United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Texas Agricultural
Experiment Station and
Texas State Soil and
Water Conservation
Board

Soil Survey of Jackson County, Texas

How To Use This Soil Survey

General Soil Map

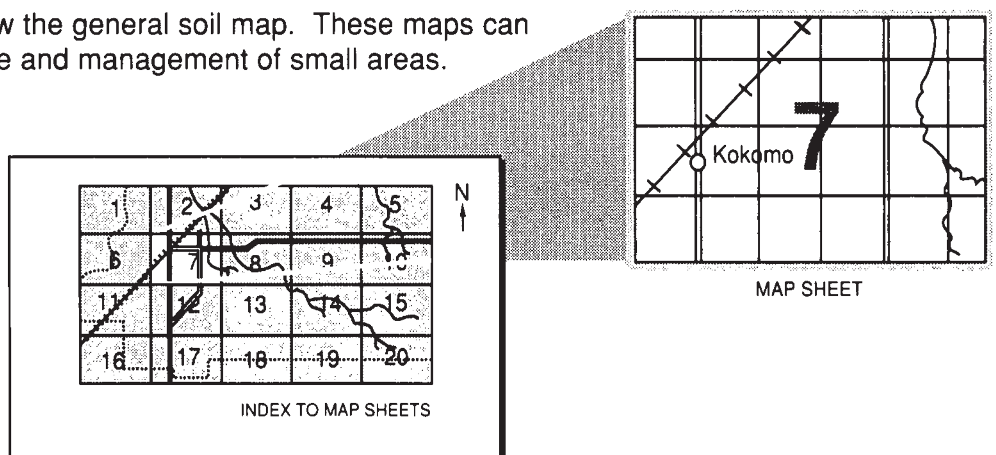
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

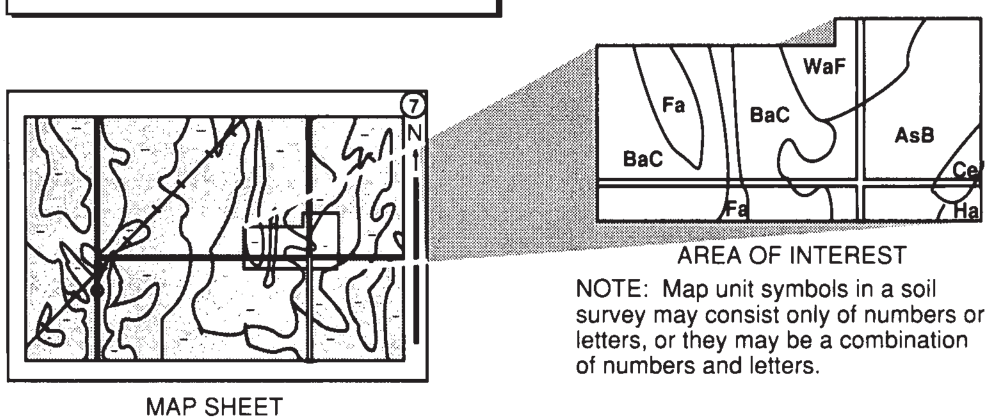
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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 Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1985. Soil names and descriptions were approved in 1986. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This soil survey was made cooperatively by the Natural Resources Conservation Service, the Texas Agricultural Experiment Station, and the Texas State Soil and Water Conservation Board. It is part of the technical assistance furnished to the Jackson 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.

All programs of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: An area of Kuy sand, 1 to 5 percent slopes, used as range. Ranching is a major land use in Jackson County.

Contents

Issued May 1997

Index to Map Units

Summary of Tables

Foreword

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

This soil survey is designed for many different users. Farmers, ranchers, 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 ensure 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 Natural Resources Conservation Service or the Cooperative Extension Service.

Harry W. Oneth
State Conservationist
Natural Resources Conservation Service

Soil Survey of Jackson County, Texas

By Wesley L. Miller, Natural Resources Conservation Service

Fieldwork by Stanley D. Clemmons, Wesley L. Miller, Plinio H. Flores, John S. Jacob, and Roy H. L. Bruns, Natural Resources Conservation Service

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
the Texas Agricultural Experiment Station and Texas State Soil and Water Conservation Board

JACKSON COUNTY is in the southeastern part of Texas (fig. 1). It has an area of about 857 square miles, or 548,730 acres, of which 18,766 acres is water.

Most of the county is a nearly level to gently sloping plain that is dissected by a few well defined creeks and rivers. The Lavaca and Navidad Rivers dissect the northwestern and central parts of the county. They flow to the southeast and south. Arenosa and Garcitas Creeks form most of the western boundary of the county. The eastern part of the county is drained by Huisache, West Carancahua, and Carancahua Creeks. The elevation ranges from sea level in the southern part of the county to 150 feet above sea level in the northwestern part.

The major land uses in Jackson County are farming and cattle ranching. In 1982, about 43 percent of the county was used as cropland, 41 percent was used as range, 6 percent was used as pasture and hayland, 6 percent was urban or built-up areas and areas of water, and 4 percent was idle land *(27)*.

Jackson County is in the Coast Prairie and Coast Saline Prairie major land resource areas *(4)*. The soils in the county are dominantly clayey and loamy and dark. They have very little slope. Because of the topography and the abundant rainfall, these nearly level soils are often seasonally wet and need adequate surface drainage outlets for the production of crops. Some of the soils, such as those in tidal areas, are continuously wet. In unprotected sloping areas, the soils are subject to sheet and gully erosion.

