequently are along field borders and in grain fields.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass, IIIe, nonirrigated, and IIe, irrigated. It is in the Clay Loam range site.

UVB—Uvalde silty clay loam, nearly level. This deep, loamy soil is on uplands. The surface is plane to convex. Slopes are mainly less than 1 percent but range from 0 to 3 percent. The areas are mostly irregular in shape and range in size from a few hundred acres to several thousand acres.

Uvalde soils make up about 85 percent of this unit. The remaining 15 percent is made up of Bookout, Caid, Chacon, Montell, Pryor, Tonio, and Valco soils. The Bookout, Pryor, Tonio, and Valco soils are on the slightly higher parts of the landscape. Chacon and Montell soils are on slightly lower parts. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 15 inches thick. The subsoil is about 34 inches thick. It is brown, friable silty clay loam in the upper part and light yellowish brown, friable silty clay loam in the lower part. The lower part of the subsoil has many soft and hard masses of calcium carbonate. The underlying material is very pale brown silty clay loam that has many soft and hard masses of calcium carbonate. This soil is calcareous and moderately alkaline throughout.

This Uvalde soil is well drained. Surface runoff is slow to medium.

Permeability is moderate. Available water capacity is high. The hazard of erosion is slight to moderate.

Most areas of this soil are used as rangeland and for wildlife habitat.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon inhabit these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil has not been assigned to a capability subclass. It is in the Clay Loam range site.

VAB—Valco clay loam, gently undulating. This shallow, loamy soil is on uplands. The surface is convex. Slopes range from 0 to 3 percent. Areas are round to irregular in shape and range from about 10 to 200 acres in size.

Valco soils make up about 70 percent of the unit. Batesville soils make up about 15 percent. The remaining 15 percent is Bookout, Olmos, Uvalde, Verick, and Zapata soils. Bookout and Uvalde soils are in deeper pockets on slightly lower parts of the landscape. Olmos and Zapata soils are on the higher parts. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer is dark grayish brown, friable clay loam 9 inches thick. The next layer is about 8 inches thick. It is dark brown, friable clay loam and has a few small, hard masses of calcium carbonate. The underlying material is caliche that is strongly cemented in the upper part. This soil is calcareous and moderately alkaline throughout.

Valco soils are well drained. Surface runoff is slow to medium. Permeability above the caliche layer is moderate. Available water capacity is very low. The rooting depth is shallow. Water erosion is a moderate hazard.

Most areas of this soil are used as rangeland and for wildlife habitat. A few areas are used for cropland or are in pasture. The caliche can be used for construction.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional, scattered woody shrubs and perennial forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are in these areas but are less common than in areas where the soils are deeper. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The most limiting feature for most urban uses and recreational development is the depth of soil to the cemented caliche.

This soil is not assigned to a capability subclass. It is in the Shallow range site.

VEC—Verick fine sandy loam, gently undulating. This shallow, loamy soil is on uplands. The surface is convex. Slopes range from 1 to 5 percent. The areas are round to irregular in shape and range from about 10 to 150 acres in size.

Verick soils make up about 75 percent of this unit. The remaining 25 percent is made up of small areas of Batesville, Caid, Dilley, Maverick, Randado, Tonio, Valco, and Zapata soils and a soil which is similar to Verick soils but which has sandstone at a depth of less than 10 inches or more than 20 inches. The Batesville, Caid, and Tonio soils are in small, deep pockets on the caps of the low hills or along the foot slopes. Dilley and Randado soils are redder than the Verick soil and are in pockets on uplands. Zapata soils are on the highest parts of the landscape. The composition of this unit is more variable than that of the other units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer of Verick soil is brown fine sandy loam about 5 inches thick. The subsoil is pale brown, friable sandy clay loam about 12 inches thick. The underlying material is very pale brown, weakly cemented sandstone. This soil is calcareous and moderately alkaline throughout.

This Verick soil is well drained. Surface runoff is medium to rapid. Permeability is moderate. Rooting depth is shallow. This soil is droughty. Available water capacity is very low. Wind erosion and water erosion are moderate hazards.

This soil is used mostly as rangeland or for wildlife habitat. A few areas are used for cropland or are in pasture.

The potential plant community for rangeland and wildlife habitat is open grassland and scattered woody plants. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are in these areas but are

less common than in areas where soils are deeper. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and songbirds also are in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The most limiting feature for most urban uses and recreational development is the depth of the soil to sandstone.

This soil is not assigned to a capability subclass. It is in the Gray Sandy Loam range site.

WbB—Webb fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping soil is on uplands. The surface is convex. Slopes are mostly less than 2 percent. The areas are round and range from about 10 to 30 acres in size.

Typically, the surface layer is reddish brown, very friable fine sandy loam about 10 inches thick. The subsoil is 34 inches thick. It is yellowish red, friable sandy clay loam in the upper 5 inches; red, firm sandy clay in the middle 7 inches; and yellowish red, firm sandy clay in the lower 22 inches. The underlying material is reddish yellow sandy clay loam to a depth of 64 inches. It has many soft masses of calcium carbonate and a few sandstone fragments. This soil is slightly acid in the surface layer and subsoil and is moderately alkaline and calcareous in the underlying material.

This Webb soil is well drained. Surface runoff is medium. Permeability is moderately slow. Available water capacity is high. Erosion is a moderate hazard.

Included in some mapped areas of this soil are small areas of nearly level Webb soils. Small areas of Brystal, Dilley, Duval, and Zavco soils are also included. The Brystal, Dilley, and Duval soils are on the higher parts of the landscape. The Zavco soils are on the lower parts. These soils make up as much as 15 percent of a mapped area.

Most areas of this soil are used as irrigated cropland or for pasture and hay. A few areas are used for nonirrigated pasture and hay; as rangeland; and for wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated cropland. Where the soils are irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. Terraces, contouring, and grassed waterways are needed in some areas. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited to pasture and hay where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and scattered woody plants and some forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning dove frequently are along field borders and in grain fields.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Tight Sandy Loam range site.

WEB—Webb fine sandy loam, gently undulating. This deep, loamy soil is on uplands. The surface is plane to convex. Slopes range from 0 to 3 percent, but they are mostly less than 2 percent. The areas are round to irregular in shape and are mostly 50 to 500 acres in size.

Webb soils make up about 80 percent of this unit. The remaining 20 percent is made up of Brystal, Caid, Dilley, Duval, Tonio, and Zavco soils. A few spots are eroded. The Brystal, Dilley, Duval, and Tonio soils mostly are on the higher parts of the landscape. Caid and Zavco soils mostly are on the lower parts. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of the soils.

Typically, the surface layer is reddish brown, very friable fine sandy loam about 10 inches thick. The subsoil is 30 inches thick. It is reddish brown, friable sandy clay loam in the upper 3 inches and red, very firm sandy clay in the lower 27 inches. The underlying material is yellowish red sandy clay loam to a depth of 64 inches. It has many films and threads of calcium carbonate and a few sandstone fragments. This soil is slightly acid in the surface layer and subsoil and is calcareous and moderately alkaline in the underlying material.

This Webb soil is well drained. Surface runoff is slow to medium. Permeability is moderately slow. Available water capacity is high. Erosion is a slight to moderate hazard.

Most areas of this soil are used as rangeland and for wildlife habitat.

The potential plant community for rangeland and wildlife habitat is open grassland and scattered woody plants and some forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is not assigned to a capability subclass. It is in the Tight Sandy Loam range site.

WnA—Winterhaven silty clay loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on bottom land. The surface is plane. Slopes are mostly less than 0.5 percent. Areas of this soil are mostly long and are parallel to the river. Most areas are 100 to 500 acres or more.

Typically, the surface layer is light brownish gray, friable silty clay loam 17 inches thick. The subsoil is about 19 inches thick. It is pale brown, friable silty clay loam. The underlying material is very pale brown clay loam and loam and thin lenses and pockets of darker silt loam, loam, and silty clay loam. This soil is calcareous and moderately alkaline throughout.

This Winterhaven soil is well drained. Surface runoff is slow. Permeability is moderate. Available water capacity is high. Flooding is rare. The hazard of water erosion is slight.

Included with this soil in mapping are small areas of Bookout, Conalb, and Divot soils. The Bookout soils are on slightly higher parts of the landscape. Conalb soils are near the streambed. Divot soils are dark spots in the lower parts of the landscape. The included soils make up less than 10 percent of a mapped area.

Most areas of this soil are used as irrigated cropland or for pasture and hay. The rest is in small areas of nonirrigated cropland, pasture, and hay; rangeland; and wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland (fig. 13). Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated cropland. If this soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. This soil can be protected by keeping crop residue on and near the surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

Figure 13.—Irrigated spinach being harvested for market. The soil is Winterhaven silty clay loam, 0 to 1 percent slopes.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is a mixture of trees, shrubs, grasses, and forbs. The vegetation varies depending on frequency and amount of overflow and the position on the bottom land. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these

areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning dove are plentiful along field borders and in and around grain fields.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and streets; rare flooding; and corrosivity of uncoated steel. The significant limitation for recreational development is the rare flooding of camp areas.

This soil is in capability subclass IIIc, nonirrigated, and capability class I, irrigated. This soil is in the Loamy Bottomland range site.

WnB—Winterhaven silty clay loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on bottom land. The surface is convex. Most slopes are short. Areas of this soil are generally long and narrow and parallel the river. Most areas are less than 100 acres.

Typically, the surface layer is brown, friable silty clay loam 16 inches thick. The subsoil is 18 inches thick. It is pale brown, friable silty clay loam. The underlying material is light yellowish brown silty clay loam to a depth of 60 inches. It has lenses and pockets of darker silt loam and loam. This soil is calcareous and moderately alkaline throughout.

This Winterhaven soil is well drained. Surface runoff is medium. Permeability is moderate. Available water capacity is high. Flooding is rare. Water erosion is a severe hazard.

Included with this soil in mapping are small spots of Bookout and Conalb soils. The Bookout soils are on the higher parts of the landscape. Conalb soils are on the lower parts. The included soils make up less than about 10 percent of a mapped area.

Most areas of this soil are used as irrigated cropland or for pasture and hay. The rest is in small areas of nonirrigated cropland, pasture, hay; rangeland; and wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated cropland. If this soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. Terraces, contouring, and grassed waterways are needed in some areas. In irrigated areas, a well designed irrigation system and proper management of irrigation water helps control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is a mixture of trees, shrubs, grasses, and forbs. The vegetation varies depending on the frequency and amount of overflow and the position on the landscape. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning dove are plentiful along field borders and in and around grain fields.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; rare flooding; and corrosivity of uncoated steel. The significant limitation for recreational development is the rare flooding of camp areas. There are no other significant limitations.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Loamy Bottomland range site.

Wv—Winterhaven silty clay loam, frequently flooded. This deep, nearly level, loamy soil is on bottom land. The surface is convex. Slopes are dominantly 0 to 1 percent and are short. Sharp breaks are along stream channels. Areas of this soil are long and narrow. They parallel and cross the stream channels. Most areas are only a few hundred feet wide but are several miles long.

Typically, the surface layer is friable silty clay loam 24 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The subsoil is pale brown silty clay loam about 10 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches. It has thin lenses and pockets of slightly darker loam and silt loam. This soil is calcareous and moderately alkaline throughout.

This Winterhaven soil is well drained. Surface runoff is slow to medium. Permeability is moderate. Available water capacity is high. This soil is flooded at least 1 year out of every 2 years after heavy rains, mostly during the spring and fall months. The flooding lasts for several hours to a few days. Water erosion is a slight hazard.

Included in some mapped areas of this soil are small areas of Winterhaven soils that are flooded less often and small areas of Conalb and Divot soils. The Conalb soils are sandier and are mostly just above the stream channel. The Divot soils are darker areas on bottom land. Also included are some steep loamy soils on slope breaks along the channel. The included soils make up as much as 15 percent of a mapped area.

Most areas of this soil are used for rangeland and as wildlife habitat. A few areas are in pasture.

This soil is not suited to cropland because of the frequent flooding, but it is well suited to nonirrigated pasture and hay. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are the better adapted grasses. Proper management of pasture and hay includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is a mixture of trees, shrubs, grasses, and forbs. The vegetation varies depending on the frequency and amount of overflow and the position on the landscape. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are frequent flooding; shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. A significant limitation for recreational development is the frequent flooding.

This soil is in capability subclass Vw, nonirrigated, and the Loamy Bottomland range site.

YHD—Yologo-Hindes association, undulating. This map unit is made up of shallow and moderately deep, very gravelly soils. The surface is convex. Slopes range from 1 to 8 percent but are more commonly between 2 and 6 percent. The areas of this soil are round to irregular in shape and are 25 acres to more than 1,000 acres in size.

Yologo soils make up about 47 percent of this association, and Hindes soils make up about 36 percent. About 7 percent is Olmos soils, and the remaining 10 percent is made up of Caid, Chacon, Randado, Valco, Webb, and Zavco soils. The Hindes soils are mostly on the caps, and the Yologo soils are on the caps of low hills and on the side slopes. The Caid, Chacon, Webb, and Zavco soils are in lower positions between the hills. Randado and Valco soils are on the caps of some hills. In most areas, the soils could have been mapped separately at the scale used; however, mapping has been controlled well enough for anticipated use of the soils.

Typically, the surface layer of the Yologo soil is reddish brown, friable, neutral very gravelly loam about 7 inches thick. The subsoil is 8 inches thick. It is reddish brown, friable, mildly alkaline very gravelly sandy clay loam. Below 15 inches is whitish caliche that is indurated in the upper few inches (fig. 14).

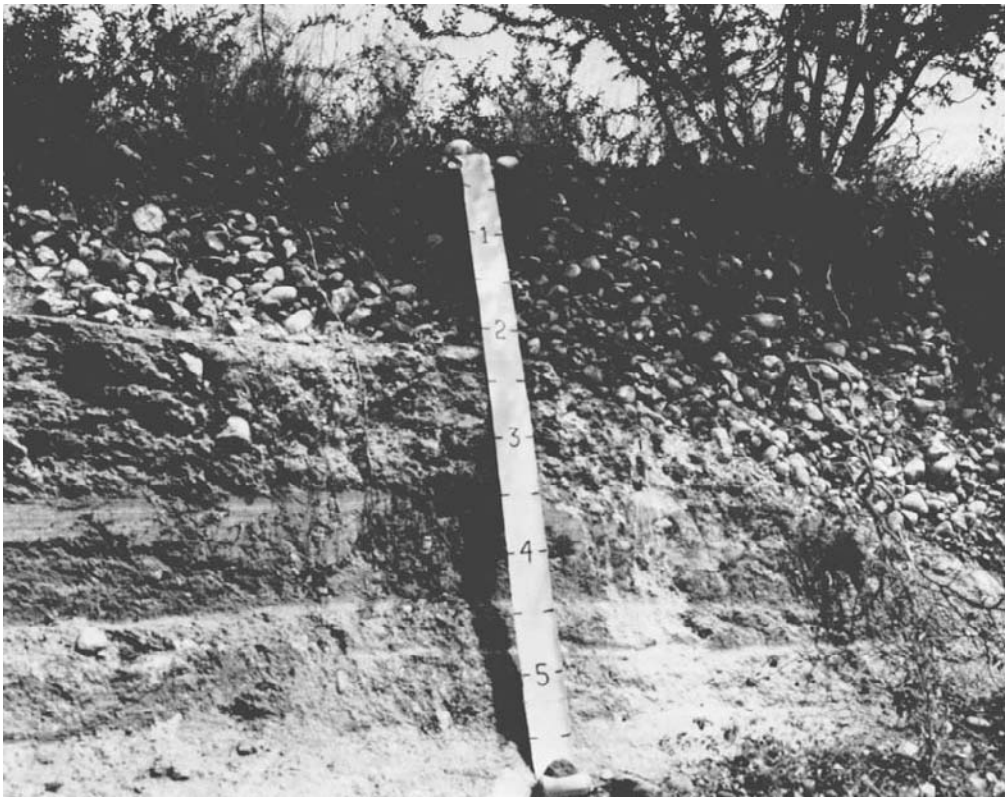


Figure 14.—Profile of Yologo very gravelly loam and Hindes very gravelly sandy clay loam in an area of Yologo-Hindes association, undulating. The Yologo soil is to the left of the marker, and the Hindes soil is to the right.

Typically, the surface layer of the Hindes soil is reddish brown, friable, slightly acid very gravelly sandy clay loam about 10 inches thick. The subsoil is reddish brown, firm, slightly acid very gravelly clay about 22 inches thick. Below 32 inches is pink, hard caliche.

The Yologo and Hindes soils are well drained. Surface runoff is medium on the crest of the hills and rapid on the side slopes. Permeability above the caliche layer is moderate in the Yologo soils and is moderately slow in the Hindes soils. Available water capacity is very low in both soils. The rooting zone is very shallow to moderately deep. These soils are droughty. Water erosion is a moderate hazard.

This soil association is used as rangeland and for wildlife habitat. The caliche can be mined for construction purposes.

This soil association is not suited to cropland or pasture because of the soil depth, gravel, slope, and low rainfall.

The potential plant community for rangeland and wildlife habitat is open grassland and a variety of scattered woody shrubs and perennial forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, a few mourning doves, and a few songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban and recreational uses are the gravelly texture, very shallow to moderate depth to a cemented pan, slope, and corrosivity of uncoated steel.

This soil is not assigned to a capability subclass. It is in the Gravelly Ridge range site.

ZAD—Zapata gravelly loam, gently undulating. This very shallow gravelly loam is on uplands. The surface is convex. Slopes range from 1 to 5 percent. Areas of this soil are irregular in shape and are 15 to 250 acres.

Zapata soil makes up about 80 percent of this unit. The remaining 20 percent is made up of Olmos, Valco, and Verick soils and a soil which is similar to the Zapata soil but which is more than 10 inches to caliche. The composition of the unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for anticipated use of the soils.

Typically, the surface layer is pale brown, very friable gravelly loam about 7 inches thick. The underlying material is caliche that is strongly cemented or indurated in the upper few inches. This soil is calcareous and moderately alkaline throughout.

The Zapata soil is well drained. Surface runoff is medium. Permeability is moderate above the caliche layer. Available water capacity is very low. Rooting depth is very shallow. This soil is droughty because of depth and gravel. Water erosion is a moderate to severe hazard.

This soil is used as rangeland and for wildlife habitat. The caliche is a source of material for construction.

This soil is unsuitable for cropland or pasture and hay.

The potential plant community for rangeland and wildlife habitat is open grassland and a variety of scattered woody plants and perennial forbs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are less plentiful in these areas than in other areas because of the scarcity of vegetative cover. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, a few mourning doves, and a few songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for urban and recreational uses of the soil are the very shallow depth to a cemented pan and corrosivity of uncoated steel.

This soil is not assigned to a capability subclass. It is in the Shallow Ridge range site.

ZcA—Zavco sandy clay loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is on uplands. The surface is plane. Areas of this soil are mostly round to irregular in shape. Some areas along shallow drainageways are long and narrow. The areas range from about 5 to 50 acres.

Typically, the surface layer is dark brown, friable, mildly alkaline sandy clay loam about 10 inches thick. The upper part of the subsoil is dark brown, firm, mildly alkaline sandy clay loam from 10 to 14 inches. The middle part is reddish brown, firm,

moderately alkaline sandy clay from 14 to 34 inches. The lower part is brown, firm, moderately alkaline sandy clay loam from 34 to 50 inches. It has a few soft and hard masses of calcium carbonate. The underlying material to a depth of 62 inches is reddish yellow sandy clay loam and has a few soft and hard masses of calcium carbonate.

This Zavco soil is well drained. Surface runoff is slow. Permeability is moderately slow. Available water capacity is moderate. The hazard of erosion is slight.

Included with this soil in mapping are small areas of the gently sloping Zavco sandy clay loam and a soil similar to Zavco soils but has sandstone or caliche within 40 inches of the surface. The shallower, similar soil is on higher parts of the landscape. Other included soils are small areas of Brystal, Caid, Duval, and Webb soils. The Brystal, Caid, and Duval soils are also on the higher parts of the landscape. The included soils make up less than 15 percent of a mapped area.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated cropland. Where this soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. The soil can be protected by keeping crop residue on and near the surface. In irrigated areas, a well designed irrigation system and proper management of irrigation water help control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds also are in these areas. Bobwhite quail and mourning dove frequently are along field borders and in grain fields.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in the capability subclass IIIc, nonirrigated, and in capability class I, irrigated. It is in the Clay Loam range site.

ZcB—Zavco sandy clay loam, 1 to 3 percent slopes. This deep, gently sloping, loamy soil is on uplands. The surface is convex. Slopes are mostly less than 2 percent. The areas are round to irregular in shape and are about 5 to 25 acres in size.

Typically, the surface layer is dark brown, friable, mildly alkaline sandy clay loam about 10 inches thick. The upper part of the subsoil is brown, firm, mildly alkaline sandy clay loam from 10 to 18 inches. The middle part is firm, moderately alkaline sandy clay from 18 to 40 inches. It is reddish brown in the upper part and yellowish red in the lower part. The lower part of the subsoil is light brown, friable, moderately alkaline sandy clay loam from 40 to 56 inches. It has many soft and hard masses of calcium carbonate. The underlying material to a depth of 64 inches is reddish yellow, moderately alkaline sandy clay loam and about 20 percent, by volume, soft masses of calcium carbonate.

This Zavco soil is well drained. Surface runoff is medium. Permeability is moderately slow. Available water capacity is moderate. Water erosion is a moderate hazard.

Included with this soil in mapping are small areas of the nearly level Zavco sandy clay loam and a soil which is similar to the Zavco soils but which has sandstone or caliche within 40 inches of the surface. This shallow, similar soil is on higher parts of the landscape. Other inclusions are small areas of Brystal, Caid, Duval, and Webb soils. The Brystal, Caid, and Duval soils are also on the higher parts of the mapped areas. The included soils make up as much as 15 percent of a mapped area.

Most areas of this soil are used as irrigated cropland or for pasture and hay. Small areas are used for nonirrigated cropland, pasture, and rangeland and wildlife habitat.

This soil is moderately well suited to nonirrigated cropland and is well suited to irrigated cropland. Low rainfall limits yields from nonirrigated cropland. In years of average or above average rainfall, yields of grain sorghum, forage sorghum, and wheat and other cool-season crops generally are satisfactory on nonirrigated cropland. Where this soil is irrigated, cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables, are grown successfully. A cropping system that provides a cover during the growing season and furnishes sufficient residue to protect the soil between crops helps control erosion and conserve moisture. This soil can be protected by keeping crop residue on and near the surface. Terraces, contour farming, and grassed waterways may be needed in some areas. In irrigated areas, a well designed irrigation system and proper management of irrigation water helps control soil and water losses.

This soil is moderately well suited to nonirrigated pasture and hay and is well suited where irrigated. Improved bermudagrass, kleingrass, introduced bluestem, blue panicum, and buffelgrass are adapted grasses. Proper management includes fertilization, weed control, controlled grazing, and proper timing and methods of harvesting hay.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Bobwhite quail and mourning doves frequently are along field borders and in grain fields.

The major limiting features for most urban uses are shrinking and swelling with the changes in soil moisture; low strength, which affects roads and streets; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is in capability subclass IIIe, nonirrigated, and IIe, irrigated. It is in the Clay Loam range site.

ZVB—Zavco sandy clay loam, gently undulating. This deep, loamy soil is on uplands. The surface is plane to convex. Slopes range from 0 to 3 percent but are mostly less than 2 percent. The areas of this soil are mostly irregular in shape and range from about 20 acres to 250 acres in size.

Zavco soils make up about 80 percent of this unit. The remaining 20 percent is made up of Brystal, Caid, Duval, and Webb soils and a soil which is very similar to Zavco soils but has sandstone or caliche within 40 inches of the surface. All of these soils are on higher parts of the landscape except Webb soils. The composition of this unit is more variable than that of other map units in the survey area; however, mapping has been controlled well enough for the anticipated use of the soils.

Typically, the surface layer is dark brown, friable, neutral sandy clay loam about 11 inches thick. The upper part of the subsoil is dark reddish brown, firm, neutral

sandy clay loam from 11 to 16 inches. The middle part is reddish brown, very firm, moderately alkaline sandy clay from 16 to 36 inches. The lower part is yellowish red, firm, moderately alkaline clay loam from 36 to 56 inches. The underlying material to a depth of 72 inches is light brown, friable, moderately alkaline sandy clay loam.

This Zavco soil is well drained. Surface runoff is slow to medium. Permeability is moderately slow. Available water capacity is moderate. The hazard of erosion is slight to moderate.

Most areas of this soil are used for rangeland and as wildlife habitat.

The potential plant community for rangeland and wildlife habitat is open grassland and occasional mesquite trees or woody shrubs. After years of heavy grazing, most areas have been invaded with variable amounts of brush. Deer and javelina are plentiful. A few furbearing animals, such as opossum and raccoon, inhabit these areas. Scaled quail, bobwhite quail, mourning dove, and many songbirds are also in these areas. Predators, such as the coyote and bobcat, frequent the areas.

The major limiting features for most urban uses are shrinking and swelling with changes in soil moisture; low strength, which affects roads and street; and corrosivity of uncoated steel. Recreational development has no significant limitations.

This soil is not assigned to a capability subclass. It is in the Clay Loam range site.

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, and 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 the 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 when it is 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 may now be in crops, pasture, rangeland, or other land, but not 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 favorable temperature and growing season and acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not flooded during the growing season. The slope ranges mainly from 0 to 5 percent. For more detailed information on the criteria for prime farmland consult the local staff of the Soil Conservation Service.

The soils are not prime farmland in Dimmit and Zavala Counties in a native state or as nonirrigated cropland or pasture. A number of soils qualify as prime farmland, however, where irrigated.

About 987,580 acres or nearly 59 percent of the soils, in Dimmit and Zavala Counties have a potential for prime farmland. Areas are scattered throughout the two counties, but general soil map units 1, 2, 4, and 5 have the largest areas of potential prime farmland. General soil map units 3, 6, 7, 8, 9, and 10 have scattered areas of potential prime farmland. Approximately 132,800 acres of prime farmland is used for irrigated crops and orchards. Crops grown on these soils are mostly cotton, corn, grain sorghum, wheat, and a variety of truck crops, especially winter vegetables.

Soil map units that make up potential prime farmland in Dimmit and Zavala Counties 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 4. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section. The map units that meet soil requirements for prime farmland where irrigated are:

BAA	Batesville fine sandy loam, nearly level[1]
BkA	Bookout clay loam, 0 to 1 percent slopes
BkB	Bookout clay loam, 1 to 3 percent slopes
BkC	Bookout clay loam, 3 to 5 percent slopes
BOB	Bookout clay loam, gently undulating[1]
BxB	Brystal fine sandy loam, 1 to 3 percent slopes
BYB	Brystal fine sandy loam, gently undulating
CaA	Caid sandy clay loam, 0 to 1 percent slopes
CaB	Caid sandy clay loam, 1 to 3 percent slopes
CDB	Caid sandy clay loam, gently undulating[1]
ChA	Chacon clay loam, 0 to 1 percent slopes
ChB	Chacon clay loam, 1 to 3 percent slopes
CKB	Chacon clay loam, gently undulating[1]
Co	Conalb loam, occasionally flooded
CtA	Cotulla clay, 0 to 1 percent slopes
CtB	Cotulla clay, 1 to 3 percent slopes
CUB	Cotulla clay, gently undulating[1]
Dt	Divot silty clay, occasionally flooded
DuB	Duval loamy fine sand, 0 to 3 percent slopes
DvB	Duval fine sandy loam, 1 to 3 percent slopes
DYB	Duval fine sandy loam, gently undulating[1]
MnA	Montell clay, 0 to 1 percent slopes
MOA	Montell clay, nearly level[1]
PrA	Pryor sandy clay loam, 0 to 1 percent slopes
PrB	Pryor sandy clay loam, 1 to 3 percent slopes
PYB	Pryor sandy clay loam, gently undulating[1]
TnA	Tonio fine sandy loam, 0 to 1 percent slopes
TnB	Tonio fine sandy loam, 1 to 3 percent slopes
TOB	Tonio fine sandy loam, gently undulating[1]
UdA	Uvalde silty clay loam, 0 to 1 percent slopes
UdB	Uvalde silty clay loam, 1 to 3 percent slopes
UVB	Uvalde silty clay loam, nearly level[1]
WbB	Webb fine sandy loam, 1 to 3 percent slopes
WEB	Webb fine sandy loam, gently undulating[1]
WnA	Winterhaven silty clay loam, 0 to 1 percent slopes
WnB	Winterhaven silty clay loam, 1 to 3 percent slopes
ZcA	Zavco sandy clay loam, 0 to 1 percent slopes
ZcB	Zavco sandy clay loam, 1 to 3 percent slopes
ZVB	Zavco sandy clay loam, gently undulating[1]

[1] The composition of these units is more variable than that of other units in the survey area but has been controlled well enough to be interpreted for the expected use of the soils.

Use and Management of the Soils

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; 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 and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils 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 Dimmit and Zavala Counties, crops, pasture hay, and orchards are grown on about 156,100 acres. Of this, 128,000 acres is irrigated cropland; 13,700 acres is nonirrigated cropland; 9,600 acres is pasture and hay; and 4,800 acres is planted in orchards. Irrigated cropland in Dimmit County decreased from about 40,000 acres in 1967 to 17,500 acres in 1981. In Zavala County, however, irrigated cropland increased from about 105,000 acres in 1967 to about 110,500 acres in 1981. Nonirrigated cropland in the two county areas decreased from about 26,500 acres in 1967 to 13,700 acres in 1981*(4).* Pasture and hay have decreased from about 28,500 acres in 1967 to about 9,600 acres in 1981. They have decreased because much of the acreage is now rangeland. The acreage in orchards has gained considerably over the years: from about 655 acres in 1967 to about 4,800 acres in 1981. Even though citrus acreage has decreased over the past years, pecan plantings have increased. Current acreage of the various land uses are from records of the local Soil Conservation Service field offices.

The major irrigated crops are cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables. On nonirrigated soil, grain sorghum, forage sorghum, and wheat or other cool-season crops are grown. The major grasses for pasture and

hay are improved bermudagrass, kleingrass, introduced bluestems, blue panicum, and buffelgrass. Orchards are made up of orange, grapefruit, and pecan trees.

Management of Crops

About 128,000 acres are irrigated cropland. Water for irrigation mainly comes from the Leona Gravel Formation or the Carrizo Sand Formation. Systems that distribute water across the surface and sprinkler systems are both used to irrigate. Large areas of nearly level soils are well suited to irrigation.

The major irrigated crops are cotton, corn, grain sorghum, wheat, and truck crops, especially winter vegetables. The major vegetables grown are spinach, cabbage, onions, and carrots (fig. 15).

Figure 15.—Irrigated cabbage on Uvalde silty clay loam, 0 to 1 percent slopes.

Conservation cropping systems, crop residue management, minimum tillage, and proper use of fertilizers are needed on all cultivated soils.

The crops that are normally grown in Dimmit and Zavala Counties are easily adapted to a conservation cropping system. Where soil conditions are favorable, the crops produce enough residue to maintain soil tilth if the residue is kept on the surface.

Crop residue on the surface protects the soil against packing rains, reduces crusting, increases the intake of water, decreases runoff and erosion, and reduces evaporation of moisture. In addition, it improves the tilth of the surface layer and reduces packing caused by farm machinery (fig. 16).

Figure 16.—Residue of grain sorghum on and near the surface protects this Bookout clay loam, 0 to 1 percent slopes. Sandhill cranes fly off in the distance.

Tillage should be sufficient to prepare a good seedbed and control weeds but should not damage the structure of the soil, especially when it is wet, or encourage formation of a plowpan. Poor structure limits the intake of water and reduces the air space in the soil. A plowpan restricts root growth. Poor soil structure and plowpans slow the penetration of water and consequently cause runoff and erosion to increase.

A chemical analysis is the best guide to follow for fertilizing the soil. This aids in estimating the kinds and amounts of elements needed to grow the crop. An annual soil test detects buildup or depletion of required nutrients for each crop.

Because of the high cost of producing irrigated crops, good farming management is especially important. Irrigation water should be applied at the proper times and in the amounts required for crop needs. It should be evenly distributed to all parts of the field. These objectives can be achieved by a properly designed system. In most areas leveling or grading the land with earthmoving equipment is necessary so that the water can be evenly applied.

About 13,700 acres is nonirrigated cropland. The major crops are grain sorghum, forage sorghum, and wheat and other cool-season crops.

Conservation of moisture is the major objective of managing nonirrigated soils for crops. Rainfall is limited, and evaporation and transpiration of moisture are high. Maintaining fertility and controlling erosion are also important. Farming practices that help to efficiently use the rainfall and protect the land from erosion can increase the growth rate of major crops.

The use of conservation cropping systems, good crop residue management, minimum tillage, and the proper use of fertilizers are needed. On many of the nearly level soils, contour farming or contouring with terraces helps control runoff by holding the rainfall on the land until it can be absorbed by the soil. In some of the steeper areas, contour farming, field terracing, diversion terracing, and grassed waterways are needed to control erosion and conserve water.

Management of Pasture and Hay

Approximately 9,600 acres in Dimmit and Zavala Counties is used for pasture and hay. This acreage is in perennial grasses but not in annual crops for livestock forage. Management of pasture or hay includes choosing plants suited to the soil, fertilizing, rotating pastures for grazing, and weed control. Management of water is very important where the soil is irrigated.

Many high producing grasses are suitable for improved pasture. The most widely used grasses are buffelgrass, kleingrass, improved bermudagrass, Kleberg bluestem, medio bluestem, and blue panicum (fig. 17). The improved bermudagrasses are the most widely used for irrigated pasture; however, kleingrass and buffelgrass are used with irrigation to some extent.

Application of fertilizer is essential for economical production of irrigated pasture and hay. Fertilizer on nonirrigated pasture should be applied when moisture is adequate. All fertilizer should be applied according to need as indicated by a soil analysis.

Rotation of pastures for grazing is an important practice. Timely rotation allows for maximum returns from the improved grasses. Weeds can be controlled by mowing or by spraying with a hormone-type herbicide.

Management of Orchards

About 4,800 acres are presently in citrus and pecan orchards. A few orchards are made up of citrus trees, mainly oranges and grapefruit (fig. 18). Citrus orchards have been decreasing primarily because past freezes have killed some trees. Frost-kill is the major hazard to citrus trees.

Figure 17.—Irrigated buffelgrass on Tonio fine sandy loam, 0 to 1 percent slopes.

A number of soils in the survey area are well suited to pecan production. Interest in pecans has increased considerably in the past few years, and a number of pecan orchards have been established. Most of the soils presently used for irrigated row crops are also suited to pecan production (fig. 19).

Good orchard management corresponds to a great degree to good management for other irrigated crops. Proper tillage, management of residue, a well designed fertilization program, timely disease and insect control, and controlled irrigation water management are important practices. Irrigation systems where surface water flows evenly across the surface have been used in the past, but the newer drip or trickle irrigation systems are becoming increasingly important to management of orchards.

Figure 18.—Irrigated orange trees on Brystal fine sandy loam, 1 to 3 percent slopes.

Figure 19.—Newly established, irrigated pecan trees on Winterhaven silty clay loam, 0 to 1 percent.

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 5, for the soils that are used mainly as cropland. 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 5 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 for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. 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 few 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.

Soils that have been mapped and defined broadly have not been assigned a capability class and subclass.

Rangeland

Kenneth D. Sparks, Soil Conservation Service, area range conservationist, Uvalde, assisted with the preparation of this section.

Rangeland is native grassland. Vegetation consists of a wide variety of grasses, plants similar to grass, forbs, shrubs, and trees. The species are generally suitable for grazing and are found in sufficient amounts to justify grazing. Rangeland has received no regular or frequent cultivation. The composition and production of the plant community is determined by soil, climate, topography, the overstory canopy, and grazing management.

About 825,000 acres, or 96 percent of Dimmit County, is rangeland. About 679,000 acres, or 82 percent of Zavala County, is rangeland. The original vegetation was dominantly open grassland of mid and short grasses interspersed with occasional trees and woody shrubs.

The vegetative community of the rangeland has changed drastically over the past 80 years. Widely fluctuating climatic conditions; heavy, continuous livestock grazing; plus the almost total elimination of fire, with the exception of wildfire, are the major factors that have caused the change. Woody plants have increased on much of the rangeland. The more productive grasses and forbs have been overgrazed in some areas and have been replaced by a mixture of short grasses and dominantly annual forbs.

Most of the local ranches are cow-calf operations. There are some stocker calf and yearling enterprises, and many ranches supplement their cow herds with stockers. This provides greater flexibility for adjusting the number of livestock in drought periods and times of stress.

A few livestock operations supplement grazing the native grassland with grazing improved pasture and crops, such as small grains and forage sorghums. Buffelgrass, kleingrass, improved bermudagrass, blue panicum, and Kleberg bluestem are common improved grasses for pasture.

Range forage grows primarily during two distinct periods. Approximately 60 percent of the annual growth is in April, May, and June when spring rains and moderate temperatures are most favorable to warm-season plants. A secondary growth period usually is in September and October when fall rains and gradually cooling temperatures are common.

Droughts of varying lengths are frequent in this area. Each year, short midsummer droughts are normal. Long droughts, lasting several months, occur often.

Range Site Descriptions

Different kinds of soils vary in their capacity to produce plants for grazing. Soils that produce about the same kinds, amounts, and proportions of forage plants make up a range site.

Climax vegetation on the range site is the stabilized plant community that the site is capable of producing. It reproduces itself and changes very little so long as the

environment remains unchanged. It consists of the plants that were growing when the region was first settled. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount under close, continuous grazing. They generally are the most productive perennial grasses and forbs and the most palatable to livestock.

Increasers in the climax vegetation increase as the more desirable plants decrease by close grazing. They are generally less palatable to livestock than decreasers.

Invaders are plants that normally cannot compete with those in the climax plant community for moisture, nutrients, and light. Hence, invaders grown along with increasers after the climax vegetation have been reduced.

Range condition is judged according to standards that apply to the particular range site. It expresses the present kind and amount of vegetation in relation to the climax plant community for that site.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site compared to the native vegetation that could grow there. A range site is in *excellent* condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is 25 or less.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during their growing season.

Table 6 shows, for each soil, the range site; the total annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 6 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 for kind of growing season 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, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about 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 vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

A primary objective of good range management is to keep the rangeland in excellent or good condition. This conserves water, improves yields, and protects the soils. The main management concern is recognizing important changes in the kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition, when actually the cover contains a large percent of annual plants, and the long term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods may have a degraded appearance that temporarily conceals its quality and ability to recover.

Following years of prolonged heavy use of range, seed sources of desirable plants may have been eliminated. In such instances, the desirable plants must be reestablished. Effective management includes brush control, range seeding, fencing, water development, or mechanical treatment to revitalize stands of native plants. Thereafter, using management practices, such as deferred grazing, controlled grazing, and planned grazing systems, can maintain and improve the range.

Good management generally results in optimum production of the natural plant community, the conservation of water, and the control of erosion. Sometimes a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

There are 17 range sites in the survey area. They are Clay Flat, Clay Loam, Clayey Bottomland, Claypan Prairie, Gravelly Ridge, Gray Sandy Loam, Lakebed, Loamy Bottomland, Loamy Sand, Rolling Hardland, Saline Clay, Sandy, Sandy Loam, Shallow, Shallow Ridge, Shallow Sandy Loam, and Tight Sandy Loam.

Clay Flat Range Site. The map units in this range site are: MnA—Montell clay, 0 to 1 percent slopes, and MOA—Montell clay, nearly level. The potential plant community is an open grassland. Species composition by weight is about 95 percent grasses, 5 percent forbs, and a few, scattered woody plants.

The dominant plants are—

- pink pappusgrass, pinhole bluestem, and fourflower trichloris—40 percent
- plains bristlegrass, vine-mesquite, white tridens, and alkali sacaton—20 percent
- curlymesquite and buffalograss—20 percent
- plains lovegrass, Arizona cottontop, lovegrass tridens, Texas wintergrass, and Texas cupgrass—15 percent
- forbs, such as bundleflower, bushsunflower, and ruellia—5 percent
- trace of woody plants, such as guayacan, spiny hackberry, Wright acacia, catclaw acacia, and mesquite (fig. 20)

Pinhole bluestem, fourflower trichloris, bushsunflower, plains lovegrass, vine-mesquite, and plains bristlegrass *decrease* with heavy, continuous grazing by livestock. They are replaced initially by such plants as buffalograss, curlymesquite, and woody plants. If overgrazing continues, woody plants native to the site increase along with invaders, such as whitebrush, cacti, and condalia. These woody plants dominate an understory of curlymesquite, red grama, Hall panicum, whorled dropseed, purple threeawn, Texas grama, and annual forbs.

Figure 20.—Clay Flat range site. The soil is Montell clay, nearly level.