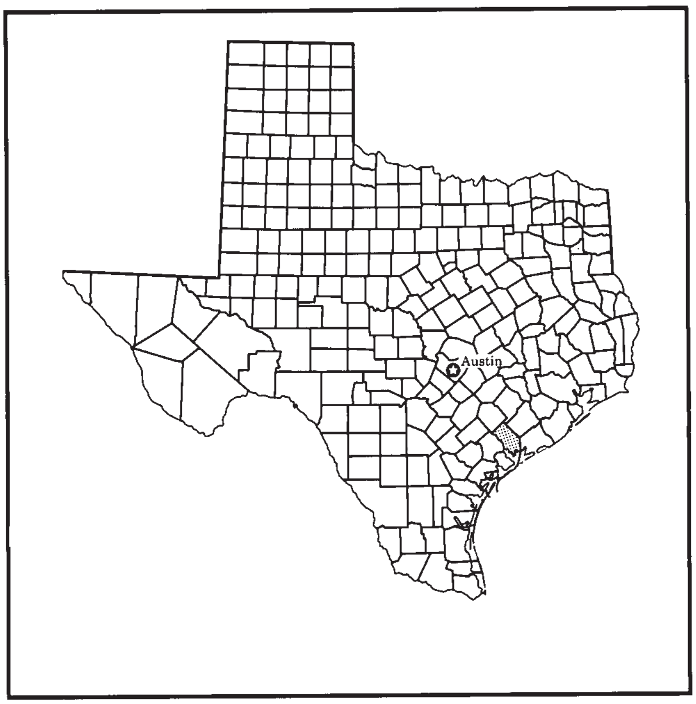


Figure 1.—Location of Jackson County in Texas.

General Nature of the County

This section briefly discusses settlement and population, climate, agriculture, and natural resources.

Settlement and Population

Jackson County was established by the Republic of Texas in 1836. It was created from a municipality of the Mexican government and named in honor of General Andrew Jackson.

The first recorded inhabitants of the area now known as Jackson County were the Karankawa Indians *(20)*. In 1685, the French, commanded by La Salle, explored the area and established a small fort near Garcitas Creek *(22)*.

Colonization of the area began in the 1820's. Mexico granted colonization contracts to Stephen F. Austin and Martin DeLeon. In 1832, Texana was the first town established in Jackson County *(24)*. Edna, the county seat, was established in 1882. It is located along what was once known as the New York, Texas, and Mexican Railroad.

In 1990, the population of the county was approximately 13,039. Edna had a population of 5,343.

Agriculture

Prior to 1890, most of Jackson County was grassland, except for a few small farms along the Navidad and Lavaca Rivers. Cattle ranching was the main agricultural enterprise in the county. The major crops were cotton, corn, and sugar cane. Rice was introduced into the county in 1901. Grain sorghum, corn, and rice are now the main crops grown in the county. Cotton was the main crop for many years but has been replaced by grain sorghum.

Natural Resources

Natural resources in Jackson County include oil, natural gas, sand and gravel, and fresh water. Commercial oil and natural gas production began in the early 1920's. Sand and gravel are mined in scattered areas along the Lavaca and Navidad Rivers. A large underground reservoir and several major rivers and streams in the county provide an abundant supply of water for residential and industrial use. In 1980, the Palmetto Bend Project was completed on the Navidad River and Lake Texana was formed. This 11,000-acre lake provides a dependable annual water supply of 75,000 acre-feet to the central Gulf Coast area for municipal and industrial use.

Climate

Jackson County has a humid, subtropical climate. Winters are mild. Polar Canadian air masses that move southward across Texas and out over the gulf in winter produce cool, cloudy, rainy weather. Precipitation is most often in the form of slow, gentle rainfall. Spring weather is variable but is generally moderate. March is relatively dry. The number of thundershowers increases in April and May. Summer weather varies little. The summer months have abundant sunshine and are relatively dry. Occasional slow-moving thunderstorms or other weather disturbances may result in excessive amounts of precipitation. Fall weather is moderate. Rainfall increases in autumn, but frequent periods of mild, dry, sunny weather occur. Heavy rains may occur early in the fall following tropical disturbances, which move westward from the gulf. Tropical storms are a threat to the area in summer and fall, but severe storms are rare.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Danevang in the period 1961 to 1990. 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 45 degrees. The lowest temperature on record, which occurred at Danevang on January 23, 1940, is 7 degrees. In summer, the average temperature is 82 degrees and the average daily maximum temperature is 92 degrees. The highest recorded temperature, which occurred at Danevang on July 26, 1954, is 108 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 about 42 inches. Of this, more than 25 inches, or about 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 17 inches. The heaviest 1-day rainfall during the period of record was 6 inches at Danevang on May 17, 1989. Thunderstorms occur on about 50 days each year.

Snowfall is rare. In 99 percent of the winters, there is no measurable snowfall.

The average relative humidity in midafternoon is about 59 percent. Humidity is higher at night, and the average at dawn is about 89 percent. The sun shines 63 percent of the time possible in summer and 47 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 9 miles per hour, in March.

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 from which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and 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 a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. 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, reaction, 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 a soil survey is in progress, samples of some of the soils in the area are generally collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are 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 are 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 predict with a fairly high degree of accuracy 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.

The soil descriptions and names in this survey do not fully match those in the surveys of adjoining counties. Differences are the result of improved knowledge and changes in series concepts, mapping intensity, or extent of soils.

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 two or three 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. In the detailed soil map units, these latter soils are called inclusions or included soils. In the general soil map units, they are called soils of minor extent.

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 behavior divergent 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 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, it 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 another 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 a 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.

Nearly level to moderately sloping, loamy and clayey soils on uplands

These soils make up about 51 percent of the county. The major soils are in the Dacosta and Laewest series. They are mostly in broad, nearly level areas on uplands. Some gently sloping to moderately sloping areas are in narrow drainageways.

These soils have a loamy or clayey surface layer and a clayey subsoil. They are moderately well drained and very slowly permeable.

These soils are well suited to most agricultural uses, and are used as cropland in most areas. Grain sorghum and corn are the principal crops. In some areas these soils are used as range or pasture. Managing surface water to improve drainage will generally result in increased productivity. The native range plants are mainly mid and tall grasses.

The main limitations affecting urban uses are the shrink-swell potential and low strength.