Clay Loam Range Site. The map units in this range site are: BAA—Batesville fine sandy loam, nearly level; BkA—Bookout clay loam, 0 to 1 percent slopes; BkB—Bookout clay loam, 1 to 3 percent slopes; BkC—Bookout clay loam, 3 to 5 percent slopes; BOB—Bookout clay loam, gently undulating; CaA—Caid sandy clay loam, 0 to 1 percent slopes; CaB—Caid sandy clay loam, 1 to 3 percent slopes; CDB—Caid

sandy clay loam, gently undulating; ChA—Chacon clay loam, 0 to 1 percent slopes; ChB—Chacon clay loam, 1 to 3 percent slopes; CKB—Chacon clay loam, gently undulating; PrA—Pryor sandy clay loam, 0 to 1 percent slopes; PrB—Pryor sandy clay loam, 1 to 3 percent slopes; PYB—Pryor sandy clay loam, gently undulating; UdA—Uvalde silty clay loam, 0 to 1 percent slopes; UdB—Uvalde silty clay loam, 1 to 3 percent slopes; UVB—Uvalde silty clay loam, nearly level; ZcA—Zavco sandy clay loam, 0 to 1 percent slopes; ZcB—Zavco sandy clay loam, 1 to 3 percent slopes; and ZVB—Zavco sandy clay loam, gently undulating.

The potential plant community is open grassland and an occasional mesquite tree or woody shrub. The species composition by weight is 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

The dominant plants are—

- plains lovegrass, fourflower trichloris, Arizona cottontop, pinhole bluestem, and plains bristlegrass—40 percent
- buffalograss and curlymesquite—20 percent
- pink pappusgrass—10 percent
- Texas wintergrass, lovegrass tridens, white tridens, perennial threeawn, and tobosagrass—20 percent
- forbs, such as bundleflower, bushsunflower, orange Zexmenia, and Mexican sagewort—5 percent
- woody plants, such as mesquite, condalia, spiny hackberry, guayacan, and cacti—5 percent

Preferred plants are plains lovegrass, fourflower trichloris, and plains bristlegrass. They decrease with continued, heavy grazing by cattle. These plants are replaced initially by woody plants, such as mesquite and whitebrush, and grasses, such as curlymesquite (fig. 21). If grazing is heavy and continuous, the site is dominated Dimmit and Zavala Counties, Texas by a wide array of woody plants and an understory of short grasses, such as red grama, curlymesquite, and Halls panicum.

Clayey Bottomland Range Site. The map units in this range site are: Cm—Cochina clay, occasionally flooded, and Cn—Cochina clay, frequently flooded. The potential plant community is a mixture of trees, shrubs, grasses, and forbs. The species composition by weight is 80 percent grasses, 10 percent forbs, and 10 percent trees and woody plants.

The dominant plants are—

- southwestern and plains bristlegrass, fourflower trichloris, big cenchrus, and big sacaton—30 percent
- Virginia wildrye, Texas wintergrass, and sedge—10 percent
- plains bristlegrass, pink pappusgrass, vine-mesquite, and white tridens—25 percent
- buffalograss and curleymesquite—15 percent
- forbs, such as bundleflower, sensitivebrier, and ruellia—10 percent
- trees and woody plants, such as oak, elm, hackberry, greenbrier, clematis, spiny aster, and mesquite—10 percent

The taller grasses, such as southwestern bristlegrass, fourflower trichloris, and big cenchrus, decrease with continued, heavy grazing by livestock. These plants are replaced initially by buffalograss, sedges, and woody plants. If grazing continues, the site may be dominated by retama, spiny aster, bitter sneezeweed, prairie coneflower, and annual weeds and grasses.

Claypan Prairie Range Site. The map units in this range site are: Br—Brundage fine sandy loam, occasionally flooded, and Bu—Brundage fine sandy loam,

Figure 21.—Clay Loam range site. The soil is Pryor sandy clay loam, gently undulating.

frequently flooded. The potential plant community is grassland of mid and short grasses and a few woody plants. Species composition by weight consists of approximately 95 percent grasses, 5 percent forbs, and a trace of woody plants.

The dominant plants are—

- fourflower trichloris—10 percent
- plains bristlegrass—15 percent
- Arizona cottontop, pink pappusgrass, vine-mesquite, and pinhole bluestem—35 percent
- buffalograss and curlymesquite—15 percent
- hooded windmillgrass, fall witchgrass, lovegrass tridens, plains lovegrass, Texas wintergrass, slim tridens, and white tridens—20 percent

- forbs, such as bundleflower, bushsunflower, sensitivebrier, and ruellia—5 percent

Plains bristlegrass and fourflower trichloris typify the plants that are preferred by livestock; therefore, they decrease with continued heavy grazing. These plants are replaced initially by such plants as curlymesquite, buffalograss, hooded windmillgrass, and fall witchgrass and invading woody plants, such as mesquite, spiny hackberry, armagosa, and condalia. If heavy grazing continues, woody plants increase and invade along with an understory of short grasses, such as red grama, whorled dropseed, Hall panicum, tumble windmillgrass, and threeawn.

Gravelly Ridge Range Site. The map units in this range site are: JED—Jimenez very gravelly loam, rolling; MAC—Maverick very gravelly clay loam, gently undulating; and YHD—Yologo-Hindes association, undulating. The potential plant community is open grassland and a variety of scattered woody shrubs and perennial forbs. Species composition by weight is approximately 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The dominant plants are—

- tanglehead, green sprangletop, pinhole bluestems, plains bristlegrass, plains lovegrass, twoflower trichloris, Arizona cottontop, lovegrass tridens, sideoats grama, Neally grama, and pink pappusgrass—60 percent
- Reverchon panicum, fall witchgrass, slim tridens, hooded windmillgrass, hairy grama, and perennial threeawn—20 percent
- buffalograss and curlymesquite—5 percent
- forbs, such as bushsunflower, orange zexmenia, menodora, and bundleflower—5 percent
- woody plants, such as guajillo, blackbrush, range ratany, Texas false mesquite, vine ephedra, guayacan, desert yaupon, littleleaf sumac, Texas colubrina, feather dalea, and ceniza—10 percent

Plants that are preferred by livestock are green sprangletop, plains lovegrass, pinhole bluestem, plains bristlegrass, and bushsunflower; therefore, they decrease with heavy, continuous grazing by livestock. These plants are replaced initially by fall witchgrass, slim tridens, and panicum and woody shrubs. If heavy grazing continues, the site is dominated by woody plants, such as blackbrush, guajillo, littleleaf sumac, shrubby blue salvia, and ceniza, and an understory of short grasses, such as red grama, hairy tridens, threeawn, Halls panicum, and annual forbs and grasses (fig. 22)

Gray Sandy Loam Range Site. The map units in this range site are: TnA—Tonio fine sandy loam, 0 to 1 percent slopes; TnB—Tonio fine sandy loam, 1 to 3 percent slopes; TOB—Tonio fine sandy loam, gently undulating; VEC—Verick fine sandy loam, gently undulating. The potential plant community is open grassland and scattered woody plants. Species composition by weight is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

Dominant plants are—

- tanglehead, fourflower trichloris, lovegrass tridens, Arizona cottontop, pinhole bluestem, and pink pappusgrass—40 percent
- plains bristlegrass—20 percent
- fall witchgrass, vine-mesquite, buffalograss, and curlymesquite—25 percent
- perennial threeawn and slim tridens—5 percent
- forbs, such as bundleflower, bushsunflower, and orange zexmenia—5 percent
- woody plants, such as mesquite, blackbrush, vine ephedra, guayacan, desert yaupon, cacti, Texas kidneywood, and Texas colubrina—5 percent

Figure 22.—Gravelly Ridge range site. The soil is Jimenez very gravelly loam, rolling.

Tanglehead, fourflower trichloris, pinhole bluestem, and plains bristlegrass decrease with heavy, continuous grazing by livestock. They are replaced initially by hooded windmillgrass, curlymesquite grass, perennial threeawn, and woody plants. As overgrazing continues, woody plants may form a dense canopy over a sparse cover of threeawn, Halls panicum, ragweed, croton, tumblegrass, red grama, grassbur, and annual weeds and grasses.

Lakebed Range Site. The map unit in this range site is Tc—Tiocano clay. The potential plant community is an open grassland that has varying degrees of wetness. Species composition by weight is about 95 percent grass and 5 percent forbs.

Dominant plants are—

- hartweg paspalum, white tridens, switchgrass, and vine-mesquite—55 percent
- buffalograss and curlymesquite—20 percent

- knotroot bristlegrass, filly panicum, and sedges and rushes—20 percent
- forbs, such as ruellia, bundleflower, fogfruit, and annuals—5 percent

Switchgrass, white tridens, hartweg paspalum, and vine-mesquite decrease with continued heavy grazing by livestock. They are replaced initially by sedges, rushes, buffalograss, bermudagrass, and knotroot bristlegrass. Retama and mesquite also invade. If heavy grazing continues, the site is dominated by such plants as retama and mesquite and an understory of sedges, rushes, common bermudagrass, roundhead sneezeweed, and annual forbs.

Loamy Bottomland Range Site. The map units in this range site are: Co—Conalb loam, occasionally flooded; DA—Dev soils, frequently flooded; Dt—Divot silty clay, occasionally flooded; WnA—Winterhaven silty clay loam, 0 to 1 percent slopes; WnB—Winterhaven silty clay loam, 1 to 3 percent slopes; Wv—Winterhaven silty clay loam, frequently flooded. The potential plant community is a mixture of trees, shrubs, grasses, and forbs that vary depending on frequency and amount of overflow and the position on the bottom land. Species composition by weight is about 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

The dominant plants are—

- fourflower trichloris, southwestern bristlegrass, big cenchrus, big sacaton, and switchgrass—40 percent
- Texas wintergrass, Virginia wildrye—10 percent
- white tridens, vine-mesquite, and pink pappusgrass—15 percent
- buffalograss, plains bristlegrass, and sedges—15 percent
- forbs, such as bundleflower, ruellia, and sensitive brier—5 percent
- woody plants, such as hackberry, pecan, elm, willow, live oak, and mesquite—15 percent

The taller grasses, such as fourflower trichloris, switchgrass, big cenchrus, southwestern bristlegrass, and big sacaton decrease with heavy, continuous grazing by livestock. These plants are replaced initially by such plants as sedges, buffalograss, hooded windmillgrass, fall witchgrass, and a wide variety of woody plants. If overgrazing continues, woody plants, such as mesquite, spiny hackberry, whitebrush, and huisache, continue to increase and invade. They dominate an understory of sedges, red threeawn, Halls panicum, filly panicum, bermudagrass, tumble windmillgrass, and annual grasses and forbs.

Loamy Sand Range Site. The map unit in this range site is DuB—Duval loamy fine sand, 0 to 3 percent slopes. The potential plant community is open grassland and a few mesquite trees. Species composition by weight is about 90 percent grass, 5 percent forbs, and 5 percent woody plants.

Dominant plants are—

- seacoast bluestem, tanglehead, and trichloris—45 percent
- pinhole bluestem, Arizona cottontop, and plains bristlegrass—25 percent
- fall witchgrass, hooded windmillgrass, hairy grama, and fringeleaf paspalum—15 percent
- Wright threeawn and balsamscale—5 percent
- forbs, such as Englemann-daisy, bushsunflower, western indigo, sensitivebrier, and sida—5 percent
- woody plants, such as mesquite, hackberry, Texas colubrina, spiny hackberry, wolfberry, pricklypear, and tasajillo—5 percent

If heavy grazing by livestock continues, the taller grasses, such as seacoast bluestem, tanglehead, and trichloris, decrease and are replaced initially by hooded windmillgrass, fall witchgrass, and woody plants. As the range site deteriorates, woody plants continue to increase and invade along with red lovegrass, fringed signalgrass, threeawn, grassbur, beebalm, annual forbs, and grasses.

Rolling Hardland Range Site. The map unit in this range site is MKC—Maverick clay loam, gently undulating. The potential plant community is open grassland and a scattering of low brush. Species composition by weight is approximately 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

Dominant plants are—

- fourflower trichloris, lovegrass tridens, pinhole bluestem, pink pappusgrass, and plains lovegrass—45 percent
- plains bristlegrass and Arizona cottontop—15 percent
- curlymesquite and buffalograss-15 percent fall witchgrass, hooded windmillgrass, perennial threeawn, bristle panicum, and Texas bristlegrass—15 percent
- forbs, such as bushsunflower, bundleflower, and orange zexmenia—5 percent
- woody plants, such as guayacan, Texas kidneywood, guajillo, blackbrush, mesquite, allthorn, and allthorn goatbush—5 percent

Fourflower trichloris, plains lovegrass, bushsunflower, and pinhole bluestem decrease with heavy, continuous grazing by livestock. They are replaced initially by woody plants and grasses, such as fall witchgrass, perennial threeawn, and curlymesquite. If heavy grazing continues, woody plants generally form a dense canopy over a sparse cover of red grama, whorled dropseed, Texas grama. Halls panicum, Texas varilla, and threeawn (fig. 23).

Figure 23.—Rolling Hardland range site. The soil is Maverick clay loam, gently undulating.

Saline Clay Range Site. The map units in this range site are: Cf—Catarina clay, frequently flooded; CGB—Catarina clay, nearly level; CtA—Cotulla clay, 0 to 1 percent slopes; CtB—Cotulla clay, 1 to 3 percent slopes; and CUB—Cotulla clay, gently undulating. The potential plant community is mid and short grasses and a few woody plants. Composition by weight is 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The dominant plants are—

- twoflower and fourflower trichloris and alkali sacaton—25 percent
- pinhole bluestem and Arizona cottontop—10 percent
- white tridens, vine-mesquite, and pink pappusgrass—20 percent
- buffalograss and curlymesquite—15 percent
- plains bristlegrass—10 percent
- whorled dropseed, Halls panicum, tobosa, and threeawn—10 percent
- forbs, such as bundleflower, and ruellia—5 percent
- woody plants, such as fourwing saltbush, armed saltbush, spiny hackberry, mesquite, guayacan, condalia, cacti, and desert yaupon—5 percent

Trichloris, vine-mesquite, and Arizona cottontop decrease with continuous heavy grazing by livestock. These plants are replaced initially by curlymesquite, tobosa, Halls panicum, and brushy plants. If heavy grazing continues, woody plants continue to increase and to invade along with such plants as whorled dropseed, red grama, tobosa, annual lovegrass, gummy lovegrass, and Texas varilla (fig. 24).

Figure 24.—Saline Clay range site. The soil is Catarina clay, nearly level.

Sandy Range Site. The map unit in this range site is ABC—Antosa-Bobillo association, gently undulating. The potential plant community is open grassland of tall and mid grasses and a few scattered mesquite and live oak trees and bumelia or coma motts.

The dominant plants are—

- seacoast bluestem—40 percent
- tanglehead, giant dropseed, and indiangrass—25 percent
- fringeleaf paspalum, fall witchgrass, sand witchgrass, hooded windmillgrass, balsamscale, sand dropseed, and Wright threeawn—30 percent
- forbs, such as snoutbean, sensitivebrier, copperleaf, and showy partridge pea—5 percent (fig. 25).

Figure 25.—Sandy range site. The soil is Antosa-Bobillo association, gently undulating.

Seacoast bluestem, indiangrass, and tanglehead are plants preferred by livestock; therefore, they decrease with continuous heavy grazing. Initially, they are replaced by hooded windmillgrass, threeawn, witchgrass, and fall witchgrass. If heavy grazing continues, the site is dominated by scattered threeawn and balsamscale along with invaders, such as red lovegrass and tumble lovegrass, grassbur, and annual grasses and forbs.

Sandy Loam Range Site. The map units in this range site are: BxB—Brystal fine sandy loam, 1 to 3 percent slopes; BYB—Brystal fine sandy loam, gently undulating; DvB—Duval fine sandy loam, 1 to 3 percent slopes; and DYB—Duval fine sandy loam, gently undulating.

This soil is well suited to rangeland. The potential plant community is open grassland dominated by mid grasses and some forbs and woody plants. Species composition by weight is 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

The dominant plants are—

- tanglehead and twoflower and fourflower trichloris—25 percent
- pinhole bluestems, plains bristlegrass, hooded windmillgrass, pink pappusgrass, and plains lovegrass—50 percent

- slim tridens, Reverchon panicum, bristle panicum, lovegrass tridens, perennial threeawn, fall witchgrass, hairy grama, and fringeleaf paspalum—15 percent
- forbs, such as Englemann-daisy, sensitivebrier, and bundleflower—5 percent
- woody plants, such as condalia, kidneywood, blackbrush, vine ephedra, desert yaupon, spiny hackberry, guayacan, mesquite, and pricklypear—5 percent (fig. 26).

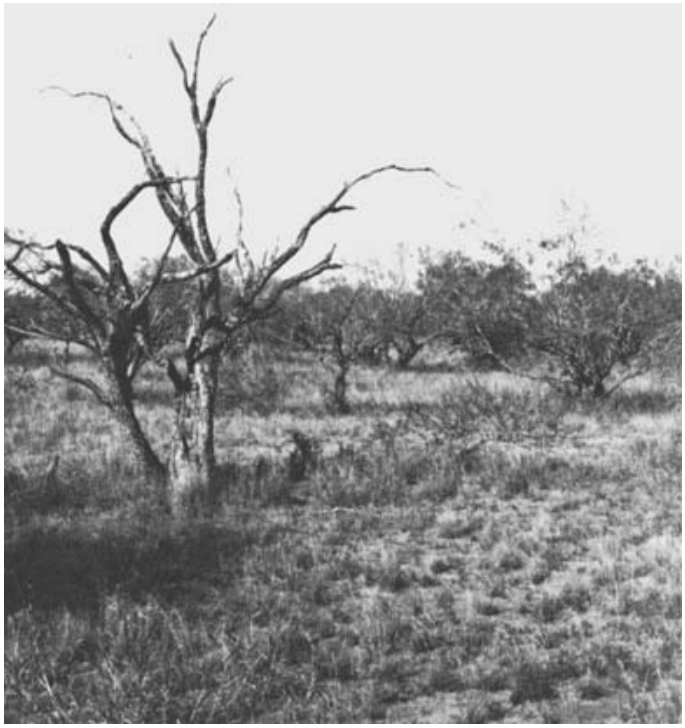


Figure 26.—Sandy Loam range site. The soil is Duval fine sandy loam, gently undulating.

The taller grasses, such as fourflower trichloris, tanglehead, and the more palatable forbs, such as Englemann-daisy, decrease with continued heavy grazing by livestock. These plants are replaced initially by hooded windmillgrass, threeawn, and fall witchgrass. Woody plants rapidly increase. If heavy grazing continues, a wide array of woody plants and an understory of threeawn, red grama, red lovegrass, Halls panicum, tumble windmillgrass, red lovegrass, grassbur, and annual grasses and forbs continue to increase and invade.

Shallow Range Site. The map unit in this range site is VAB—Valco clay loam, gently undulating. The potential plant community is open grassland and occasional woody shrubs and perennial forbs. Species composition by weight is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The dominant plants are—

- pinhole bluestems and pink pappusgrass—20 percent
- plains bristlegrass, plains lovegrass, Reverchon panicum, and Arizona cottontop—35 percent
- fall witchgrass, slim tridens, hooded windmillgrass, and perennial threeawn—20 percent

- buffalograss and curlymesquite—15 percent
- forbs, such as bushsunflower, bundleflower, orange zexmenia, and halfshrub sundrop—5 percent
- woody plants, such as guajillo, guayacan, vine ephedra, skeletonleaf goldeneye, condalia, blackbrush, ceniza, mesquite, cacti, littleleaf sumac, and bushsunflower—5 percent

Preferred plants by livestock are plains bristlegrass, plains lovegrass, and the pinhole bluestems; therefore, they decrease with heavy, continuous grazing. These plants are replaced initially by perennial threeawn, fall witchgrass, and slim tridens and woody plants. If heavy grazing continues, woody shrubs continue to increase and invade and dominate an understory of sparse short grasses, such as red grama, hairy tridens, threeawns, gray coldenia, and annual weeds.

Shallow Ridge Range Site. The map units in this range site are: OMD—Olmos very gravelly loam, undulating, and ZAD—Zapata gravelly loam, gently undulating. The potential plant community is an open grassland and a variety of scattered woody plants and perennial forbs. Species composition by weight is about 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The dominant plants are—

- pinhole bluestem, sideoats and Neally grama, green sprangletop, tanglehead, Arizona cottontop, pink pappusgrass, and lovegrass tridens—45 percent
- plains bristlegrass—10 percent
- Reverchon panicum, hooded windmillgrass, fall witchgrass, slim tridens, buffalograss, curlymesquite, hairy grama, and perennial threeawn—30 percent
- forbs, such as bushsunflower, orange zexmenia, menodora, and bundleflower—5 percent
- woody plants, such as guajillo, Texas kidneywood, range ratany, vine ephedra, Texas false mesquite, guayacan, Texas colubrina, feather dalea, and cenzia—10 percent

With heavy continuous grazing by livestock, sideoats grama, green sprangletop, plains lovegrass, and plains bristlegrass decrease. They are replaced initially by fall witchgrass, slim tridens, perennial threeawn, and woody shrubs. If heavy grazing continues, shrubs continue to increase and invade. Generally, ceniza dominates the site along with a sparse understory of threeawn, red grama, hairy tridens, gray coldenia, and annual weeds.

Shallow Sandy Loam Range Site. The map units in this range site are: DcC—Dilley-Rock outcrop complex, 1 to 5 percent slopes; DFC—Dilley fine sandy loam, gently undulating; and RAC—Randado fine sandy loam, gently undulating.

The potential plant community is open grassland and a few, scattered woody plants and a wide variety of forbs. Composition by weight is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The dominant plants are—

- tanglehead, plains bristlegrass, silver bluestem, and Arizona cottontop—45 percent
- hooded windmillgrass, pink pappusgrass, slender grama, and perennial threeawn—20 percent
- forbs, such as menodora, dalea, bundleflower, bushsunflower, orange zexmenia, and sensitive brier—10 percent
- woody plants, such as guajillo, blackbrush, range ratany, Texas kidneywood, vine ephedra, spiny hackberry, desert yaupon, condalia, and cacti—5 percent

Plants that decrease with heavy, continuous grazing by livestock are tanglehead, bushsunflower, plains bristlegrass, silver bluestem, and Arizona cottontop. These plants are replaced initially by increasers, such as perennial threeawn, hooded windmillgrass, hairy grama, fall witchgrass, and a wide variety of woody plants. If heavy grazing continues, the site is dominated by a wide variety of woody plants, such as blackbrush, leatherstem, shrubby blue salvia, spiny hackberry, Texas colubrina. and cacti. The understory is slender grama, red grama, perennial threeawn, gummy lovegrass, and annual grasses and forbs.

Tight Sandy Loam Range Site. The map units in this range site are: Po—Poteet fine sandy loam, frequently flooded; WbB—Webb fine sandy loam, 1 to 3 percent slopes; and WEB—Webb fine sandy loam, gently undulating. The potential plant community is open grassland and scattered, woody plants and some forbs. Species composition by weight is about 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

The dominant plants are—

- fourflower trichloris, pinhole bluestem, tanglehead, Arizona cottontop, and pink pappusgrass—40 percent
- plains bristlegrass and plains lovegrass—15 percent
- hooded windmillgrass, slender grama, fringeleaf paspalum, and threeawn—20 percent
- buffalograss and curlymesquite—15 percent
- forbs, such as bushsunflower; Englemann-daisy, orange zexmenia, and bundleflower—5 percent
- woody plants, such as Texas kidneywood, vine ephedra, bumelia, mesquite, condalia, spiny hackberry, and cacti—5 percent

The taller grasses, such as fourflower trichloris, pinhole bluestem, tanglehead, and plains lovegrass decrease with continuous, heavy grazing by livestock. They are replaced initially by hooded windmillgrass, curlymesquite, and woody plants. If heavy grazing continues, the woody plants native to the site and twisted acacia, whitebrush, and goldenweed form a moderately dense canopy. The understory is lantana, broomweeds, crotons, red grama, Texas grama, threeawn, and fringed signalgrass.

Recreation

The soils of the survey area are rated in table 7 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 sewer lines. 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 7, 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 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and

interpretations for dwellings without basements and for local roads and streets in table 9.

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

By Jerry Turrentine, area biologist, Soil Conservation Service, Uvalde

Wildlife is a primary source of income and recreation in Dimmit and Zavala Counties. Most of the land that supports wildlife is leased for hunting or used for hunting by the landowners. Because of good management of the habitat, many wildlife species in the survey area are increasing. Special emphasis is being given to the improvement of wildlife habitat for game species.

The main game species include white-tail deer, javelina, bobwhite quail, scaled (blue) quail, white-winged dove, mourning dove, and turkey. Also present are fox, raccoon, ring-tail cat, badger, skunk, opossum, nutria, armadillo, cottontail and jackrabbits, squirrel, bats, and numerous rodents. Common predators are the coyote and bobcat, along with an occasional mountain lion.

Many ponds are stocked with channel catfish, black bass, and sunfish. Fishing is fair in the Nueces River.

Water areas receive a high degree of use by animals and birds and provide habitat for amphibians. Among the several species of reptiles is the diamondback rattlesnake, which is the best known.

During the migration period, waterfowl rest in water areas and feed in cropland. These species include the white-fronted goose; the widgeon, pintail, gadwall, teal, and ring-necked ducks; and sandhill cranes. Other birds in the county include numerous species of songbirds, water associated species, and vultures. Many raptors, such as the white-tailed kite, sharp-shinned hawk, red-tailed hawk, and harris hawk, live in or migrate through the survey area.

Successful management of wildlife on any tract of land requires food, cover, and water in suitable combination. Lack of any one of these, an unfavorable balance among them, or an inadequate distribution of them can severely limit, or account for the absence of, a desired kind of wildlife. Information on the soil provides a valuable tool in creating, improving, or maintaining suitable food, cover, and water for wildlife.

Most wildlife habitat is created or managed by planting suitable vegetation, by increasing or improving existing vegetation, or by a combination of those measures. The influence that most soils have on plants is known. The influence of others can be reliably inferred from a knowledge of the soil characteristics. Soil information is also useful in selecting sites for creating or improving water areas for wildlife habitat.

Soil interpretations for wildlife habitat aid in selecting the more suitable sites for specific animals or birds, and they serve as indicators of the level of management intensity needed to achieve satisfactory results. They also show why a particular area may not be generally feasible for a given kind of wildlife. These interpretations can be used for broad-scale planning of wildlife management areas, parks, and nature areas, or for acquiring land to be used for wildlife habitat. They also can be important where wildlife is a secondary use, for example, on range.

In table 8 the soils of this survey area are rated for their suitability for producing four elements of wildlife habitat and for two groups, or kinds, of wildlife. The ratings indicate relative suitability of the soils for various elements. A rating of *good* means the element of wildlife habitat is easily created, improved, and maintained. Few or no limitations affect management in this category, and satisfactory results are expected when the soil is used for the prescribed purposes. A rating of *fair* means the element of wildlife habitat can be created, improved, or maintained in most places. Moderate intensity of management and fairly frequent attention may be required for satisfactory results. A rating of *poor* means the element of habitat and limitations for the designed use are rather severe. Habitat can be created, improved, or maintained in most places, but management is difficult and requires intensive effort. A rating of *very poor* means the elements of wildlife habitat are very severe and that unsatisfactory results are to be expected. It is either impossible or impractical to create, improve, or maintain habitat on soils in this category.

The ratings for elements of wildlife habitat take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account present use of soils or present distribution of wildlife and people. For this reason, selection of a site for development as a habitat for wildlife requires inspection at the site.

The elements of wildlife habitat, as referred to in table 8 are briefly described in the following paragraphs:

Grain and seed crops are agriculture grain or seed producing annuals that are planted to produce food for wildlife. Examples are corn, grain sorghum, wheat, and oats.

Grasses and legumes are improved kinds of domestic grasses and legumes which are mostly established by planting and which furnish foliage, seeds, and/or cover for wildlife. Examples are blue panicum, kleingrass, sorghum almum, and clovers.

Wild herbaceous plants are perennial grasses, forbs, and weeds that provide food and cover for wildlife. Some of the most common examples are vine-mesquite, bristlegrass, native sunflowers, orange zexmenia, bundleflower, Englemann-daisy, western ragweed, and tephrosia.

Shrubs are perennial or biennial woody shrubs that furnish numerous wildlife species various types of food and cover. This habitat element contributes greatly to the diets of deer. Examples are spiny hackberry, guayacan, kidneywood, guajillo, blackbrush, Texas colubrina, and pricklypear cactus.

Openland wildlife are birds and mammals that normally frequent cropland, pastures, range, and areas overgrown with grasses, herbs, and shrubby growth. Examples of this kind of wildlife are quail, dove, cottontail rabbit, jackrabbit, and sandhill crane.

Management of these areas takes several forms. Cropland planted to corn and grain sorghum provides food for dove and quail. Small grain plantings are used for food by deer where suitable cover exists and also feeds geese and sandhill cranes. Crop residue that remains on the surface provides forage for numerous wildlife species. Small areas of unharvested grain can be left next to good cover. Waterways can be managed to provide cover for small mammals and birds. Fence rows can be allowed to grow up to provide additional cover. Disking of field borders greatly improves pasture for food supplies. Brush retained in pasture functions as food as well as for cover. Increasing use of kleingrass provides seed for birds.

Rangeland wildlife are birds and mammals that normally frequent areas of hardwood trees and shrubs. Examples of brush wildlife are deer, turkey, quail, javelina, raccoon, and coyote.

Management includes several practices for improving rangeland. Controlled grazing, planned grazing systems, and deferred grazing allow increased forage production for wildlife habitat. This provides cover for quail and turkey and fawning areas for deer. Grasses allowed to mature also provide seed for dove, quail, and turkey.

Brush management is an important management tool. Brush is cleared in strips and patterns to create diversity in the food source for various species. Other practices include disking and planting for food. Range seeding provides food and cover. Water facilities help distribute and extend habitat areas.

Engineering

Joseph G. Miller, area engineer, Soil Conservation Service, Uvalde, assisted with preparation of this section.

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, earth fill, 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 9 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 (fig. 27). 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.

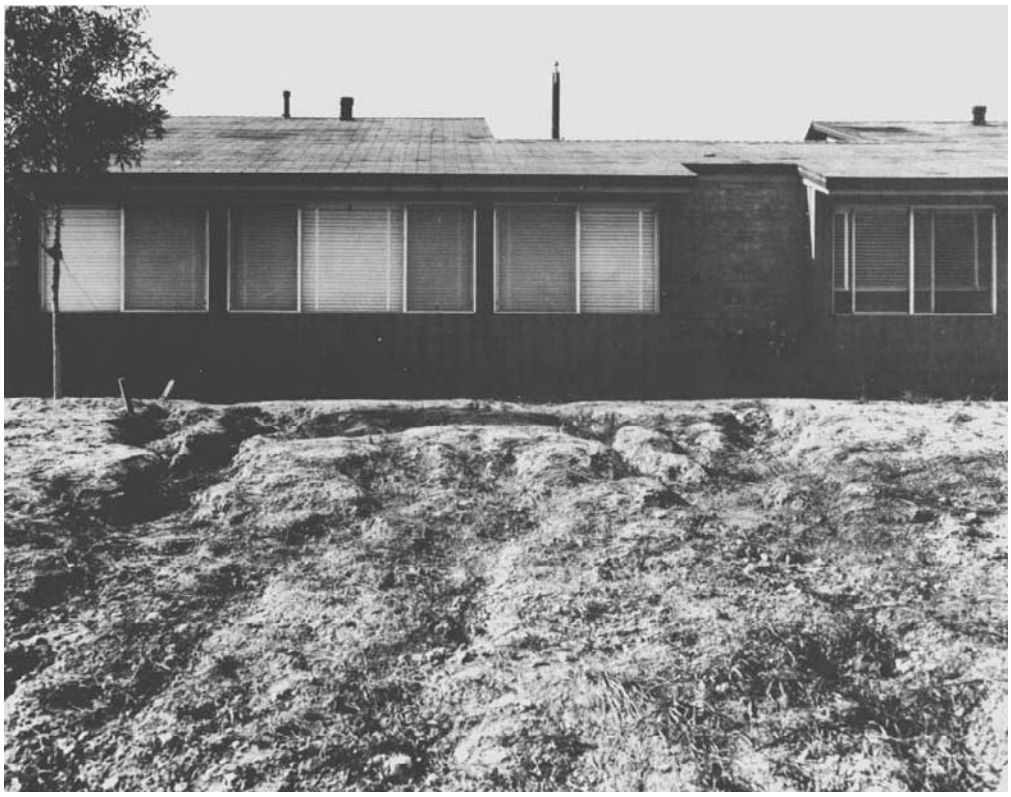


Figure 27.—This Pryor sandy clay loam, 1 to 3 percent slopes, has eroded during construction of a new house.

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 sulfuric materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect traffic ability after vegetation is established.

Sanitary Facilities

Table 10 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 10 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 filter the effluent effectively. 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 10 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 10 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 11 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 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor is 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 12 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 (figs. 28 and 29), terraces and diversions, and grassed waterways.

Figure 28.—Heavy machinery levels the land so that irrigation water can be more evenly distributed across the surface. This soil is Bookout clay loam, 0 to 1 percent slopes.

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.

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.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditch banks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks

caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

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 and slope. 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.

Figure 29.—Placing pipeline for a subirrigation system on Uvalde silty clay loam, 0 to 1 percent slopes.

Soil Properties

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 16.

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 13 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 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, 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 18.

Rock fragments larger than 3 inches in 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 ovendry 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 14 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.

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.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

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.

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

In table 14, the estimated content of organic matter 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 15 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 or by runoff from adjacent slopes. Water standing for short periods after rainfall is not considered flooding.

Table 15 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 the average, no more than once in 2 years; and *frequent* that it occurs, on the average, 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; May-September, for example, means that flooding will most likely be during the period May through September.

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.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 16 and the results of chemical analysis in table 17. The data are for soils sampled at carefully selected sites. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." Soil samples were analyzed by the National Soil Survey Laboratory.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an oven-dry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods *(8).*

Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).
Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).
Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).
Carbonate clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1a).
Water retained—pressure extraction, percentage of oven-dry weight of less than 2 mm material; 15 bars (4B2).
Moist bulk density—of less than 75 mm material, saran-coated clods (4A1).
Organic carbon—dichromate, ferric sulfate titration (6A1a).
Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (602), sodium (6P2), potassium (6Q2).
Extractable acidity—barium chloride-triethanolamine II (6H2a).
Cation-exchange capacity—sum of cations (5A3a).
Cation-exchange capacity—ammonium acetate, pH 7.0 (5A6a).
Base saturation—ammonium acetate, pH 7.0 (5C1).
Reaction (pH)—1:1 water dilution (8C1a).
Reaction (pH)—calcium chloride (8C1e).
Iron—dithionate-citrate extract (6C2b).
Carbonate as calcium carbonate—manometric (6E1b).
Calcium saturation—NH4OAC,pH: 7.0.

Engineering Index Test Data

Table 18 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 the Texas State Department of Highways 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); Plasticity index—T 90 (AASHTO); Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(9).* 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. Table 19 shows the classification of the soils in the survey area. 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 Ustoll *(Ust,* meaning ustic moisture regime, 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 presence of horizon of calcium carbonate, plus *Ustoll,* the suborder of the Mollisols that have an Ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic 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 *Acidic* identifies the subgroup that is more arid or drier than is typical for the great group. An example is Aridic 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 fine-silty, mixed, hyperthermic Aridic 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. The Uvalde series is a member of the fine-silty, mixed hyperthermic family of Aridic 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 *(7).* Many of the technical terms used in the descriptions are defined in Soil Taxonomy *(9).* Unless otherwise stated, colors in the descriptions are for moist 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."

Antosa Series

The Antosa series consists of deep, nearly level and gently undulating, sandy soils that are moderately well drained. These soils formed in sandy and loamy sediment on uplands. Slopes range from 0 to 5 percent.

Typical pedon of Antosa sand in an area of Antosa-Bobillo association, gently undulating; from Carrizo Springs, 1.7 miles south on Farm Road 186, 1.6 miles south on Farm Road 2368, 1.0 mile west on dirt road, and 100 feet north; in rangeland:

A11—0 to 14 inches; pale brown (10YR 6/3) sand, dark brown (10YR 4/3) moist; single grained; loose, very friable; common fine roots; slightly acid; gradual smooth boundary.

A12—14 to 24 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; single grained; loose, very friable; few fine roots; slightly acid; gradual wavy boundary.

A2—24 to 30 inches; very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) moist; few fine faint to distinct light brownish gray (10YR 6/2) and brownish yellow (10YR 6/6) mottles; single grained; loose, very friable; a few roots; slightly acid; abrupt wavy boundary.

B21t—30 to 38 inches; light brownish gray (10YR 6/2) sandy clay, grayish brown (10YR 5/2) moist; common fine and medium distinct brownish yellow (10YR 6/6) and reddish yellow (7.5YR 6/6) and few fine prominent yellowish red (5YR 5/6) and red (2.5YR 4/6) mottles; moderate coarse columnar structure parting to moderate medium blocky; very hard, firm; few fine roots; few fine pores; common patchy clay films and organic coatings on ped surfaces; slightly acid; gradual wavy boundary.

B22t—38 to 47 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; common fine, medium, and coarse prominent red (2.5YR 4/6) and yellowish red (5YR 5/6) mottles and few fine and medium distinct grayish brown (10YR 5/2) mottles; moderate medium columnar structure parting to moderate medium blocky; very hard, firm; few fine pores; few patchy clay films and organic coatings on ped surfaces; slightly acid; gradual wavy boundary.

B23t—47 to 72 inches; very pale brown (10YR 7/4) sandy clay loam, very pale brown (10YR 7/4) moist; common fine, medium, and coarse distinct reddish yellow (7.5YR 6/6) and few fine and medium faint grayish brown (10YR 5/2) mottles; weak fine and medium subangular blocky structure; very hard, firm; few patchy clay films; mildly alkaline.

Sandstone is at a depth of 60 to 80 inches or more. The sandy epipedon is 20 to 40 inches thick. The upper part of the solum ranges from medium acid to neutral, and the lower part ranges from slightly acid to moderately alkaline.

The A11 horizon is 6 to 16 inches thick. The A12 horizon is 0 to 20 inches thick. These horizons are brown, pale brown, light brown, or light yellowish brown. The A11 horizon is sand, fine sand, or loamy fine sand. The A2 horizon is 5 to 12 inches thick. It is pale brown, light yellowish brown, or very pale brown and has grayish, yellowish, and brownish mottles. The A2 horizon is sand, fine sand, or loamy fine sand.

The B21t horizon is grayish brown, light brownish gray, light gray, or light olive gray. It has grayish, yellowish, brownish, and reddish mottles. The B21t horizon is sandy clay or sandy clay loam. The B22t and B23t horizons are light brownish gray, light gray, pale brown, very pale brown, and pale yellow and have reddish, brownish, yellowish, and grayish mottles. They are sandy clay loam or fine sandy loam. A few sandstone fragments are below a depth of 50 inches in some pedons.

A Cr horizon of sandstone is in some pedons below a depth of 60 inches.

Batesville Series

The Batesville series consists of moderately deep, nearly level, loamy soils that are well drained. These soils formed over thick beds of caliche on uplands. Slopes range from 0 to 1 percent.

Typical pedon of Batesville fine sandy loam, nearly level; from Batesville, 4.2 miles east on U.S. Highway 57, 3.3 miles south on Farm Road 1866, 0.9 miles south on small county road, 0.3 mile east to gate, 2.0 miles east on ranch road to ranch headquarters, and 0.15 mile southwest of headquarters; in rangeland:

A1—0 to 10 inches; dark brown (10YR 4/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; common fine pores; few flecks and concretions of calcium carbonate as much as 4 millimeters across; few shell fragments; calcareous; moderately alkaline; gradual smooth boundary.

B2—10 to 19 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; hard, friable; common fine roots; common fine pores; few flecks and concretions of calcium carbonate as much as 1 centimeter across; few worm casts; calcareous; moderately alkaline; gradual wavy boundary.

B2ca—19 to 28 inches; light yellowish brown (10YR 6/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak fine and medium subangular blocky structure; hard, friable; few fine roots; common fine pores; few flecks and concretions of calcium carbonate as much as 3 centimeters across; few worm casts; calcareous; moderately alkaline; abrupt wavy boundary.

Ccam—28 to 32 inches; white (10YR 8/1) caliche, light gray (10YR 7/1) moist; strongly cemented; contains a few solution channels filled with soil material; few streaks of pink and very pale brown; calcareous; clear wavy boundary.

Cca—32 to 40 inches; white (10YR 8/1) caliche, light gray (10YR 7/1) moist; weakly cemented; contains a few solution channels filled with soil material; few streaks of pink and very pale brown; calcareous.

The solum is 20 to 40 inches deep to caliche. In most pedons, however, the solum is 20 to 30 inches thick. Calcium carbonate equivalent ranges from about 5 to 40 percent.

The A horizon is 7 to 12 inches thick. It is grayish brown, brown, dark grayish brown, or dark brown. Moist values are less than 3.5.

The B2 horizon is grayish brown, brown, or dark brown. The B2 horizon is sandy clay loam or clay loam. The B2ca horizon is brown, pale brown, light yellowish brown, yellowish brown, or light brown. It is sandy clay loam or clay loam.