1. Dacosta-Laewest

Moderately well drained, very slowly permeable, loamy and clayey soils

This map unit consists of nearly level to moderately sloping soils in broad areas on uplands. Slopes are plane to slightly concave. They are mainly less than 1 percent but range to as much as 8 percent in narrow drainageways. Dacosta and Laewest soils are in similar positions on the landscape. In some areas near meander-belt ridges, Dacosta soils are slightly higher on the landscape than Laewest soils. Surface drainage is poorly defined except in areas near a few local streams and rivers. Vertical relief mainly ranges from 2 to 5 feet within a 1-mile radius but may be as much as 10 feet in a few areas. It is 10 to 30 feet in areas near the drainageways.

This map unit makes up about 51 percent of the county. It is about 49 percent Dacosta soils, 48 percent Laewest soils, and 3 percent other soils (fig. 2).

Typically, the surface layer of the Dacosta soils is neutral, very dark gray sandy clay loam about 9 inches thick. The subsoil is sandy clay. The upper part, from a depth of 9 to 21 inches, is slightly acid and very dark gray. The next part, from a depth of 21 to 44 inches, is neutral and gray. The lower part, from a depth of 44 to 62 inches, is moderately alkaline and light brownish gray. The underlying material, to a depth of 80 inches, is moderately alkaline, pale brown sandy clay loam.

Typically, the surface layer of the Laewest soils is neutral, black clay about 29 inches thick. The subsoil, to a depth of 80 inches, is moderately alkaline clay. It ranges from very dark gray in the upper part to light gray in the lower part.

Of minor extent in this map unit are the loamy Edna, Texana, Telferner, Nada, Cieno, and Inez soils. Edna, Texana, and Telferner soils are in the slightly higher positions on nearly level uplands or on convex meander-belt ridges. Nada and Inez soils are also in the slightly higher positions on nearly level uplands. Cieno

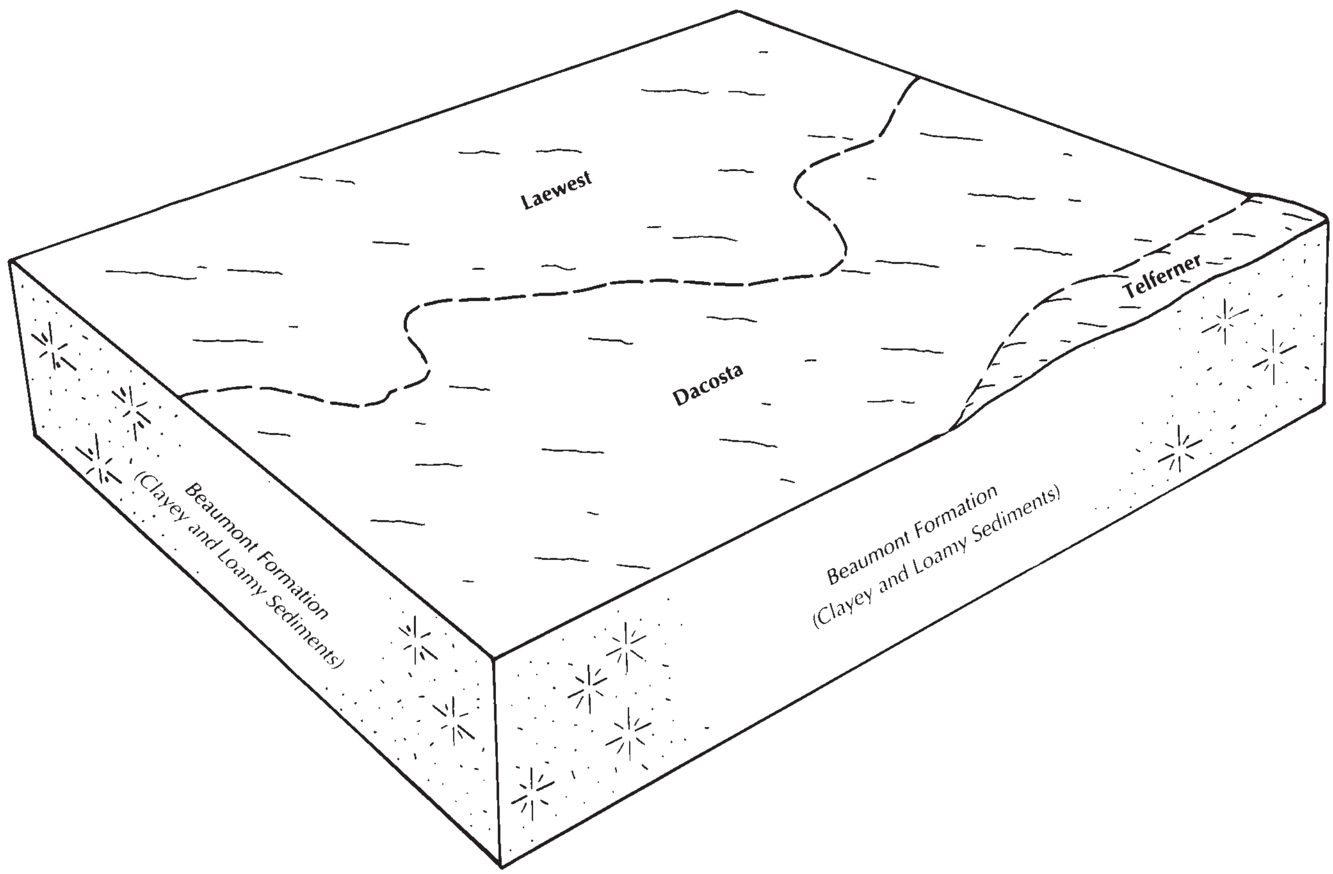


Figure 2.—Typical pattern of soils and parent material in the Laewest-Dacosta general soil map unit.

soils are in circular or oval depressions on uplands or in relict stream channels.

Most areas of this unit are used as cropland. Some areas are used as range or pasture.

The Dacosta and Laewest soils are well suited to crops, except in areas where erosion has occurred. Grain sorghum and corn are the principal crops. Soybeans and cotton also are grown in some areas. A well designed system of surface water management helps to improve drainage and thus increases yields.

These soils are well suited to rangeland. The main native range plants are bluestems, indiangrass, switchgrass, brownseed paspalum, and sensitive briar.

These soils are poorly suited to most urban uses. The main limitations are the shrink-swell potential and low strength.

Nearly level and very gently sloping, mainly loamy soils on uplands

These soils make up about 42 percent of the county. The major soils are in the Texana, Inez, Milby, Morales, Nada, Cieno, Telferner, Edna, and Livco series. They are on broad, nearly level areas on uplands, low coastal uplands, or narrow, very gently sloping side slopes bordering natural drainageways.

The surface layer of these soils is loamy or sandy and the subsoil is loamy or clayey. These soils are moderately well drained, somewhat poorly drained, or poorly drained and are slowly permeable or very slowly permeable.

These soils are well suited or moderately well suited to most agricultural uses. In most areas these soils are used as cropland or range. Rice, grain sorghum, and corn are the principal crops. Managing surface water to improve drainage will usually result in increased productivity. In some areas these soils are used as pasture. Some areas have scattered areas of post oak and live oak.

The native range plants are mainly mid and tall grasses.

The main limitations affecting urban uses are wetness and the shrink-swell potential.

2. Texana-Cieno

Moderately well drained and poorly drained, very slowly permeable, loamy soils

This map unit consists of nearly level soils on meander-belt ridges and in relict stream channels. Slopes are plane to slightly convex and are 0 to 1 percent. Texana soils are in broad, plane to slightly convex areas on meander-belt ridges. Cieno soils are in oval or oblong depressions that are in relict stream channels. Drainage is poorly defined in most areas except in areas near local streams and rivers. Most areas of Cieno soils are ponded. Vertical relief ranges from 5 to 15 feet within a radius of less than 1 mile.

This map unit makes up about 12 percent of the county. It is about 57 percent Texana soils, 22 percent Cieno soils, and 21 percent other soils (fig. 3).

Typically, the surface layer of the Texana soils is slightly acid, very dark grayish brown, fine sandy loam about 10 inches thick. The subsurface layer, from a depth of 10 to 14 inches, is slightly acid, grayish brown fine sandy loam. The upper part of the subsoil, from a depth of 14 to 33 inches, is clay mottled in shades of brown, gray, and yellow. The lower part, from a depth of 33 to 69 inches, is moderately alkaline clay loam or sandy clay loam mottled in shades of gray, yellow, and red. The underlying material, to a depth of 80 inches, is neutral, yellowish brown fine sandy loam that has strong brown mottles.

Typically, the surface layer of the Cieno soils is dark grayish brown sandy clay loam about 8 inches thick. The upper part of the subsoil, from a depth of 8 to 25 inches, is dark grayish brown sandy clay loam that has brownish mottles. The lower part, from a depth of 25 to 58 inches, is gray and light brownish gray sandy clay loam that has brownish mottles. Below this, to a depth of 80 inches, is sandy clay loam mottled in shades of brown, yellow, and gray. The soil is neutral in the upper part and moderately alkaline in the lower part.

Of minor extent in this map unit are Dacosta, Laewest, Telferner, Edna, Fordtran, and Livco soils. The loamy Edna and Dacosta and the clayey Laewest soils are in the slightly lower areas on nearly level uplands. The loamy Telferner and Livco soils are in similar landscape positions on nearly level uplands. The sandy Fordtran soils are in the slightly higher positions on nearly level uplands.

Most areas are used as cropland or range.