The Ccam horizon is laminar and indurated in the upper part in some pedons.

Bobillo Series

The Bobillo series consists of deep, nearly level and gently undulating, sandy soils that are well drained. These soils formed in sandy and loamy sediment on uplands. Slopes range from 0 to 5 percent.

Typical pedon of Bobillo sand in an area of Antosa-Bobillo association, gently undulating; from Carrizo Springs, 1.7 miles south on Farm Road 186, 1.6 miles south on Farm Road 2368, 0.7 mile west on dirt road, and 100 feet south; in rangeland:

A11—0 to 30 inches; light yellowish brown (10YR 6/4) sand, dark yellowish brown (10YR 4/4) moist; single grained; loose, very friable; slightly acid; gradual smooth boundary.

A12—30 to 48 inches; very pale brown (10YR 7/4) sand, yellowish brown (10YR 5/4) moist; single grained; loose, very friable; slightly acid; clear wavy boundary.

A2—48 to 58 inches; very pale brown (10YR 8/3) sand, pale brown (10YR 6/3) moist: few fine faint mottles of white (10YR 8/2) and yellow (10YR 7/6); single grained; loose, very friable; slightly acid; abrupt wavy boundary.

B21t—58 to 72 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; common fine and coarse distinct mottles of reddish yellow (7.5YR 6/6), few fine faint mottles of light brownish gray (10YR 6/2); moderate medium columnar structure parting to weak subangular blocky; very hard, friable; few fine pores; patchy clay films; medium acid; gradual wavy boundary.

B22t—72 to 80 inches; pale yellow (5Y 7/3) sandy clay loam, pale yellow (5Y 7/3) moist; common fine to coarse distinct mottles of reddish yellow, yellowish red, and red and few fine faint mottles of white; weak blocky structure; very hard, friable; patchy clay films; slightly acid.

Sandstone is at a depth of 80 to 100 inches or more. The Bt horizon is 40 to 80 inches thick. The A horizon and upper part of Bt horizon ranges from medium acid to neutral. The lower part of the Bt horizon is slightly acid to mildly alkaline.

The A11 horizon is 8 to 30 inches thick. The A12 horizon is 12 to 30 inches thick. These horizons are brown, pale brown, very pale brown, light brown, and light yellowish brown. The A11 and A12 horizons are sand, fine sand, or loamy fine sand. The A2 horizon is 6 to 24 inches thick. It ranges from very pale brown to pink and has grayish, whitish, brownish, and yellowish mottles. The A2 horizon is sand, fine sand, or loamy fine sand.

The B2t horizon is light brownish gray, pale brown, very pale brown, or pale yellow. It is mottled with varying shades of brown, red, and gray. The B2t horizon is sandy clay loam or fine sandy loam. Sandstone fragments are below a depth of 60 inches in some pedons.

A Cr horizon of sandstone is below a depth of 80 inches in some pedons.

Bookout Series

The Bookout series consists of deep, nearly level to gently undulating, loamy soils that are well drained. These soils formed in ancient, loamy alluvium several feet thick. They are on old terraces on uplands. Slopes range from 0 to 5 percent.

Typical pedon of Bookout clay loam, 0 to 1 percent slopes; from the junction of U.S. Highway 83 and Farm Road 1433 on the north side of Crystal City, 7.0 miles north on U.S. Highway 83, 7.6 miles east on Farm Road 1025, and 100 feet north; in rangeland:

A11—0 to 1 inch; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; thin platy and weak fine subangular blocky structure; slightly hard, very friable; common fine roots; few snail shell fragments; calcareous; moderately alkaline; abrupt smooth boundary.

A12—1 to 14 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, friable; many fine roots; many fine pores and old root channels; few wormcasts; few snail shell fragments; about 12 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual smooth boundary.

B21ca—14 to 24 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, friable; common fine roots; few fine pores and old root channels; few wormcasts and termite tunnels; few snail shell fragments; few threads and masses of calcium carbonate as much as $^1/_4$ inch in diameter; about 17 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual wavy boundary.

B22ca—24 to 35 inches; very pale brown (10YR 7/3) clay, pale brown (10YR 6/3) moist; weak fine and medium subangular blocky structure; hard, friable; few fine roots; about 10 percent by volume calcium carbonate visible as threads and soft masses as much as $^1/_2$ inch across; about 26 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual wavy boundary.

B23ca—35 to 50 inches; very pale brown (10YR 8/4) clay, very pale brown (10YR 7/4) moist; weak fine and medium subangular blocky structure; hard, firm; few fine roots; about 10 percent by volume calcium carbonate as threads, soft masses, and concretions as much as $^1/_2$ inch across; about 30 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual wavy boundary.

B24ca—50 to 64 inches; very pale brown (10YR 8/4) silty clay, light yellowish brown (10YR 6/4) moist; weak fine and medium subangular blocky structure; very hard, firm; many threads and few concretions and soft masses of calcium carbonate as much as $^1/_2$ inch across; about 35 percent calcium carbonate equivalent; calcareous; diffuse wavy boundary.

B25ca—64 to 80 inches; pink (7.5YR 8/4) silty clay, pink (7.5YR 7/4) moist; weak fine and medium subangular blocky structure; very hard, firm; many threads and few concretions and soft masses of calcium carbonate as much as $^1/_2$ inch in diameter; calcareous; moderately alkaline.

The solum ranges from 60 inches to more than 80 inches in thickness. Calcium carbonate equivalent averages 15 to 40 percent in the 10- to 40-inch control section. About 30 to 50 percent of the calcium carbonate is the size of clay. The solum is clay loam, silty clay loam, silty clay, or clay. The noncarbonate clay content is 18 to 35 percent.

The A11 horizon is $^1/_4$ inch to 2 inches thick, and the A12 horizon is 7 to 20 inches thick. These horizons are grayish brown, brown, light brownish gray, pale brown, or very pale brown.

The B21ca and B22ca horizons are light brownish gray, pale brown, very pale brown, light yellowish brown, and light brown. The lower B2ca horizons have colors

similar to those of the upper B2ca horizons, but they are generally of slightly higher value. They have higher content of calcium carbonate that ranges from 1 percent to about 25 percent by volume of visible accumulations that are soft masses, concretions, and threads.

Brundage Series

The Brundage series consists of deep, nearly level, loamy soils that are moderately well drained. These soils formed in loamy sediment. They are in narrow valleys along drainageways. Slopes range from 0 to 2 percent.

Typical pedon of Brundage fine sandy loam, frequently flooded; from Asherton, 6.6 miles southeast on U.S. Highway 83, and 100 feet east; in rangeland:

A1—0 to 3 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; $^{1}/_{4}$-inch platy crust on surface; neutral; abrupt smooth boundary.

B21t—3 to 7 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium and coarse columnar structure parting to moderate fine and medium subangular blocky and angular blocky; thin light gray (10YR 7/2) caps on columns about 1.0 to 3.0 millimeters thick; very hard, firm; few fine roots; very few fine pores and root channels; patchy clay films on surfaces of peds; saline; noncalcareous; moderately alkaline; clear wavy boundary.

B22t—7 to 26 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; weak medium and coarse columnar structure parting to moderate fine and medium subangular blocky; hard, firm; very few fine roots; very few fine pores and old root channels; few patchy clay films on surfaces of peds; few flecks of calcium carbonate; saline; moderately alkaline; gradual wavy boundary.

B23tca—26 to 42 inches; very pale brown (10YR 7/4) sandy clay loam, light yellowish brown (10YR 6/4) moist; moderate fine and medium subangular blocky structure; hard, firm; very few fine roots; very few fine and medium pores and root channels; contains about 3 percent by volume of soft masses of calcium carbonate; saline; calcareous; moderately alkaline; gradual wavy boundary.

B3ca—42 to 72 inches; pale yellow (2.5Y 7/4) sandy clay loam, light yellowish brown (2.5Y 6/4) moist; weak fine and medium subangular blocky structure; hard, friable; contains about 10 percent by volume soft masses of calcium carbonate as much as 1.0 centimeter in diameter; saline; calcareous; moderately alkaline.

The solum is 40 inches to more than 80 inches thick. Exchangeable sodium ranges from 15 to 40 percent in some parts of the upper 16 inches of the argillic horizon. Soft, powdery calcium carbonate is at a depth of 6 to 22 inches. Electrical conductivity of the saturation extract is less than 4 millimhos in the A horizon, 4 to 16 millimhos in the upper Bt horizon, and more than 8 millimhos in the lower B and C horizons.

The A horizon is 2 to 10 inches thick. It ranges from dark grayish brown to brown to light yellowish brown, yellowish brown, or light gray. Reaction is medium acid to neutral.

The B21t and B22t horizons are dark grayish brown or brown to light brownish gray, yellowish brown, light yellowish brown, very pale brown, or light gray. The upper part of the B2t horizon, in most places, is darker than the A horizon or the lower part of the B2t horizon. These horizons are sandy clay loam or clay loam. The upper part

of the B21t and B22t horizons is slightly acid to mildly alkaline, and the lower part is mildly alkaline to moderately alkaline. The B3 horizon ranges from grayish brown or brown to very pale brown or yellow. Visible segregations of calcium carbonate and calcium sulfate are in the form of soft masses and concretions. They range from 2 to 20 percent by volume. Threads and small pockets of other neutral salts are scarcely evident to conspicuous.

Brystal Series

The Brystal series consists of deep, gently sloping and gently undulating, loamy soils that are well drained. These soils formed in interbedded sandstone and loamy sediment on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Brystal fine sandy loam, 1 to 3 percent slopes; from Crystal City, 2.0 miles south on U.S. Highway 83, 0.6 mile west on Farm Road 191, 1.0 mile south on Farm Road 1918, and 75 feet west from highway centerline; in cultivated field (site is 0.25 mile south of old Experiment Station entrance):

Ap—0 to 7 inches; brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine roots; few fine pores and old root channels; thin surface crust; neutral; clear smooth boundary.

B21t—7 to 14 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable; few fine roots; few fine pores and old root channels; sand grains bridged by clay; neutral; gradual smooth boundary.

B22t—14 to 24 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; few fine roots; few fine pores and old root channels; few patchy clay films on surfaces of peds and in pores; neutral; gradual wavy boundary.

B23t—24 to 35 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; very few fine roots; few fine pores and old root channels; few patchy clay films on surface of peds and in pores; mildly alkaline; gradual wavy boundary.

B24tca—35 to 44 inches; reddish yellow (7.5YR 6/6) sandy clay loam; strong brown (7.5YR 5/6) moist; weak fine and medium subangular blocky structure; hard, friable; few fine roots; few fine pores and old root channels; few patchy clay films on surface of peds and in pores; few soft masses of calcium carbonate; mildly alkaline; clear wavy boundary.

B25tca—44 to 72 inches; reddish yellow (7.5YR 7/6) sandy clay loam, reddish yellow (7.5YR 6/6) moist; few fine distinct strong brown and reddish mottles; weak fine subangular blocky structure; hard, friable; few patchy clay films; contains about 10 percent by volume soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to 90 inches in thickness. Secondary calcium carbonate is at a depth of about 20 to 35 inches.

The A horizon is 6 to 15 inches thick. It is brown or reddish brown. The A horizon ranges from neutral to mildly alkaline.

The B21t and B22t horizons are brown, strong brown, reddish yellow, reddish brown, or yellowish red. They are sandy clay loam or sandy loam. Clay content ranges from 18 to 30 percent. The B21t and B22t horizons are neutral to moderately alkaline. The B2tca horizons range from strong brown or light yellowish brown to

reddish yellow, yellow, or yellowish red. They are slightly less clayey than the B2t horizons above. Visible secondary calcium carbonate in the form of soft masses and concretions range from few to as much as 25 percent by volume.

A Cr horizon of sandstone is below a depth of 60 inches in some pedons.

Caid Series

The Caid series consists of deep, nearly level to gently undulating soils that are well drained. These soils formed in calcareous sandy clay loam and clay loam on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Caid sandy clay loam, gently undulating; from La Pryor, 9.0 miles west on U.S. Highway 57, 1.1 miles south on road to ranch headquarters, and 100 feet west; in rangeland:

A1—0 to 12 inches; dark brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable; many fine roots, few fine pores and old root channels; few snail shell fragments; thin crust on surface; calcareous; moderately alkaline; clear, smooth boundary.

B21t—12 to 29 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, friable; many fine roots; many fine pores and old root channels; many thin clay films on peds; few worm casts; few concretions of calcium carbonate less than 2 millimeters in diameter; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B22tca—29 to 39 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; moderate fine and medium subangular blocky structure; very hard, firm; few roots; few fine pores and old root channels; many clay films on peds; few wormcasts; about 10 percent by volume calcium carbonate; soft masses and concretions as much as $^{1}/_{2}$ inch in diameter; few chert pebbles; calcareous; moderately alkaline; gradual, wavy boundary.

B23tca—39 to 58 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; moderate fine and medium subangular blocky and angular blocky structure; very hard, very firm; few fine roots; about 20 percent by volume soft masses and concretions of calcium carbonate; few black masses as much as 1 millimeter in size; calcareous; moderately alkaline; clear, wavy boundary.

B24tca—58 to 72 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; common medium and common coarse reddish yellow (7.5YR 6/6) mottles; moderate fine and medium subangular blocky and angular blocky structure; very hard, firm; few thin clay films on peds; about 5 percent by volume soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

Crca—72 to 80 inches; brownish yellow (10YR 6/6) soft sandstone, yellowish brown (10YR 5/6) moist; contains about 20 percent light gray (5Y 7/2) soft sandstone, light olive gray (5Y 6/2) moist; contains few pockets of shaly material and about 5 percent soft masses and films of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to 100 inches or more in thickness. The soil above the calcic horizon ranges from 25 to 40 inches in thickness. Secondary forms of calcium carbonate are in all horizons.

The A horizon is brown, dark brown, dark grayish brown, or very dark grayish brown. The A horizon is 10 to 20 inches in thickness.

The B21tca and B22tca horizons are brown, grayish brown, strong brown, pale brown, or light yellowish brown. These horizons are sandy clay loam or clay loam. Clay content in the upper 20 inches is 27 to 35 percent. The B23tca and B24tca horizons range from pale brown or very pale brown to light yellowish brown, brownish yellow, or reddish yellow. The B23tca and B24tca horizons are sandy clay loam, sandy clay, or clay loam. Clay content ranges from 23 to 35 percent.

Some pedons do not have a Crca horizon below a depth of 60 inches. The Crca horizon has cemented, yellowish sandstone fragments or sandstone interbedded with shale.

Catarina Series

The Catarina series consists of deep, moderately well drained, clayey soils that are nearly level. These soils formed in calcareous, saline clay and shale on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Catarina clay, nearly level; from Catarina, 2.2 miles northwest on U.S. Highway 83, 0.5 mile southwest on Farm Road 2688, and 100 feet south of right-of-way; in rangeland:

A11—0 to 2 inches; brown (10YR 5/3) clay; dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; very hard, very firm; common fine roots; cracks as much as 1 inch wide; calcareous; moderately alkaline; abrupt smooth boundary.

A12—2 to 12 inches; brown (10YR 5/3) clay; dark brown (10YR 4/3) moist; moderate fine and medium blocky structure; extremely hard, very firm; cracks 0.5 to 1 inch wide; common fine roots; calcareous; gradual wavy boundary.

A13—12 to 26 inches; brown (10YR 5/3) clay; dark brown (10YR 4/3) moist; moderate fine and medium blocky structure, the peds are mostly wedge-shaped; extremely hard, extremely firm; cracks 0.5 to 1 inch wide; few fine roots; few threads of calcium carbonate and other salts; saline; calcareous; moderately alkaline; diffuse wavy boundary.

AC1sa—26 to 58 inches; light yellowish brown (10YR 6/4) clay; yellowish brown (10YR 5/4) moist; weak fine and medium blocky structure; slickensides throughout that intersect; extremely hard, extremely firm; few fine masses of soft calcium carbonate; saline; calcareous; moderately alkaline; gradual wavy boundary.

AC2sa—58 to 64 inches; light yellowish brown (10YR 6/4) clay; yellowish brown (10YR 5/4) moist; weak blocky structure; very hard, very firm; common threads and pockets of salts and few concretions of calcium carbonate, few gypsum crystals; saline; calcareous; moderately alkaline.

The solum ranges from 40 to 80 inches in thickness. Exchangeable sodium is in excess of 15 percent in some parts of the upper 30 inches of the solum. Conductivity of the saturation extract is 1 to 12 millimhos in the upper part of the solum and 4 to 20 millimhos in the lower part. Reaction is moderately alkaline or strongly alkaline throughout.

The A horizon ranges from grayish brown, brown, and yellowish brown through pale brown, light yellowish brown, and light olive brown, olive gray, light olive gray, and pale olive.

The AC horizon ranges from brown and yellowish brown through pale brown, very pale brown, and light yellowish brown to light olive brown, olive, and pale olive. Soft masses, concretions, and threads of calcium carbonate range from few to as much

as 20 percent by volume. Visible crystals and threads of gypsum and pockets of other neutral salts are few to about 10 percent by volume.

AC horizon is in some pedons and is clay, shaly clay, or shale. In some pedons, the shaly material is interbedded with sandstone. Threads and crystals of salts are few to many in this horizon.

Chacon Series

The Chacon series consists of deep, nearly level and gently sloping or gently undulating, loamy soils that are well drained. These soils formed in calcareous, saline clay and shale on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Chacon clay loam, gently undulating; from La Pryor, 8.5 miles west on U.S. Highway 57, 4.5 miles north on ranch road to ranch headquarters, 0.8 mile east along fenceline road, 2.2 miles north along fenceline road, 0.4 mile west through gate and continue 0.9 mile on ranch road, 50 feet east; in rangeland:

A1—0 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, friable; many fine roots; calcareous; moderately alkaline; clear smooth boundary.

B21t—15 to 32 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium angular blocky and subangular blocky structure; very hard, firm; many fine roots; few fine pores and root channels; some surfaces of peds have shiny faces; vertical cracks $^{1}/_{4}$ to $^{5}/_{16}$ inch wide at intervals of 3 to 8 inches; calcareous; moderately alkaline; gradual wavy boundary.

B22t—32 to 40 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium and coarse blocky structure; extremely hard, very firm; few roots in upper part decreasing with depth; few fine pores; shiny faces on peds presumed to be pressure planes; few vertical cracks; dark stains on few faces of peds; few small pebbles as much as $^{1}/_{2}$ inch in diameter; few fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

B3ca—40 to 52 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak medium angular blocky structure; very hard, very firm; few fine roots; few root channels; estimated 1 to 2 percent by volume of soft lumps of calcium carbonate as much as $^{1}/_{4}$ inch in diameter; few small pockets of neutral salts; calcareous; moderately alkaline; diffuse wavy boundary.

Cca—52 to 66 inches; very pale brown (10YR 7/4) clay, light yellowish brown (10YR 6/4) moist; weak fine and medium subangular blocky structure; very hard, very firm; about 5 percent by volume soft lumps of calcium carbonate; few gypsum crystals; calcareous; moderately alkaline.

The solum is 40 to 80 inches deep to calcareous clay that is stratified, weakly consolidated sandstone and shale. The mollic epipedon is 10 to 20 inches thick. The soil is slightly to moderately affected by salinity, which increases with depth. COLE is 0.07 to 0.15 in the upper 1.25 meters.

The A horizon ranges from gray or grayish brown to very dark gray or very dark grayish brown.

The B2t horizons range from dark gray or grayish brown to light brownish gray and pale brown. The darker colors are in the upper part of the B2t horizon. This horizon is clay loam, sandy clay, or clay. Clay content of the upper 20 inches ranges from 35 to 50 percent. The B3 horizon ranges from light brownish gray or pale brown to yellowish brown and pale yellow. Calcium carbonate or other neutral salts are

visible as threads, films, lumps, or concretions that range from a few to as much as 10 percent by volume.

The C horizon is the same color, or slightly lighter in value, than the B3 horizon. Calcium carbonate or other neutral salts are visible as threads, films, lumps, or concretions, which range from a few to as much as 20 percent by volume. In some pedons, the C horizon is interbedded clayey shale and sandstone.

Cochina Series

The Cochina series consists of deep, nearly level, clayey soils that are moderately well drained. These soils formed in recent clayey alluvium on bottom lands. Slope ranges from 0 to 1 percent.

Typical pedon of Cochina clay, frequently flooded; from junction of U.S. Highway 83 and Loop 155 on southwest side of Crystal City, 0.5 mile south on U.S. Highway 83, and 150 feet east from right-of-way fence; in rangeland:

A11—0 to 7 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; few shell fragments; electrical conductivity is 1.6 millimhos; calcareous; moderately alkaline; gradual wavy boundary.