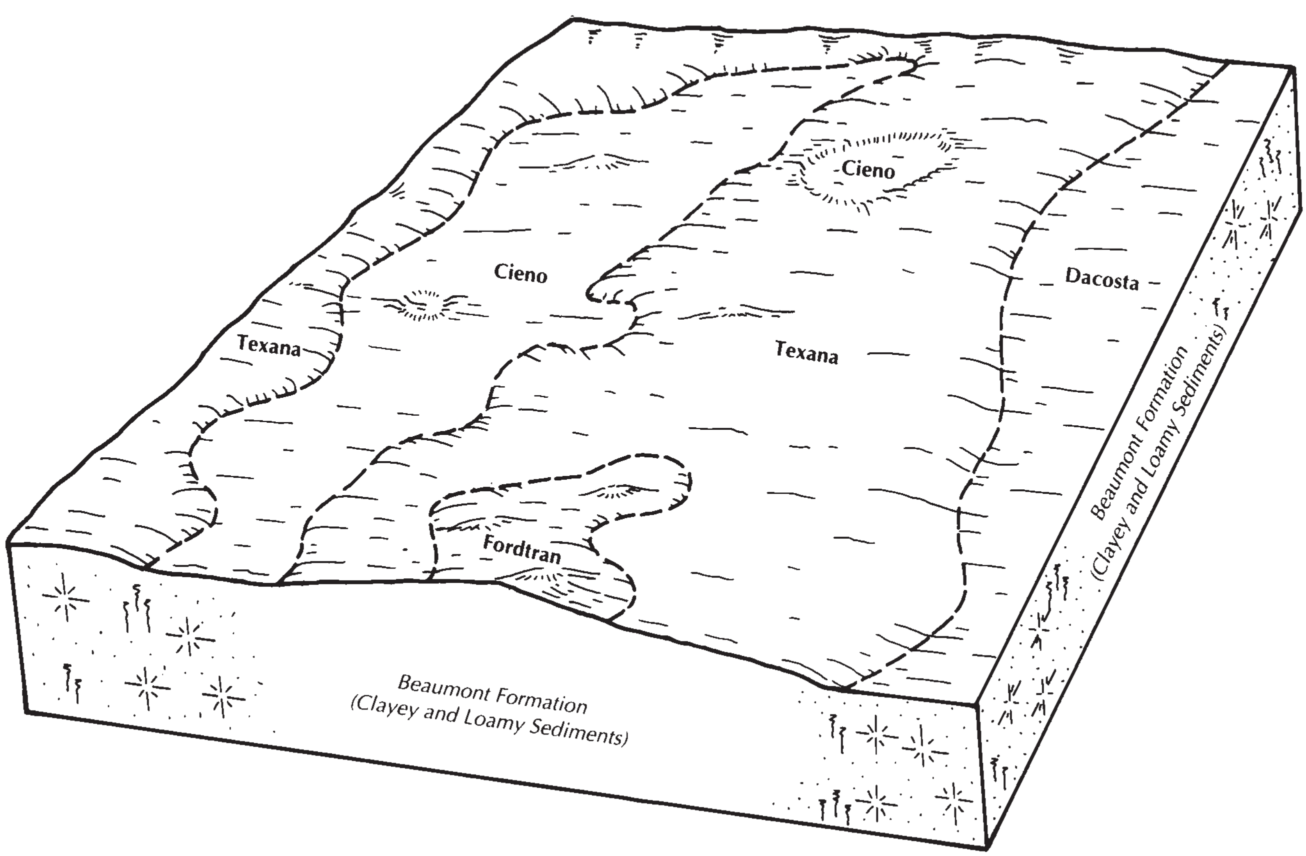


Figure 3.—Typical pattern of soils and parent material in the Texana-Cieno general soil map unit.

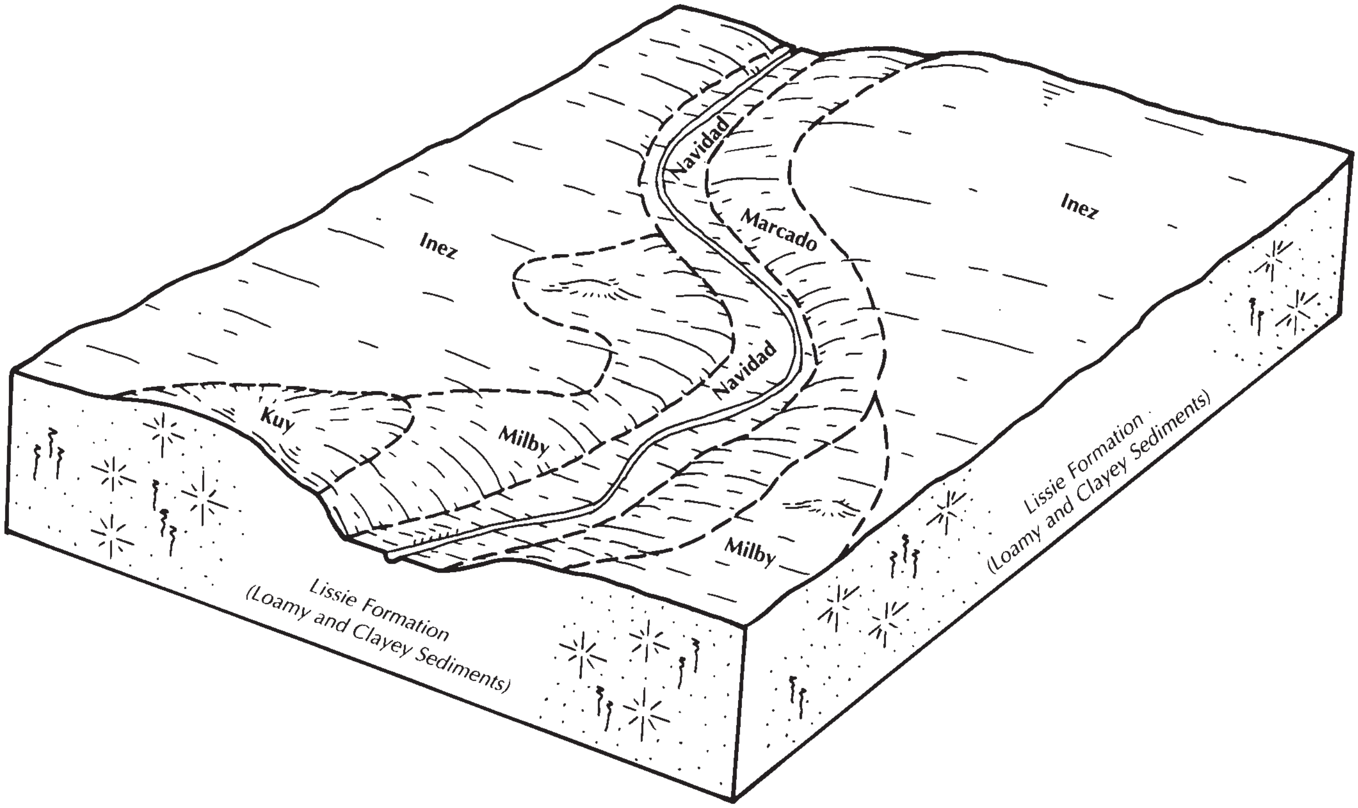


Figure 4.—Typical pattern of soils and parent material in the Inez-Milby general soil map unit.

The Texana and Cieno soils are moderately well suited to crops. Rice, grain sorghum, and corn are the principal crops. A well designed system of surface water management helps to improve drainage and thus increases yields and improves grazing distribution.

These soils are well suited to rangeland. The main native range plants are little bluestem, indiangrass, Florida paspalum, brownseed paspalum, Maximilian sunflower, and bundleflower.

These soils are poorly suited to most urban uses. The main limitations are the shrink-swell potential, wetness, and low strength.

3. Inez-Milby

Moderately well drained, slowly permeable and very slowly permeable, loamy and sandy soils

This map unit consists of nearly level to very gently sloping soils near drainageways. Slopes are plane to slightly convex and range from 0 to 2 percent. Milby soils are in the slightly higher positions on the landscape and are mostly near drainageways. Inez soils are in slightly lower positions on the landscape than the Milby soils. They are near drainageways and on broad, nearly level uplands between drainageways. Small drainageways originate in areas of this map unit. They become incised small streams and creeks near major rivers in other areas of the county. Vertical relief mainly is less than 5 feet within a 1-mile radius in areas between drainageways but may range to as much as 10 feet within a 1-mile radius near drainageways.

This map unit makes up about 10 percent of the county. It is about 63 percent Inez soils, 17 percent Milby soils, and 20 percent other soils (fig. 4).

Typically, the surface layer of the Inez soils is slightly acid, grayish brown fine sandy loam that has brownish mottles. It is about 12 inches thick. The upper part of the subsoil, from a depth of 12 to 18 inches, is moderately acid, dark brown sandy clay that has brownish mottles. The lower part, from a depth of 18 to 47 inches, is moderately acid, grayish brown sandy clay that has brownish and reddish mottles. The underlying material, to a depth of 80 inches, is moderately alkaline, light gray sandy clay loam.

Typically, the surface layer of the Milby soils is strongly acid, brown sand about 6 inches thick. The subsurface layer, from a depth of 6 to 30 inches, is slightly acid, pale brown and very pale brown sand. The upper part of the subsoil, from a depth of 30 to 35 inches, is very strongly acid, light yellowish brown sandy clay loam that has brownish and reddish mottles. The next part, from a depth of 35 to 44 inches, is very strongly acid, grayish brown sandy clay that has brownish and reddish mottles. The lower part, from a depth of 44 to 70 inches, is strongly acid and very strongly acid, very pale brown sandy clay loam that has brownish and reddish mottles. The underlying material, to a depth of 80 inches, is strongly acid, light brownish gray sandy clay that has brownish and reddish mottles.

Of minor extent in this map unit are the sandy Kuy and Rupley soils and the loamy Telferner, Nada, Cieno, Marcado, Morales, Navidad, and Chicolete soils. Kuy and Rupley soils are in the slightly higher, mounded positions near rivers and streams. The nearly level Morales, Telferner, and Nada soils are in the slightly lower positions. Cieno soils are in circular or oval depressions on uplands. Marcado soils are in the slightly lower positions on steep, narrow side slopes along streams and rivers. Navidad and Chicolete soils are on flood plains along streams.

Most areas are used as range, pasture, or cropland.

The Inez and Milby soils are moderately well suited to crops. Rice and grain sorghum are the principal crops. A well designed system of surface water management helps to improve drainage and thus increases yields and improves grazing distribution.

These soils are moderately well suited to rangeland. The main native range plants are little bluestem, switchgrass, brownseed paspalum, post oak, and live oak.

Inez soils are poorly suited to most urban uses. The main limitations are wetness and the shrink-swell potential. Milby soils are moderately well suited to most urban uses. The main limitations are the shrink-swell potential and slow permeability.

4. Morales-Cieno

Moderately well drained and poorly drained, slowly permeable and very slowly permeable, loamy soils

This map unit consists of nearly level soils in broad areas on uplands. Slopes are plane and are 0 to 1 percent. Morales soils are slightly higher on the landscape than the Cieno soils. Cieno soils are in oval or oblong depressions. Surface drainage is poorly defined in most places except in areas near local streams and rivers. Vertical relief mainly is less than 5 to 10 feet within a 1-mile radius.

This map unit makes up about 6 percent of the county. It is about 82 percent Morales soils, 8 percent Cieno soils, and 10 percent other soils.

Typically, the surface layer of the Morales soils is slightly acid or moderately acid, yellowish brown and light yellowish brown fine sandy loam about 8 inches thick. The upper part of the subsoil, from a depth of 8 to 18 inches, is very strongly acid or strongly acid, yellowish brown sandy clay loam that has reddish mottles. The next part, from a depth of 18 to 29 inches, is slightly acid, grayish brown sandy clay that has reddish and brownish mottles. The lower part, from a depth of 53 to 76 inches, is slightly acid or neutral, light brownish gray sandy clay loam that has yellowish and brownish mottles. The underlying material, to a depth of 80 inches, is light gray sandy clay loam that has yellowish and reddish mottles.

Typically, the surface layer of the Cieno soils is moderately acid, dark gray sandy clay loam about 12 inches thick. The upper part of the subsoil, from a depth of 12 to 23 inches, is moderately acid, dark grayish brown sandy clay loam. The next part, from a depth of 23 to 50 inches, is slightly acid, dark gray sandy clay loam. The lower part, from a depth of 50 to 66 inches, is slightly acid, gray sandy clay loam. The underlying material, to a depth of 80 inches, is neutral, gray and light brownish gray sandy loam. The soil has brownish mottles to a depth of 50 inches and yellowish mottles below that depth.

Of minor extent in this map unit are the sandy Milby soils and the loamy Inez and Nada soils. Milby soils are in the slightly higher positions near drainageways. Nada and Inez soils are in landscape positions similar to those of the Morales soils.

Most areas are used as range or pasture. Some areas are used as cropland.

The Morales and Cieno soils are moderately well suited to crops. Rice is the principal crop. In a few areas corn and grain sorghum are grown. A well designed system of surface water management helps to improve drainage and thus increases yields and improves grazing distribution.

These soils are moderately well suited to rangeland. The main native range plants are little bluestem, switchgrass, Florida paspalum, post oak, live oak, and blackjack oak.

These soils are poorly suited to most urban uses. The main limitations are wetness, the shrink-swell potential, and low strength.

5. Nada-Cieno

Moderately well drained and poorly drained, very slowly permeable, loamy soils

This map unit consists of nearly level soils in broad areas on uplands. Slopes are plane and are 0 to 1 percent. Nada soils are slightly higher on the landscape than the Cieno soils. Cieno soils are in oval or oblong depressions. Ponding occurs in most areas for a few days to several months. Surface drainage is poorly defined in most places except for a few areas near local streams and rivers. Vertical relief mainly is 5 to 10 feet within a 1-mile radius.