A12—7 to 34 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure parting to moderate fine angular blocky; extremely hard; very firm; very sticky and very plastic; common fine roots; few shell fragments; few slickensides in lower part; very few brown-black concretions 1 millimeter across; electrical conductivity 1.0 millimhos; calcareous; moderately alkaline; diffuse wavy boundary.

AC1—34 to 52 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; moderate medium subangular blocky structure parting to moderate fine angular blocky; extremely hard, very firm, very sticky and very plastic; few fine roots; few dark streaks; few slickensides; few brown-black concretions 1 millimeter across; electrical conductivity 4.2 millimhos; calcareous; moderately alkaline; diffuse wavy boundary.

AC2sa—52 to 72 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; extremely hard, very firm, very sticky and very plastic; few slickensides; few salt threads; few crystals of gypsum; few brown-black concretions 1 millimeter across; electrical conductivity 7.0 millimhos; saline; calcareous; saline; moderately alkaline.

The solum ranges from 60 to 80 inches or more in thickness. Electrical conductivities of the saturation extract range from 0 to 4 millimhos in the A11 and A12 horizons; from about 4 to 8 millimhos in the AC1 horizon; and from 4 to 12 millimhos in the AC2 horizon. The clay content of the 10- to 40-inch control section ranges from 60 to 80 percent.

The A horizon is grayish brown, light brownish gray, light yellowish brown, or light olive brown. The A11 horizon is 4 to 12 inches thick, and the A12 horizon is 12 to 30 inches thick.

The AC horizon is light brownish gray, pale brown, or very pale brown.

Conalb Series

The Conalb series consists of deep, nearly level and gently sloping, loamy soils that are well drained. These soils formed in stratified, loamy alluvium on bottom land.

Slopes range from 0 to 3 percent.

Typical pedon of Conalb loam, occasionally flooded; from Nueces River Bridge on U.S. Highway 83 in northern Zavala County, 0.1 mile southwest, 300 feet south to old reservoir, and 100 feet southwest; in perennial grass pasture:

Ap—0 to 6 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, very friable; slightly compacted; few fine roots; few fine pores and old root channels; $^1/_4$-inch platy crust on surface; calcareous; about 50 percent calcium carbonate equivalent; moderately alkaline; abrupt smooth boundary.

A1—6 to 14 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; few fine roots; common fine pores and old root channels; few wormcasts and termite tunnels; calcareous; about 50 percent calcium carbonate equivalent; moderately alkaline; gradual smooth boundary.

B2—14 to 28 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; few fine roots; common fine pores and old root channels; few wormcasts and termite tunnels; few threads of segregated calcium carbonate; calcareous; about 48 percent calcium carbonate equivalent; moderately alkaline; clear wavy boundary.

C1—28 to 56 inches; very pale brown (10YR 7/4) loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, friable; few thin discontinuous strata of fine sandy loam, silt loam, and silty clay loam; calcareous; about 50 percent calcium carbonate equivalent; moderately alkaline; diffuse wavy boundary.

C2—56 to 80 inches; very pale brown (10YR 7/4) loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, friable; few thin strata of fine sandy loam, silt loam, and silty clay loam; stratification slightly more prominent than in above horizon; calcareous; about 50 percent calcium carbonate equivalent; moderately alkaline.

The soil above the stratified C horizon ranges from 14 to 36 inches in thickness. Carbonates comprise 40 to 70 percent of the whole soil. Average texture of the 10- to 40-inch control section is loam, silt loam, or clay loam. Clay content ranges from 18 to 35 percent.

The A horizon is 4 to 14 inches thick and ranges from grayish brown or brown to light brownish gray or pale brown.

The B2 horizon ranges from brown and light brown to pale brown or very pale brown. It is loam, silt loam, or clay loam 10 to 22 inches thick. A few films and threads of calcium carbonate are in some pedons.

The C horizon ranges from light brown to pale brown or very pale brown. Stratification is faint to distinct. Some pedons have gravelly strata below a depth of 42 inches.

Cotulla Series

The Cotulla series consists of deep, nearly level to gently undulating, clayey soils that are moderately well drained. These soils formed in calcareous, saline clays and shales on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Cotulla clay, gently undulating; from junction of U.S. Highway 83 and Farm Road 1433 on the north side of Crystal City, 4.2 miles north on U.S. Highway 83, 0.4 mile east on county road, and 150 feet north; in rangeland:

A11—0 to 5 inches; grayish brown (10Th 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; very

hard, firm; common fine roots; few snail shell fragments; thin surface crust; electrical conductivity 0.6 millimhos; calcareous; moderately alkaline; clear smooth boundary.

A12—5 to 20 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium blocky structure; extremely hard, very firm; few fine roots; few snail shell fragments; electrical conductivity 5.5 millimhos; calcareous; saline; moderately alkaline; gradual boundary.

A13—20 to 32 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate fine and medium blocky structure; extremely hard, very firm; few intersecting slickensides; few streaks of darker material; few fine roots; few snail shell fragments; electrical conductivity 14.0 millimhos; calcareous; saline; moderately alkaline; gradual wavy boundary.

AC1sa—32 to 48 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; moderate fine and medium blocky structure; extremely hard, very firm; few intersecting slickensides; few streaks of darker material; few very fine roots; few concretions of calcium carbonate as much as 1 millimeter in size; few threads of neutral salts; electrical conductivity 14.0 millimhos; calcareous; saline; moderately alkaline; diffuse wavy boundary.

AC2sa—48 to 62 inches; brownish yellow (10YR 6/6) clay, yellowish brown (10YR 5/6) moist; weak fine and medium blocky structure; very hard, very firm; few intersecting slickensides; common fine threads and pockets of neutral salts; few crystals of gypsum; few concretions of calcium carbonate as much as 2 millimeters in size; few streaks of darker material; electrical conductivity 11.5 millimhos; calcareous; saline; moderately alkaline; diffuse wavy boundary.

AC3sa—62 to 72 inches; very pale brown (10YR 7/3) clay, brown (10YR 5/3) moist; weak fine and medium blocky structure; very hard; very firm; common fine threads and pockets of neutral salts; many pockets of crystalline gypsum; few masses of calcium carbonate; electrical conductivity 12.0 millimhos; calcareous; saline; moderately alkaline.

The solum ranges from 40 to 80 inches in thickness. Exchangeable sodium is more than 15 percent in some parts of the upper 30 inches of the solum. Salinity ranges from slight to moderate in the upper part of the solum and from moderate to extreme in the lower part. Clay content ranges from 40 to about 60 percent.

The A horizon is grayish brown, light brownish gray, brown, pale brown, light olive brown, or light yellowish brown.

The AC horizon has slightly higher value and chroma than the A horizon. It has few to common threads and crystals of salts. Some pedons have a few quartzitic pebbles.

In some pedons, a C horizon is above 80 inches. It is clay, shaly clay, or shale. In some pedons, the shaly material is interbedded with sandstone. Crystals and threads of salts are few to many.

Dev Series

The Dev series consists of deep, nearly level, loamy and gravelly soils that are well drained. These soils formed in gravelly and loamy alluvium on bottom land. Slopes range from 0 to 2 percent.

Typical pedon of Dev very gravelly loam in an area of Dev soils, frequently flooded; from the west end of the Nueces River Bridge on U.S. Highway 83, 250 feet south, in northern Zavala County:

A1—0 to 28 inches; dark grayish brown (10YR 4/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular

blocky and granular structure; slightly hard, very friable; common fine roots; 60 percent by volume subrounded limestone pebbles mostly 1/4 inch to 2 inches in diameter, few larger pebbles and few cobbles; calcareous; diffuse wavy boundary.

C1ca—28 to 45 inches; brown (10YR 5/3) very gravelly loam, dark grayish brown (10YR 4/2) moist; weak fine and medium subangular blocky and granular structure; slightly hard, very friable; few fine roots; 80 percent by volume subrounded limestone pebbles mostly 1/4 inch to 2 inches in diameter, few larger pebbles and few cobbles; few threads of calcium carbonate and few pebbles have coatings of calcium carbonate; calcareous; diffuse wavy boundary.

C2ca—45 to 72 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 5/3) moist; weak subangular blocky and granular structure; slightly hard, very friable; 70 percent by volume of subrounded limestone pebbles mostly 1/4 inch to 2 inches in diameter; few larger pebbles and few cobbles; few threads of calcium carbonate and few siliceous pebbles with coatings of calcium carbonate; calcareous.

The solum is 20 to 40 inches thick. All horizons have 35 to 90 percent by volume limestone gravel that is mostly less than 3 inches in diameter. Some pedons have a few cobbles and stones. Some pedons have fragmental strata, which are nearly all coarse fragments, and discontinuous strata of loamy soil.

The A horizon is very dark grayish brown, dark grayish brown, very dark brown, or brown. The fine earth fraction is loam or clay loam.

The C horizon ranges from grayish brown or brown to light brownish gray, light yellowish brown, or very pale brown. The fine earth fraction is loam or clay loam. Clay content ranges from 18 to 35 percent.

Dilley Series

The Dilley series consists of shallow, gently undulating, loamy soils that are well drained. These soils formed in interbedded sandstone and loamy sediment on uplands. Slopes range from 1 to 5 percent.

Typical pedon of Dilley fine sandy loam, gently undulating; from Batesville, 13 miles south on Farm Roads 117 and 1025, 3.8 miles east on Farm Road 1867, 2.7 miles northeast on county road, and 30 feet south; in rangeland:

A1—0 to 5 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; few worm tunnels; neutral; gradual smooth boundary.

B21t—5 to 12 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; compound weak medium prismatic structure parting to weak fine subangular blocky; hard, friable; common fine roots; few fine pores and worm tunnels; clay films bridge sand grains; neutral; gradual wavy boundary.

B22t—12 to 16 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; weak fine subangular blocky structure; hard, friable; few fine roots; few fine pores; clay bridging sand grains; few sandstone fragments and a few hard concretions of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—16 to 36 inches; very pale brown (10YR 7/4) weakly cemented sandstone and thin seams of calcium carbonate; sandstone is noncalcareous.

The solum ranges from 10 to 20 inches in thickness. Reaction ranges from slightly acid to mildly alkaline. Coarse fragments of sandstone or chert range from 0 to 25 percent by volume.

The A horizon ranges from grayish brown, brown, or light brown to lightly yellowish brown, reddish brown, yellowish red, or reddish yellow. The A horizon ranges from 4 to 12 inches in thickness.

The Bt horizon ranges from red or reddish brown through yellowish red or reddish yellow to brown or yellowish brown. It is fine sandy loam or sandy clay loam.

The Cr horizon is weakly or strongly cemented sandstone. Some pedons are interbedded in loamy and clayey sediment.

Divot Series

The Divot series consists of deep, nearly level, clayey soils. These soils formed in clayey and limy alluvium on bottom land. Slopes range from 0 to 1 percent.

Typical pedon of Divot silty clay, occasionally flooded; from Crystal City, 7.0 miles north on U.S. Highway 83, 2.4 miles east on Farm Road 1025, 1.2 miles south on county road, and 150 feet east; in old field:

Ap—0 to 6 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; hard, friable; common fine roots; many fine pores and old root channels; few snail shell fragments; calcareous; moderately alkaline; clear smooth boundary.

A1—6 to 24 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; few fine roots; many fine pores and old root channels; few snail shell fragments; calcareous; moderately alkaline; gradual smooth boundary.

B21—24 to 38 inches; light brownish gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; few fine roots; fine pores and old root channels; few vertical cracks filled with soil material from above; few pressure faces; few flecks and fine threads of calcium carbonate; calcareous; moderately alkaline; diffuse wavy boundary.

B22—38 to 50 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; very hard, firm; few fine pores; few vertical cracks filled with soil from above; few pressure faces; few flecks and threads of calcium carbonate; calcareous; moderately alkaline; diffuse wavy boundary.

C—50 to 64 inches; very pale brown (10YR 7/3) silty clay loam, pale brown (10YR 6/3) moist; few yellowish brown flecks and splotches; massive; hard, firm; few flecks and threads of calcium carbonate; calcareous; moderately alkaline.

The mollic epipedon is 20 to 40 inches thick. The calcium carbonate equivalent is 25 to 40 in the 10- to 40-inch control section. The dry soil has cracks $^{1}/_{2}$ to 1 inch wide that extend to a depth of 20 to 30 inches.

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

The B2 horizon is light brownish gray, pale brown, brown, or yellowish brown. It is clay, silty clay, or silty clay loam.

The C horizon is pale brown, very pale brown, or light yellowish brown. It is silty clay, silty clay loam, or clay loam.

Duval Series

The Duval series consists of deep, nearly level to gently undulating, sandy and loamy soils that are well drained. These soils formed in loamy sediment and interbedded sandstone on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Duval fine sandy loam, gently undulating; from Big Wells, 9.4 miles east on Texas Highway 85, and 100 feet north; in rangeland:

A1—0 to 15 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; few fine roots; few fine and medium pores and old root channels; slightly acid; clear smooth boundary.

B21t—15 to 32 inches; red (2.5YR 4/6) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable; few patchy clay films, clay bridges sand grains; few fine roots; few fine pores and old root channels; slightly acid; gradual wavy boundary.

B22t—32 to 38 inches; red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable; few patchy clay films, clay bridges sand grains; few fine pores and old root channels; neutral; gradual wavy boundary.

B23t—38 to 44 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak fine and medium subangular blocky structure; hard, very friable; few patchy clay films, clay bridges sand grains; few fine threads and flecks of calcium carbonate; mildly alkaline; gradual wavy boundary.

B3ca—44 to 50 inches; yellowish red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) moist; weak fine subangular blocky structure; slightly hard, very friable; few noncalcareous sandstone fragments as much as 1 inch across; few fine threads and flecks of calcium carbonate; moderately alkaline; abrupt wavy boundary.

Crca—50 to 70 inches; yellow (10YR 7/6) sandstone, brownish yellow (10YR 6/6) moist; strata and pockets of reddish brown and yellowish brown sandstone; soft; few seams of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. Secondary lime is below a depth of 36 inches.

The A horizon ranges from 10 to 20 inches in thickness. It ranges from brown or reddish brown to light brown or yellowish red. This horizon is loamy fine sand or fine sandy loam. It is slightly acid to neutral.

The B2t horizon ranges from red, reddish brown, or yellowish red to brown, strong brown, or reddish yellow. The B2t horizon ranges from sandy loam to sandy clay loam. The average clay content is 18 to 30 percent. This horizon is slightly acid to mildly alkaline. The B3 horizon has colors that are 1 or 2 units higher in value and chroma than the B2t horizon.

Some pedons have a Cca horizon that is sandy clay loam or fine sandy loam and fragments of sandstone. The Cca horizon is weakly to moderately expressed.

Hindes Series

The Hindes series consists of moderately deep, undulating, loamy and very gravelly soils that are well drained. These soils are on uplands. They formed in thick beds of gravelly sediment and caliche. Slopes range from 1 to 8 percent.

Typical pedon of Hindes very gravelly sandy clay loam in an area of Yologo-Hindes association, undulating; from Batesville, 1.0 mile east on U.S. Highway 57, 7.0 miles northeast on Farm Road 187, and 50 feet north; in rangeland (50 feet west of highway marker 359):

A1—0 to 10 inches; reddish brown (5YR 4/3) very gravelly sandy clay loam, dark reddish brown (5YR 3/3) moist; moderate fine and very fine subangular blocky structure; hard, friable; many fine roots; estimated 40 percent by volume rounded chert pebbles, mainly $^1/_2$ inch to 2 inches in diameter; slightly acid; clear wavy boundary.

B21t—10 to 18 inches; reddish brown (5YR 4/4) very gravelly clay, dark reddish brown (5YR 3/4) moist; moderate fine and very fine angular blocky structure; very hard, firm; many roots; estimated 75 percent by volume rounded chert pebbles mainly $^1/_2$ inch to 2 inches in diameter; clay films on peds and coarse fragments; slightly acid; gradual, wavy boundary.

B22t—18 to 32 inches; reddish brown (2.5YR 4/4) very gravelly clay, dark reddish brown (2.5YR 3/4) moist; moderate fine and very fine angular blocky structure; very hard, firm; few fine roots; an estimated 75 percent by volume rounded chert pebbles mainly $^1/_2$ inch to 2 inches in diameter; clay films on peds and coarse fragments; slightly acid; abrupt wavy boundary.

IIC1ca—32 to 40 inches; pink (5YR 8/4) caliche of clay loam texture, reddish yellow (5YR 6/6) moist; massive; hard, friable; few fine distinct reddish brown, strong brown, and yellowish red seams and pockets of loamy to clayey material; few rounded chert pebbles; calcareous; moderately alkaline; gradual wavy boundary.

IIC2ca—40 to 80 inches; pink (7.5YR 8/4) caliche, pink (7.5YR 7/4) moist; hard, friable; few fine distinct whitish and brownish stains in seams and pockets; calcareous; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness.

The A horizon ranges from 4 to 12 inches in thickness. It is dark grayish brown to dark reddish brown, reddish brown, dark brown, or brown. The A horizon is slightly acid to mildly alkaline. The fine earth fraction is sandy clay loam, loam, or clay loam. This horizon is 15 to 75 percent by volume coarse fragments. Coarse fragments are mostly siliceous pebbles and cobbles.

The B21t horizon ranges from 17 to 26 inches in thickness. It is dark reddish brown to reddish brown or dark brown. It has 35 to 80 percent by volume waterworn chert pebbles. The fine earth fraction ranges from clay to clay loam. This horizon is slightly acid to mildly alkaline in reaction.

The IICca horizon is mainly soft caliche. It can have clayey material intermixed with lumps and concretions of calcium carbonate and weakly consolidated sandstone and seams of calcium carbonate.

Jimenez Series

The Jimenez series consists of very shallow and shallow, rolling, very gravelly soils that are excessively drained. These soils are on uplands. They formed in thick beds of gravelly caliche and are on side slopes of old, high terraces. Slopes range from 1 to 12 percent.

Typical pedon of Jimenez very gravelly loam, roiling; from Carrizo Springs, 14.5 miles southwest on Farm Road 186 to ranch entrance gate, 8.8 miles southwest on ranch road to ranch headquarters, 0.4 mile southeast to second house, 0.3 mile south, 0.2 mile west along fenceline, 1.1 miles southwest, 1.6 miles west to fenceline, 0.3 mile south along fenceline, and 50 feet east; in rangeland:

A1—0 to 12 inches; dark grayish brown (10YR 4/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak granular structure; slightly hard, very friable; 65 percent by volume of subrounded waterworn chert, quartzite, limestone, sandstone, and basalt pebbles mostly less than 2 inches in diameter, some larger pebbles and a few cobbles; calcareous; moderately alkaline; abrupt wavy boundary.

Ccam—12 to 16 inches; white (10YR 8/2) strongly cemented caliche with a few embedded pebbles of gravel; upper surfaces are smooth and finely etched; hardness of about 3 by Moh's scale when dry; gradual irregular boundary.

Cca—16 to 24 inches; very pale brown (10YR 8/4) weakly cemented caliche; about 50 percent of the mass is embedded gravel.

The solum is 4 to 20 inches deep to strongly cemented caliche. This range of depth is common within a pedon. The surface is covered with 5 to 75 percent gravel of mixed origin.

The A horizon is dark grayish brown, dark brown, or brown. This horizon is 35 to 85 percent by volume of subrounded, waterworn chert, quartzite, limestone, sandstone, and basalt pebbles and a few cobbles.

The Ccam horizon is laminar in its upper part in many pedons. In others it is fractured and platy in the upper part. The Cca horizon ranges from a few pebbles to as much as 75 percent by volume gravel of mixed origin. The gravel is similar to that in the A horizon.

Maverick Series

The Maverick series consists of moderately deep, gently undulating, saline, clayey and loamy soils that are well drained. These soils are on uplands. They formed in calcareous, saline clay and shale. Slopes range from 1 to 5 percent.

Typical pedon of Maverick clay loam, gently undulating; from La Pryor, 6.0 miles south on U.S. Highway 83, 1.0 mile west on county road to pipeline, 1.0 mile north along fenceline, 50 feet east; in rangeland:

A1—0 to 6 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure parting to moderate fine and very fine angular blocky; very hard, firm; many fine roots; few fine pores and root channels; few wormcasts; few dark streaks and pockets; calcareous; moderately alkaline; clear wavy boundary.

B2—6 to 18 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate fine and medium angular blocky structure; extremely hard, very firm; few fine roots; few fine pores and root channels; few organic stains on faces of peds; few hard concretions of calcium carbonate about 1.0 millimeter across; calcareous; saline; moderately alkaline; gradual wavy boundary.

B2ca—18 to 28 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist, few faint yellowish brown and brownish yellow mottles; moderate fine and medium angular blocky structure; extremely hard, very firm; few pockets and threads of calcium carbonate and other salts; few seams of crystalline gypsum; calcareous; saline; moderately alkaline; abrupt wavy boundary.

Cr—28 to 60 inches; light yellowish brown (2.5Y 6/4) shale, light olive brown (2.5Y 5/4) moist; few faint yellowish brown and brownish yellow mottles; rock structure; few pockets and threads of calcium carbonate and other salts; calcareous; saline; moderately alkaline.

The solum is 20 to 40 inches thick. The electrical conductivity is about 0 to 4 millimhos in the A horizon, 4 to 12 millimhos in the B2 horizon, and 8 to 16 millimhos in the Cr horizon. It increases with depth in most pedons.

The A horizon ranges from clay loam to very gravelly clay loam. It is grayish brown, light brownish gray, olive gray, light olive gray, pale brown, brown, light yellowish brown, yellowish brown, light olive brown, olive gray, light olive gray, or pale olive. The A horizon is 4 to 10 inches thick. It is moderately alkaline to strongly alkaline.

The B2 horizon ranges from clay to clay loam. It is very pale brown, pale brown, yellowish brown, light olive brown, light yellowish brown, pale yellow, or pale olive. In the B2 horizon visible carbonates range from a few to about 10 percent by volume. The calcium carbonate equivalent is less than 15 percent.

The Cr horizon is shale or shaly clay that has evident bedding planes. A few beds of gypsum, layers that have calcium carbonate, and strata of sandstone are in the Cr horizon.

Montell Series

The Montell series consists of deep, nearly level, clayey soils that are moderately well drained. These soils are on uplands. They formed in thick beds of ancient, clayey alluvium. Slopes range from 0 to 1 percent.

Typical pedon of Montell clay, 0 to 1 percent slopes; from Crystal City, 1.0 mile south on Farm Road 65 to railroad and junction with county road, 4.2 miles southeast on Farm Road 65 (0.7 mile southeast of county line), and 75 feet north from railroad right-of-way; in rangeland:

A11—0 to 7 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine roots; few fine pores and root channels; few snail shell fragments; calcareous; moderately alkaline; gradual smooth boundary.

A12—7 to 19 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate fine and medium blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores and root channels; shiny pressure faces on peds; slickensides in lower part; few snail shell fragments; calcareous; moderately alkaline; gradual smooth boundary.

AC—19 to 40 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots; few fine pores and root channels; shiny pressure faces on many peds; intersecting slickensides; few tongues of gray clay; few pockets of pale brown clay; calcareous; saline; moderately alkaline; gradual wavy boundary.

C1ca—40 to 50 inches; very pale brown (10YR 7/4) clay, light yellowish brown (10YR 6/4) moist; weak fine blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots and root channels; contains a few soft masses of calcium carbonate; few threads and small pockets of neutral salts; few narrow tongues and streaks of gray and grayish brown clay; calcareous; saline; moderately alkaline; diffuse wavy boundary.

C2cacs—50 to 64 inches; very pale brown (10YR 7/4) clay, light yellowish brown (10YR 6/4) moist; weak fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; contains about 5 percent by volume soft masses of gypsum crystals and other neutral salts; few soft masses of calcium carbonate; calcareous; saline; moderately alkaline.

The solum ranges from 36 to 54 inches in thickness. Microdepressions range from 5 to 8 feet in diameter and are 3 to 12 inches in depth. Cracks range from 0.4 inch to 4 inches wide and are more than 20 inches deep. Exchangeable sodium ranges from 15 percent to more than 40 percent in some horizons within 30 inches of the surface with intersecting slickensides being from about 20 to 30 inches below the surface. Salinity ranges from none to moderate in the A horizon and from moderate to strong in the AC and C horizons.

The A horizon is 12 to 36 inches thick. It is gray to dark gray. The darker color is in the microdepressions.

The AC horizon ranges from grayish brown to light brownish gray and pale brown to brown. Accumulations of calcium carbonate in the AC horizon range from a few films and threads to about 3 percent by volume.

The Cca and Ccacs horizons range from very pale brown to light yellowish brown to olive. The amount of gypsum crystals in the C horizon ranges from few to about 30 percent, and the amount of calcium carbonate equivalent ranges from about 2 percent to about 15 percent.

Olmos Series

The Olmos series consists of very shallow and shallow, very gravelly soils that are well drained. These soils formed in loamy outwash sediment on uplands. Slopes range from 1 to 8 percent.

Typical pedon of Olmos very gravelly loam, undulating; from Carrizo Springs, 1.5 miles northwest on U.S. Highway 277, and northeast 0.25 mile to caliche pit:

A11—0 to 6 inches; dark grayish brown (10YR 4/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, friable; many fine roots; about 50 percent by volume indurated caliche fragments, mostly less than 1 centimeter in size but some range to as much as 7 centimeters; an estimated 20 percent of the surface is covered with the same type of fragments; calcareous; moderately alkaline; clear wavy boundary.

A12—6 to 14 inches; dark grayish brown (10YR 42/) very gravelly loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; hard, friable; many fine roots; estimated 75 percent of the mass is indurated caliche fragments; calcareous; moderately alkaline; abrupt wavy boundary.

C1cam—14 to 18 inches; indurated white caliche that has hardness of more than 3 on Moh's scale and is laminar in the upper $^1/_4$ inch; calcareous; gradual wavy boundary.

C2cam—18 to 72 inches; whitish caliche; weakly cemented; calcareous; moderately alkaline.

The solum is 6 to 20 inches deep to indurated caliche. This range in depth is common within horizontal distances of less than 20 feet. Caliche fragments and chert gravel cover 5 to 75 percent of the surface.

The A horizon is very dark grayish brown, dark grayish brown, brown, or dark brown. The fine earth fraction ranges from loam to clay loam. Caliche fragments comprise 35 to 80 percent. Some pedons have a few limestone and chert fragments. Most of the fragments are in the A12 horizon. Many of these fragments are indurated and laminar on the upper side and knobby or nodular on the lower side.

The C1cam horizon is beds of caliche which are indurated and laminar in the upper $^1/_4$ inch to 4 inches and which become softer with depth. The C2cam horizon is weakly to strongly cemented. Rounded chert and other kinds of gravel make up a few pebbles to 75 percent by volume of this horizon.

Poteet Series

The Poteet series consists of deep, nearly level, loamy soils that are moderately well drained. These soils formed in clayey and loamy sediment and are along weakly depressed drainageways. The surface is concave, and slopes range from 0 to 1 percent.

Typical pedon of Poteet fine sandy loam, frequently flooded; from Big Wells; 3.1 miles east on Texas Highway 85, 1.5 miles south on Farm Road 468, continue south 5.4 miles on Farm Road 1019, 1.5 miles northeast on county road, 0.5 mile southeast, 0.5 mile north, 0.1 mile east, and 100 feet north; in rangeland:

A11—0 to 8 inches; dark brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine roots; few fine pores and old root channels; slightly acid; clear smooth boundary.

A12—8 to 16 inches; dark brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine roots; few fine pores and old root channels; slightly acid; clear smooth boundary.

A13—16 to 24 inches; reddish brown (5YR 4/3) fine sandy loam, dark reddish brown (5YR 3/3) moist; weak fine subangular blocky structure; slightly hard, very friable; few flecks of yellowish red; slightly acid; clear smooth boundary.

B21t—24 to 34 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; common fine distinct mottles of reddish brown, yellowish red, and grayish brown; moderate fine and medium blocky structure; very hard, firm; patchy clay films on surface of peds; few dark stains on peds; medium acid; gradual wavy boundary.

B22t—34 to 40 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; few fine distinct mottles of reddish brown, yellowish red, and grayish brown; moderate fine and medium blocky structure; very hard, firm; patchy clay films on surfaces of peds; few dark stains on peds; slightly acid; gradual wavy boundary.

B23t—40 to 52 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; few fine faint strong brown mottles; weak fine and medium blocky structure; very hard, firm; patchy clay films on surface of peds; few dark stains on peds; neutral; gradual wavy boundary.

B3—52 to 64 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; weak fine and medium subangular blocky structure; hard, friable; few dark stains on peds; patchy clay films; concretions of calcium carbonate as much as $^{1}/_{4}$ inch across; calcareous; moderately alkaline.

The solum ranges from 60 to 90 inches in thickness. The mollic epipedon is 20 to 40 inches thick.

The A horizon is 16 to 26 inches thick. It is very dark grayish brown, dark brown, or reddish brown. It is medium acid to mildly alkaline.

The B21t and B22t horizons are brown, dark brown, reddish brown, dark reddish brown, or yellowish brown. Mottles are few to many; faint to prominent; and reddish, brownish, yellowish, or grayish. These horizons are dominantly sandy clay loam or clay loam. A few pedons have thin layers of sandy clay in the upper part of the B21t horizon. The upper 20 inches of the B2t horizon has an average clay content of 25 to 35 percent. The B21t and B22t horizons are slightly acid to moderately alkaline. The B23t and B3 horizons are slightly lighter in color and are less clayey than the B21t

horizons. Calcium carbonate is visible as threads, soft masses, and concretions, which vary from a few to 30 percent by volume.

Pryor Series

The Pryor series consists of deep, nearly level to gently undulating, loamy soils that are well drained. These soils are on uplands. They formed in calcareous, saline clay and shale.

Typical pedon of Pryor sandy clay loam in an area of Pryor sandy clay loam, gently undulating; from La Pryor, 8.5 miles west on U.S. Highway 57, 4.5 miles north on ranch road to ranch headquarters, 0.8 mile east along fenceline road, 2.0 miles north along fenceline road, and 100 feet west; in rangeland:

A1—0 to 9 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak fine and medium subangular blocky structure; hard, friable; many fine roots; many fine pores and root channels; few chert pebbles in soil mass and on surface; about 10 percent calcium carbonate equivalent; calcareous; moderately alkaline; clear smooth boundary.

B21tca—9 to 22 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; very hard, firm; common fine roots; few fine pores and root channels; few films and threads of calcium carbonate; few cracks filled with grayish brown sandy clay loam; about 15 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual wavy boundary.

B22tca—22 to 32 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate fine and medium subangular blocky and angular blocky structure; very hard, firm; few roots; few fine pores and root channels; few flecks and threads of calcium carbonate; about 20 percent calcium carbonate equivalent; few cracks filled with soil from above; calcareous; saline; moderately alkaline; gradual wavy boundary.

B3ca—32 to 46 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; moderate fine and medium angular blocky structure; very hard, firm; few roots; few fine pores; contains about 3 percent soft masses of calcium carbonate; about 20 percent calcium carbonate equivalent; calcareous; saline; moderately alkaline; clear wavy boundary.

C1—46 to 62 inches; very pale brown (10YR 7/4) clayey shale, light yellowish brown (10YR 6/4) moist; rock structure that is thin and medium platy parting to moderate fine and medium blocky; extremely hard, very firm; few soft masses of calcium carbonate; few gypsum crystals; about 20 percent calcium carbonate equivalent; calcareous; saline; moderately alkaline; diffuse wavy boundary.

C2—62 to 72 inches; very pale brown (10YR 7/4) clayey shale, light yellowish brown (10YR 6/4) moist; rock structure that is thin and medium platy parting to moderate fine and medium blocky; extremely hard, very firm; about 5 percent gypsum crystals; few soft masses of calcium carbonate and other neutral salts; about 15 percent calcium carbonate equivalent; calcareous; saline; moderately alkaline.

The thickness of the solum and the depth to shaly material ranges from 40 to 60 inches. Salinity ranges from slight to moderate in the upper 24 inches and from moderate to strong below 24 inches. COLE ranges from 0.06 to 0.11 below the A horizon.

The A horizon is grayish brown, brown, or light olive brown. It is 6 to 20 inches thick.

The B2t horizon is grayish brown, brown, yellowish brown, light olive brown, light yellowish brown, pale brown, or pale yellow. It is clay loam or clay 12 to 26 inches thick. Clay content ranges from 35 to 45 percent. The B3 horizon is light gray, light yellowish brown, olive yellow, brownish yellow, yellow, or pale yellow. Calcium carbonate content is visible as masses and concretions that range from a few to about 15 percent by volume.

The C horizon is light gray, light olive gray, pale olive, pale yellow, or very pale brown, clayey shale.

Randado Series

The Randado series consists of shallow, gently undulating, loamy soils that are well drained. These soils formed in loamy material that overlies thick beds of caliche. They are on uplands. Slopes range from 1 to 3 percent.

Typically pedon of Randado fine sandy loam, gently undulating; from La Pryor, 12 miles north on U.S. Highway 83 to county line marker, 180 feet south, and 80 feet west:

A1—0 to 7 inches; yellowish red (5YR 4/6) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable; many fine roots; many fine and medium pores and old root channels; mildly alkaline; clear smooth boundary.

B2t—7 to 15 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 3/6) moist; weak fine and medium subangular blocky structure; hard, friable; many fine roots; many fine and medium pores and old root channels; a few clay bridges and clay films in pores and root channels; few wormcasts and termite tunnels; neutral; abrupt wavy boundary.

Ccam—15 to 18 inches; pinkish white (7.5YR 8/2) strongly cemented caliche, pinkish gray (7.5YR 7/2) moist; weakly laminar in upper part; clear wavy boundary.

Cca—18 to 26 inches; pink (7.5YR 8/4) weakly cemented caliche, pink (7.5YR 7/4) moist; massive.

The solum ranges from 9 to 20 inches in thickness. Reaction ranges from mildly alkaline to slightly acid.

The A horizon is brown, reddish brown, red, or yellowish red. The A horizon ranges from 4 to 10 inches in thickness.

The B2t horizon is strong brown, reddish brown, yellowish red, or red. It is sandy clay loam or loam.

The Ccam horizon is strongly cemented or indurated in the upper 1 inch to 5 inches.

Tiocano Series

The Tiocano series consists of deep, nearly level, clayey soils that are somewhat poorly drained. These soils formed in calcareous clay in slightly depressed, intermittent lakebeds. Slopes are less than 1 percent.

Typical pedon of Tiocano clay; from Big Wells, 3.1 miles east on Texas Highway 85, 1.5 miles south on Farm Road 468, continue 5.4 miles south on Farm Road 1019, 1.5 miles northeast, 0.5 mile southeast, 0.5 mile north, 0.5 mile east on county road, then 100 feet south; in depressed area:

A11—0 to 12 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; many fine distinct reddish brown streaks and mottles; moderate medium and coarse blocky structure; extremely hard, very firm; shiny ped

surfaces; few fine roots; fine pores and old root channels; noncalcareous; neutral; gradual wavy boundary.

A12—12 to 32 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; few reddish brown mottles in upper part; moderate medium and coarse blocky structure; extremely hard, very firm; common intersecting slickensides; shiny ped surfaces; few fine roots; fine pores and old root channels; noncalcareous; neutral; diffuse wavy boundary.

AC—32 to 52 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; weak blocky structure; very hard, very firm; common intersecting slickensides; shiny ped surfaces; few very fine roots; noncalcareous; moderately alkaline; gradual wavy boundary.

C—52 to 64 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; structureless; massive; very hard, very firm; few threads and soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum is 40 to 60 inches thick. The soil is clay, sandy clay, or silty clay throughout. When the soil is dry, it has cracks 1 inch to 3 inches wide. These cracks extend to a depth of more than 20 inches. Reaction ranges from neutral to moderately alkaline.

The A11 and A12 horizons are dark gray or very dark gray and range from 15 to 40 inches in thickness. Many pedons have an overburden of colluvial material. This layer is brown to very dark grayish brown fine sandy loam or clay loam that is as much as 6 inches thick.

The AC horizon is gray, grayish brown, or light brownish gray.

The C horizon is slightly lighter in color than the AC horizon. It is as much as 5 percent concretions and lumps of calcium carbonate.

Tonio Series

The Tonio series consists of deep, nearly level to gently undulating, loamy soils that are well drained. These soils are on uplands. They formed in interbedded sandstone and loamy sediment. Slopes range from 0 to 3 percent.

Typical pedon of Tonio fine sandy loam, gently undulating; from Carrizo Springs, 10 miles southwest on Farm Road 186, 2.7 miles west on Farm Road 3252, 0.9 mile south on Farm Road 3252, 2.7 miles west on private road to ranch headquarters, 3.4 miles north to corrals, 0.8 mile north to pipeline, northwest, 1.1 miles across pond dam to metal gate, 0.7 miles northwest across pond dam, and 50 feet east; in rangeland:

A1—0 to 10 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; many fine pores; few fine roots; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B21t—10 to 30 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; few patchy clay films on faces of peds; many fine pores; few fine roots; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B22t—30 to 40 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; moderate fine and medium subangular blocky structure; hard, friable; few patchy clay films on faces of peds; many fine pores; few fine roots; common threads and films of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

B23tca—40 to 54 inches; very pale brown (10YR 7/4) sandy clay loam, light yellowish brown (10YR 6/4) moist; weak fine and medium subangular blocky structure; few fine pores; about 10 percent by volume of soft masses of calcium carbonate as much as $^{1}/_{2}$ inch in diameter; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—54 to 74 inches; pink (7.5YR 7/4) sandstone; reddish yellow (7.5YR 6/6) moist; few yellowish red (5YR 5/6) streaks; weakly cemented; brittle; calcareous; moderately alkaline.

The solum is 40 to 60 inches deep to weakly to strongly cemented sandstone. Conductivity of the saturation extract is about 1 to 4 millimhos.

The A horizon is dark brown, brown, pale brown, dark grayish brown, grayish brown, yellowish brown, or light yellowish brown. Mollic colors extend to less than 6 inches in this A horizon. Calcium carbonate equivalent is 1 percent to about 10 percent.

The Bt horizon is brown, light brown, yellowish brown, light olive brown, pale brown, light yellowish brown, very pale brown, reddish yellow, and yellow. The lower parts of the Bt horizon in most places are lighter colored than the upper parts. The Bt horizon is fine sandy loam, loam, sandy clay loam, or clay loam. Clay content of the upper 20 inches of the Bt horizon ranges from 19 to 34 percent. Calcium carbonate equivalent is 10 to 30 percent. Threads, films, masses, and concretions of calcium carbonate range from a few to as much as 25 percent by volume in some part of the Bt horizon.

The Cr horizon is weakly to strongly cemented, calcareous sandstone. In some pedons this horizon is interbedded with layers of shale, calcium carbonate, or gypsum.

Uvalde Series

The Uvalde series consists of deep, nearly level to gently undulating, loamy soils that are well drained. These soils are on uplands. They formed in ancient, loamy alluvium. Slopes range from 0 to 3 percent.

Typical pedon of Uvalde silty clay loam, 0 to 1 percent slopes; from La Pryor, 3.1 miles north on U.S. Highway 83 and 50 feet east of highway; in pasture (approximately 7.3 miles south of the Uvalde-Zavala County line on U.S. Highway 83):

A1—0 to 17 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky and granular structure; hard, friable; 20 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual smooth boundary.

B21ca—17 to 34 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; few fine pores; few films and threads of calcium carbonate; 30 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual wavy boundary.

B22ca—34 to 50 inches; very pale brown (10YR 7/4) silty clay loam, light yellowish brown (10YR 6/4) moist; moderate very fine subangular blocky structure; hard, friable; 15 to 20 percent by volume of strongly cemented concretions of calcium carbonate; 40 percent calcium carbonate equivalent; calcareous; moderately alkaline; diffuse wavy boundary.

Cca—50 to 84 inches; very pale brown (10YR 7/4) silty clay loam, light yellowish brown (10YR 6/4) moist; structureless; hard, friable; few fine weakly cemented concretions and soft lumps of calcium carbonate; 50 percent calcium carbonate equivalent; calcareous; moderately alkaline.

The solum is 40 to 60 inches deep to the Cca horizon. The average calcium carbonate equivalent in the 10- to 40-inch control section exceeds 20 percent. Calcium carbonate equivalent ranges from 5 to 25 percent in the A horizon, from 20 to 39 percent in the B horizon, and from 40 to 75 percent in the Cca horizon. The 10- to 40-inch control section is silty clay loam, clay loam, silty clay, or clay. Total clay content ranges from 35 to 50 percent. Silicate clay ranges from 22 to 35 percent. Sand coarser than very fine ranges from 5 to 15 percent.

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

The B horizon is grayish brown, brown, pale brown, light brown, light yellowish brown, or very pale brown. Strongly cemented calcium carbonate concretions make up 15 to 30 percent of the B22ca horizon.

The Cca horizon is pale brown, very pale brown, light yellowish brown, pink, or light brown. It is silty clay loam, silty clay, or clay.