This map unit makes up about 6 percent of the county. It is about 71 percent Nada soils, 16 percent Cieno soils, and 13 percent other soils.

Typically, the surface layer of the Nada soils is neutral, dark grayish brown sandy loam about 7 inches thick. The upper part of the subsoil, from a depth of 7 to 28 inches, is neutral, dark gray sandy clay loam that has brownish mottles. The lower part, from a depth of 28 to 43 inches, is neutral, dark grayish brown sandy clay loam that has brownish mottles. The underlying material, to a depth of 80 inches, is slightly alkaline or moderately alkaline, gray and light brownish gray sandy clay loam that has brownish mottles.

Typically, the surface layer of the Cieno soils is moderately acid, dark gray sandy clay loam about 10 inches thick. The upper part of the subsoil, from a depth of 10 to 39 inches, is neutral, dark gray sandy clay loam that has brownish mottles. The lower part, from a depth of 39 to 80 inches, is moderately alkaline, light brownish gray sandy clay loam and clay loam that has brownish and yellowish mottles.

Of minor extent in this map unit are the loamy Inez, Edna, Fordtran, and Telferner soils. Inez soils are in the slightly higher positions on uplands near streams and rivers. Edna, Fordtran, and Telferner soils are in landscape positions similar to or slightly higher than those of the Nada soils.

Most areas are used as cropland, range, or pasture.

The Nada and Cieno soils are well suited to crops. Rice and grain sorghum are the principal crops. A well designed system of surface water management helps to improve drainage and thus increases yields and improves grazing distribution.

These soils are moderately well suited to rangeland. The main native range plants are little bluestem, switchgrass, indiangrass, eastern gamagrass, and Maximilian sunflower.

These soils are poorly suited to most urban uses. The main limitations are wetness, ponding, and the very slow permeability.

6. Edna-Telferner

Somewhat poorly drained and moderately well drained, very slowly permeable, loamy soils

This map unit consists of nearly level soils in broad areas on uplands. Slopes are 0 to 1 percent. Edna soils are in broad, plane to slightly concave areas that are slightly lower than the Telferner soils. Telferner soils are in plane to slightly convex areas and on scattered low relief mounds on meander-belt ridges. Surface drainage is poorly defined in most places except in areas near local streams and rivers. Vertical relief is 5 to 10 feet within a 1-mile radius.

This map unit makes up about 6 percent of the county. It is about 50 percent Edna soils, 47 percent Telferner soils, and 3 percent other soils.

Typically, the surface layer of the Edna soils is dark grayish brown fine sandy loam about 10 inches thick. The upper part of the subsoil, from a depth of 10 to 15 inches, is dark gray clay that has brownish mottles. The lower part, from a depth of 15 to 51 inches, is gray clay that has brownish and yellowish mottles. The underlying material, to a depth of 80 inches, is light gray sandy clay loam that has yellowish mottles. The soil is slightly acid in the surface layer. The upper part of the subsoil grades from slightly acid, and the lower part is moderately alkaline and calcareous.

Typically, the surface layer of the Telferner soils is slightly acid, dark grayish brown fine sandy loam that has brownish mottles. It is about 14 inches thick. The subsurface layer, from a depth of 14 to 18 inches, is slightly acid, grayish brown fine sandy loam that has brownish mottles. The subsoil extends to a depth of 74 inches. From a depth of 18 to 33 inches, it is moderately acid, very dark gray clay that has reddish mottles; from a depth of 33 to 41 inches, it is moderately alkaline, dark gray clay that has brownish mottles; from a depth of 41 to 55 inches, it is moderately alkaline, dark grayish brown sandy clay that has brownish mottles; and from a depth of 55 to 74 inches, it is moderately alkaline, brown sandy clay loam. The underlying material, to a depth of 80 inches, is moderately alkaline, very pale brown fine sand.

Of minor extent in this map unit are the Laewest, Dacosta, Nada, Cieno, Inez, and Fordtran soils. The clayey Laewest and loamy Dacosta soils are in landscape positions similar to or slightly lower than those of the Edna and Telferner soils. The loamy Cieno soils are in the lower areas in undrained, circular or oval depressions. The loamy Inez soils are in the slightly higher positions near streams and rivers. The sandy Fordtran soils are in the slightly higher positions that have low mounds.

Most areas are used as range, cropland, or pasture.

The Edna and Telferner soils are moderately well suited to crops. Grain sorghum, corn, and rice are the principal crops. A well designed system of surface water management helps to improve drainage and thus increases yields and improves grazing distribution.

These soils are moderately well suited to rangeland. The main native range plants are little bluestem, indiangrass, Florida paspalum, Maximilian sunflower, and bundleflower.

These soils are poorly suited to most urban uses. The main limitations are the shrink-swell potential, wetness, and low strength.

7. Palacios-Francitas

Poorly drained, very slowly permeable, loamy and clayey soils that are sodic

This map unit consists of nearly level soils in broad areas on uplands. Slopes are plane to slightly concave and are 0 to 1 percent. Palacios soils are in slightly higher areas than the Francitas soils. Vertical relief is 2 to 5 feet within a 1-mile radius.

This map unit makes up about 1 percent of the county. It is about 84 percent Palacios soils, 15 percent Francitas soils, and 1 percent other soils.

Typically, the surface layer of the Palacios soils is neutral, very dark grayish brown loam about 7 inches thick. The subsoil extends to a depth of 70 inches. From a depth of 7 to 14 inches, it is moderately sodic, very slightly saline, neutral, very dark gray clay; from a depth of 14 to 40 inches, it is dark gray clay that has brownish mottles; from a depth of 27 to 40 inches, it is light gray clay that has brownish mottles; and from a depth of 40 to 70 inches, it is light brownish gray silty clay loam that has brownish mottles. The underlying material, to a depth of 80 inches, is light brownish gray silty clay loam that has yellowish mottles. The soil is moderately sodic, moderately saline, and moderately alkaline below a depth of 14 inches.