Valco Series

The Valco series consists of shallow, gently undulating, loamy soils that are well drained. These soils formed over indurated caliche on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Valco clay loam, gently undulating; from Batesville, 1.0 mile east on U.S. Highway 57, 6.0 miles northeast on Farm Road 187, 2.0 miles north to ranch headquarters, 1.6 miles east along fence line ranch road, and 100 feet south; in rangeland:

A11—0 to 9 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky and fine granular structure; hard, friable; common fine roots and root channels; few wormcasts and termite tunnels; few flecks of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

A12—9 to 17 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, friable; common fine roots; few fine pores and old root channels; few cemented concretions of calcium carbonate as much as 2 millimeters in diameter; calcareous; moderately alkaline; abrupt wavy boundary.

Ccam—17 to 21 inches; white (10YR 8/2), strongly cemented caliche that is weakly laminar in the upper part; a few old solution channels filled with soil material similar to that of the horizon above; calcareous; abrupt smooth boundary.

Cca—21 to 40 inches; white (10YR 8/2) weakly cemented caliche.

The solum above the cemented caliche layer ranges from 10 to 20 inches in thickness.

The A horizon is very dark grayish brown, grayish brown, dark brown, or brown. The strongly cemented caliche in the Ccam horizon ranges from about 1 inch to as much as 7 inches in thickness. The Cca horizon ranges from weakly cemented caliche to pinkish limy earth of about clay loam texture.

Verick Series

The Verick series consists of shallow, gently undulating, loamy soils that are well drained. These soils formed in interbedded sandstone and loamy sediment on uplands. Slopes range from 1 to 5 percent.

Typical pedon of Verick fine sandy loam, gently undulating; from Carrizo Springs, 10 miles southwest on Farm Road 186 to Farm Road 3252, 2.7 miles west on Farm Road 3252, 1.5 miles northwest on county road to ranch entrance, continue 0.65 mile

northwest on private ranch road, 1.0 mile west to windmill, 1.4 miles north, and 100 feet west; in rangeland:

A1—0 to 5 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, very friable; many fine roots and old root channels; common fine and medium pores; few snail shell fragments; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B2tca—5 to 17 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; moderate fine and medium subangular blocky structure; hard, friable; few patchy clay films on peds and in pore channels; common fine roots and old root channels; few threads and fine concretions of calcium carbonate; few sandstone fragments that increase in number with depth; calcareous; moderately alkaline; abrupt wavy boundary.

Crca—17 to 40 inches; very pale brown (10YR 7/3) weakly cemented sandstone, pale brown (10YR 6/3) moist; contains few yellowish brown streaks; platy structure; plates $^{1}/_{4}$ to 1 inch thick with patchy coatings of calcium carbonate; few thin layers of sandy clay loam; a few roots in fractures in upper part; calcareous; moderately alkaline.

The solum is 10 to 20 inches thick.

The A horizon is grayish brown, brown, pale brown, light yellowish brown, or light olive brown.

The B2tca horizon is grayish brown, pale brown, yellowish brown, or light yellowish brown. It is fine loam or sandy clay loam. Sandstone fragments are 10 percent by volume of this horizon in some pedons.

The Crca horizon is platy sandstone that is weakly consolidated or cemented. It is as much as 50 percent shaly material interbedded with sandstone in some pedons.

Webb Series

The Webb series consists of deep, gently undulating, loamy soils that are well drained. These soils formed in interbedded sandstone and loamy sediment on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Webb fine sandy loam, gently undulating; from Big Wells, 2.0 miles east on U.S. Highway 85, 3.0 miles north, 0.5 mile east, and 100 feet south; in rangeland:

A1—0 to 10 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; hard, very friable; many fine roots and old root channels; slightly acid; clear smooth boundary.

B1—10 to 13 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; hard, friable; many fine roots and old root channels; common fine pores; few thin clay films; slightly acid; gradual smooth boundary.

B21t—13 to 26 inches; red (2.5YR 4/6) sandy clay, dark red (2.5YR 3/6) moist; moderate fine and medium angular blocky structure; very hard, very firm; few fine roots and old root channels; common thin clay films; slightly acid; gradual wavy boundary.

B22t—26 to 40 inches; red (2.5YR 5/6) sandy clay, red (2.5YR 4/6) moist; moderate fine and medium angular blocky structure; very hard, very firm; few fine roots and old root channels; common thin clay films; few sandstone fragments; slightly acid; gradual wavy boundary.

B3ca—40 to 64 inches; yellowish red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) moist; weak fine subangular blocky structure; hard, friable;

patchy clay films; many films and threads of calcium carbonate; few chert pebbles and sandstone fragments partly coated with calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to 80 inches in thickness.

The A and B1 horizons are reddish brown, yellowish red, or brown. These horizons range from neutral to medium acid. The boundary is abrupt to clear between the A and the B1 horizons. In pedons where the B1 horizon is absent, the boundary of the A horizon and the Bt horizon is gradual or diffuse.

The B1 horizon is sandy clay loam or fine sandy loam. The B2t horizon is red, reddish brown, reddish yellow, or yellowish red. Chroma below a depth of 50 inches is 6 or 8. The B2t horizon is sandy clay, clay, or clay loam in the upper part and grades to sandy clay loam or fine sandy loam in the lower part. The average clay content in the upper 20 inches of the B2t horizon is 35 percent. The B2t horizon ranges from slightly acid to mildly alkaline. The B3ca horizon is sandy clay loam or fine sandy loam. It is mildly alkaline or moderately alkaline.

Where present, the C horizon is reddish, yellowish, or brownish fine sandy loam or sandy clay loam that grades into stratified beds of weakly consolidated sandstone. Some pedons have calcic horizons below a depth of 40 inches.

Winterhaven Series

The Winterhaven series consists of deep, nearly level to gently sloping, loamy soils that are well drained. These soils formed in calcareous, silty and loamy sediment on stream terraces and in flood plains. Slopes range from 0 to 3 percent.

Typical pedon of Winterhaven silty clay loam, 0 to 1 percent slopes; from Crystal City High School, 1.6 miles east on Farm Road 582, 0.5 mile north on small farm road, and 100 feet west; in cropland:

Ap—0 to 7 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; hard, friable; few fine roots; few fine pores; thin surface crust of slightly lighter color; about 38 percent calcium carbonate equivalent; calcareous; moderately alkaline; abrupt smooth boundary.

A1—7 to 17 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; hard, friable; few fine roots; common fine pores; few wormcasts; about 42 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual smooth boundary.

B2—17 to 36 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; hard, friable; few fine roots; many fine pores; few wormcasts; few films and threads of calcium carbonate; about 44 percent calcium carbonate equivalent; calcareous; moderately alkaline; diffuse wavy boundary.

C1—36 to 45 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; massive; hard, friable; common thin lenses and small pockets of slightly darker silt loam and loam; about 40 percent calcium carbonate equivalent; calcareous; moderately alkaline; diffuse wavy boundary.

C2—45 to 72 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; massive; hard, friable; common thin lenses and small pockets of slightly darker silt loam and loam; about 44 percent calcium carbonate equivalent; calcareous; moderately alkaline.

The solum ranges from 25 to 40 inches in thickness. The calcium carbonate equivalent is 40 to 65 percent in the 10- to 40-inch control section. Visible stratification is at a depth of 16 to 49 inches. Average texture of the 10- to 40-inch

control section is silty clay loam, clay loam, or silt loam. It is 18 percent to about 30 percent silicate clay. Less than 15 percent of the sand is coarser than very fine.

The A horizon is light brownish gray, grayish brown, brown, or pale brown.

The B horizon is pale brown, brown, or light brownish gray. A few films and threads of calcium carbonate are in the B horizon of most pedons.

The C horizon is very pale brown, pale brown, or light yellowish brown. Thin lenses and pockets of silty clay loam, silt loam, or loam, mainly less than about 5 millimeters thick, are in the C horizon. The lenses and pockets are the same color or slightly darker than the dominant clay loam of the horizon. Many films and threads and a few small masses of calcium carbonate are in the C horizon in some pedons.

Yologo Series

The Yologo series consists of shallow to very shallow, undulating, very gravelly soils that are well drained. These soils are on uplands. They formed in very gravelly loamy sediment. Slopes range from 1 to 8 percent.

Typical pedon of Yologo very gravelly loam, in an area of Yologo-Hindes association, undulating; from Batesville, about 1.0 mile east on U.S. Highway 57, 3.3 miles northeast on Farm Road 187 to ranch pond on north side of road, 0.75 mile north along fenceline, and 65 feet east:

A1—0 to 7 inches; reddish brown (5YR 4/3) very gravelly loam, dark reddish brown (5YR 3/3) moist; weak fine subangular blocky structures; hard, friable; many fine roots; few fine pores and old root channels; an estimated 60 percent by volume water rounded chert pebbles mainly $^1/_2$ inch to 2 inches in diameter; neutral; clear, smooth boundary.

B2t—7 to 15 inches; reddish brown (5YR 4/4) very gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky structure; hard, friable; many fine roots; few fine pores and old root channels; few thin clay films on peds and on coarse fragments; an estimated 80 percent by volume water-rounded chert pebbles and cobbles that are mainly less than 3 inches in diameter; mildly alkaline; abrupt, wavy boundary.

IICcam—15 to 18 inches; indurated whitish caliche with laminar layers in the upper part, $^1/_{16}$ to $^1/_2$ inch thick; a few thin seams of reddish brown loamy material from horizon above; calcareous; moderately alkaline; abrupt, wavy boundary.

IICca—18 to 60 inches; whitish caliche of about clay loam texture; massive; hard, friable; calcareous; moderately alkaline.

The thickness of the solum and the depth to indurated caliche is 7 to 20 inches. The solum ranges from slightly acid to mildly alkaline in reaction.

The A horizon ranges from 4 to 14 inches in thickness. It is dark grayish brown, brown, or reddish brown. The fine earth fraction is loam or sandy clay loam. Coarse fragments make up 20 to 75 percent.

The B2t horizon is 5 to 12 inches thick. It is dark brown or reddish brown. The fine earth is clay loam or sandy clay loam. Coarse fragments make up 35 to 80 percent.

The IICcam horizon ranges from layers that are about $^1/_4$ inch of strongly cemented laminar caliche over slightly hardened caliche to layers about 6 inches thick and are strongly cemented and laminar throughout.

The IICca horizon is weakly cemented to soft caliche and in places has chert pebbles.

Zapata Series

The Zapata series consists of very shallow, gently undulating, gravelly soils that are well drained. These soils are on uplands. They formed in loamy and gravelly sediment over thick beds of caliche. Slopes range from 1 to 5 percent.

Typical pedon of Zapata gravelly loam, gently undulating; from Carrizo Springs, 6.2 miles northwest on U.S. Highway 277, 0.1 mile northeast on ranch road, and 100 feet south; in rangeland:

A1—0 to 7 inches; pale brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; common fine roots; about 20 percent caliche fragments mostly $^{1}/_{4}$ inch to 2 inches across; few flat platy fragments as much as 1 inch thick and 6 inches across; few threads and films of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

Ccam—7 to 10 inches; white (10YR 8/2) strongly cemented caliche; weakly laminar in upper part; gradual wavy boundary.

Cca—10 to 30 inches; white (10YR 8/2) strongly cemented caliche that becomes weakly cemented with depth.

The solum ranges from 2 to 10 inches in thickness. Coarse fragments range from few to as much as 25 percent by volume.

The A horizon is very pale brown, light brownish gray, grayish brown, or brown. Calcium carbonate equivalent is less than 40 percent.

The Ccam horizon is strongly cemented to indurated.

Zavco Series

The Zavco series consists of deep, nearly level to gently undulating, loamy soils that are well drained. These soils formed in calcareous, loamy and clayey sediment on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Zavco sandy clay loam, gently undulating; from La Pryor, 9.0 miles west on U.S. Highway 57, 1.6 miles south on ranch headquarters road, 2.1 miles northwest and west on small ranch road, and 100 feet south of road; in rangeland:

A1—0 to 11 inches; dark brown (7.5YR 3/2) sandy clay loam, very dark brown (7.5YR 2/2) moist; moderate fine and medium subangular blocky structure; hard, friable; many fine roots; many fine pores; upper 1 inch is slightly lighter in color; neutral; clear smooth boundary.

B1—11 to 16 inches; dark reddish brown (5YR 3/2) sandy clay loam, dark reddish brown (5YR 2/2) moist; moderate medium subangular and blocky structure parting to moderate fine angular blocky; very hard, firm; many fine roots; fine pores; thin patchy clay films on peds; few dark stains on surfaces of peds; neutral; gradual smooth boundary.

B2t—16 to 36 inches; reddish brown (5YR 4/4) sandy clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium angular blocky structure; very hard, very firm; few fine roots; fine pores; thin patchy clay films on peds; few dark stains on surfaces of peds; few krotovina; few threads of calcium carbonate on vertical ped faces; moderately alkaline; gradual wavy boundary.

B3Ca—36 to 56 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak fine and medium subangular blocky structure; hard, firm; few fine roots and pores; about 5 percent by volume soft masses and few strongly cemented concretions of calcium carbonate in upper part that increase to about 10 percent in lower part; few fine yellowish brown and

reddish brown fragments of sandstone; few dark stains and old channels partly filled with darker material; calcareous; moderately alkaline; clear wavy boundary.

C—56 to 72 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; many fine and medium distinct light gray (10YR 6/1), strong brown (7.5YR 5/6), and yellowish red (5YR 5/6) mottles; massive; hard, friable; few soft masses and cemented concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 40 to 80 inches in thickness. Secondary calcium carbonate is 10 to 28 inches below the surface.

The A and B1 horizons are very dark grayish brown, dark grayish brown, dark brown, dark reddish brown, or reddish brown. The A horizon is 6 to 16 inches thick. The B1 horizon is sandy clay loam or sandy clay 4 to 11 inches thick. The A and B1 horizons range from slightly acid to mildly alkaline.

The B2t horizon is brown, reddish brown, strong brown, or yellowish red. Clay content of the upper 20 inches of the Bt horizon ranges from 35 to 45 percent. The B2t horizon is mildly alkaline to moderately alkaline.

The B3ca and C horizons are brown, light brown, strong brown, yellowish red, or reddish yellow. They are sandy clay loam or clay loam. These horizons have a few to as much as 30 percent visible, secondary concretions or soft masses of calcium carbonate. They are mildly alkaline to moderately alkaline. Fragments of sandstone are in the C horizon in some pedons. Weakly consolidated sandstone or shale is below a depth of 40 inches in some pedons.

Formation of the Soils

This section discusses the factors of soil formation and briefly describes important processes in the development of soil horizons.

Factors of Soil Formation

The characteristics of the soil at any given place are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and vegetation are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and bring about the development of genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme instances, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. Generally, a long time is required for the development of distinct horizons.

Climate

Precipitation, temperature, humidity, evaporation, and wind have all been important in the formation of the soils in Dimmit and Zavala Counties. The wet climate of past geologic ages has influenced the deposition of parent materials. The present climate, characterized by low rainfall, hot summers, and mild winters, has a striking effect on soil formation. It influences the kind and density of vegetation, the organic matter content, the leaching of soluble material from the soils, and the activity of micro-organisms. Low rainfall limits the vegetation to grasses, shrubs, and small trees, except in some areas along streambeds where there are large trees. Free lime is throughout most of the soils because not enough water passes through them to leach out the lime. Some of the soils, however, have an accumulation of calcium

carbonate in the lower part. Most of the precipitation is in the form of rain. At times the rain comes as torrential showers, which cause soil material to erode, especially on the sparse, steeper slopes.

During the hot summers and mild winters, microbial decomposition is almost continuous, and the residue from plants and animals breaks down almost as fast as it accumulates. For this reason the organic matter content of most soils in the survey area is below about two percent.

Living Organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of the soils. Native vegetation of the mixed prairie type has contributed most of the organic matter to the soil. Organic matter in the surface layer comes from decaying leaves and stems. It is distributed throughout the solum by fine, fibrous roots that decompose into humus and leave a network of tubes and pores. These tubes and pores hasten the passage of air and water through the soil. The humus provides food for bacteria, actinmycetes, and fungi.

Plant roots may take calcium, potassium, phosphorus, or other elements from the lower layers of the soils and redeposit these elements on the soil surface when the plants die. Burrowing animals also mix soil horizons as they build homes or gather food. Earthworms mix the soil material and increase the movement of air, water, and plant roots through it. Even though the rainfall in this area is low, and there are periods when the entire solum is dry, some soils have an abundance of earthworm casts.

The influence of man on soil formation should not be ignored. Man has permitted the range to be severely overgrazed. This overgrazing has removed many kinds of grasses from the range and has encouraged other, less nutritious grasses to take their place. Much of the range now has sparse vegetation. This condition allows large amounts of rainfall to run off and carry soil with it. In addition, the sparse vegetation permits higher soil temperatures in the summer months, which kills many of the microbes in the soil.

Parent Material

Parent material is the unconsolidated mass from which a soil is formed. It determines the chemical and mineralogical composition of the soil.

The parent material in the Dimmit and Zavala County survey area has been derived mainly from sand, sandstone, shale, caliche, and marl and clayey, loamy, or silty alluvium *(3).*

Sand and sandstone of different ages make up the parent material of the Antosa, Bobillo, Brystal, Caid, Dilley, Duval, Tonio, Verick, Webb, and Zavco soils. Although these soils formed in similar kinds of parent material, the varying weathering rates of the materials have caused significant differences among the soils.

Catarina, Chacon, Cotulla, Maverick, and Pryor soils formed in parent materials derived from shale and shaly clay. Batesville, Hindes, Jimenez, Olmos, Randado, Valco, Yologo, and Zapata soils formed in parent materials derived from caliche or marls of differing ages.

Bookout, Brundage, Montell, Poteet, Tiocano, and Uvalde soils formed in loamy to clayey outwash or old alluvium that was transported by water and redeposited at its present location.

Cochina, Conalb, Dev, Divot, and Winterhaven soils formed in recent alluvium along the major streams.

The soils that formed in sand or sandstone tend to be less limy than those that formed in caliche or marl. Exceptions are the Tonio and Verick soils, which are calcareous throughout their profile. The soils that formed in shale and shaly clay are saline, especially in their subsoil and substratum.

Topography

Topography affects soil formation by its influence on drainage, erosion, plant cover, and soil temperature. The topography of Dimmit and Zavala Counties ranges from nearly level to rolling. The drainage pattern is distinctly expressed in most of the area.

Nearly level and gently undulating Uvalde soils are deeper and have more distinct horizons than the Valco and Olmos soils that are on the upper slopes or the caps of low hills. The Uvalde soils are different because they are in lower positions and receive additional water. They also are subject to less runoff and erosion. Therefore, more water is available to move downward through these soils and horizons develop faster.

On the rolling hills, soils that are underlain at a shallow to very shallow depth by strongly cemented or indurated caliche, such as the Jimenez soils, erode almost as fast as they form. These soils have been in place and have been forming about as long as many of the less sloping soils in valleys, but erosion keeps these soils thin and shallow.

Time

A long time is required for the formation of distinct horizons. The differences in the length of time that parent material has been in place are generally reflected in the degree of development in the soil profile.

The soils in Dimmit and Zavala Counties range from young to old. The young soils have very little horizon development, and the old soils have well expressed horizons. Conalb soil is an example of a young soil that has only partial horizon development. It has calcareous A and B horizons about 28 inches deep to a calcareous C horizon that has stratification. Brystal soil is an example of an older soil that has more distinct horizon development. The Brystal soil has a darkened, noncalcareous A horizon over a thick Bt horizon. The Bt horizon is illuvial clay and is noncalcareous in the upper part. It contains soft masses of calcium carbonate and is calcareous in the lower part.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

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.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

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—

	Inches
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.

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.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of 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 to 38 centimeters (6 to 15 inches) long.

Coefficient of Linear Extensibility (COLE). A quantitative method of determining shrink-swell behavior of soil. It is an estimate of the vertical component of swelling of a natural soil clod. COLE is expressed as: low (0.03); moderate (0.03-0.06); and high (00.06).

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.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

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 resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

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 sail 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.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

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 alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not 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.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

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 ovendry 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.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

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 O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon 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 Arabic numeral 2 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.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

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.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

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.

Mottling, soil Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many,* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

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.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

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 0.2 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

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipe-like 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.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

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—

	pH
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.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

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.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables.) Water that is too salty for consumption by livestock.

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.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

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.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

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.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

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.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

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 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
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.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

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.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

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."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

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 top-dress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

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.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

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 materials.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

The tables in this soil survey contain information that affects land use planning in this survey area. More current data tables may be available from the Web Soil Survey at the Tabular Data tab.

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