Typically, the surface layer of the Francitas soils is neutral, very dark gray clay that has brownish mottles. It is about 14 inches thick. The upper part of the subsoil, from a depth of 14 to 44 inches, is moderately sodic, neutral very dark gray clay. The next part, from a depth of 44 to 54 inches, is moderately sodic, very slightly saline, moderately alkaline, dark gray clay that has brownish mottles. The lower part, from a depth of 54 to 75 inches, is moderately sodic, very slightly saline, moderately alkaline, gray clay that has brownish mottles. The underlying material, to a depth of 80 inches, is slightly sodic, slightly saline, moderately alkaline, light olive gray and strong brown silty clay loam.

Of minor extent in this map unit are the clayey Laewest soils and the loamy Dacosta and Livco soils. These minor soils are in the slightly higher positions.

Most areas are used as cropland, pasture, or range.

The Palacios and Francitas soils are moderately well suited to crops. Grain sorghum, corn, and rice are the principal crops. A well designed system of surface water management helps to improve drainage and thus increases yields.

The main native range plants are gulf cordgrass, switchgrass, indiangrass, bush sea-ox-eye, and slim aster.

These soils are poorly suited to most urban uses. The main limitations are the shrink-swell potential, wetness, and low strength.

8. Livco

Moderately well drained, very slowly permeable, loamy soils that are sodic

This map unit consists of nearly level soils on meander-belt ridges. Slopes are plane to slightly convex and are 0 to 1 percent. Surface drainage is poorly defined in most places except in areas near local streams and rivers. Vertical relief mainly ranges from 2 to 5 feet within a 1-mile radius.

This map unit makes up about 1 percent of the county. It is about 95 percent Livco soils and 5 percent other soils.

Typically, the surface layer of the Livco soils is slightly alkaline, dark grayish brown fine sandy loam about 8 inches thick. The upper part of the subsoil, from a depth of 8 to 15 inches, is moderately sodic, very slightly saline, moderately alkaline, dark grayish brown clay loam. The next part, from a depth of 15 to 60 inches, is moderately sodic, slightly saline, moderately alkaline, grayish brown clay loam that has brownish mottles. The lower part, from a depth of 60 to 80 inches, is moderately sodic, slightly saline, moderately alkaline, light brownish gray clay loam that has yellowish brownish mottles.

Of minor extent in this map unit are the loamy Dacosta, Edna, and Telferner soils. Dacosta soils are in landscape positions similar to or slightly lower than those of the Livco soils. Edna and Telferner soils are in the slightly higher positions.

Most areas are used as range, pasture, or cropland.

The Livco soils are moderately well suited to crops. Grain sorghum, corn, and rice are the principal crops. A well designed system of surface water management helps to improve drainage and thus increases yields and improves grazing distribution.

The main native range plants are gulf cordgrass, switchgrass, indiangrass, bushy sea-ox-eye, and slim aster.

These soils are poorly suited to most urban uses. The main limitations are the shrink-swell potential, wetness, and low strength.

Nearly level, clayey and loamy soils on flood plains and in coastal marshes

These soils make up about 7 percent of the county. The major soils are in the Ganado, Navidad, Swan, and Aransas series. They are on nearly level flood plains along streams and rivers or in coastal areas adjacent to bays.

The surface layer of these soils is clayey or loamy, and the subsoil is loamy or clayey. These soils range from well drained to very poorly drained and from moderately rapidly permeable to very slowly permeable.

These soils are poorly suited to cropland because of the hazard of flooding. Most areas are used as range. The native range plants on loamy and clayey bottom land soils are mid and tall grasses and pecan and elm trees. The native range plants on salt marsh and salty bottom land soils are cordgrass and mid and tall grasses.

These soils are not suited to urban uses because of the hazard of flooding.

9. Ganado-Navidad

Somewhat poorly drained and well drained, very slowly permeable and moderately rapidly permeable, clayey and loamy soils

This map unit consists of nearly level soils on flood plains. Slopes are plane and are 0 to 1 percent. Ganado soils are in slightly concave areas that are lower than the Navidad soils. Navidad soils are on natural levees of flood plains.

This map unit makes up about 4 percent of the county. It is about 34 percent Ganado soils, 32 percent Navidad soils, and 34 percent other soils.

Typically, the surface layer of the Ganado soils is black clay about 6 inches thick. The subsoil, from a depth of 6 to 68 inches, is black or very dark gray clay. The underlying material, to a depth of 80 inches, is dark gray clay loam. The soil is moderately alkaline throughout and calcareous below a depth of 27 inches.

Typically, the surface layer of the Navidad soils is very dark grayish brown fine sandy loam about 33 inches thick. The underlying material extends to a depth of 80 inches. From a depth of 33 to 43 inches, it is dark grayish brown loamy fine sand; from a depth of 43 to 59 inches, it is grayish brown fine sand; from a depth of 59 to 70 inches, it is dark grayish brown sandy clay loam that has brownish mottles; and to a depth of 80 inches, it is dark brown sandy clay loam. The soil is moderately alkaline and calcareous throughout.

Of minor extent in this map unit are the loamy Chicolete soils and the sandy Zalco soils. These minor soils are in the slightly higher positions on natural levees of flood plains.

Most areas are used as range or pasture. A few areas are used as cropland.

The main native range plants are eastern gamagrass, indiangrass, switchgrass, snoutbean, pecan, hackberry, oak, elm, and cottonwood.

Because of the hazard of flooding, the Ganado and Navidad soils are not suited to urban uses.

10. Swan-Aransas

Very poorly drained and poorly drained, saline, slowly permeable and very slowly permeable, loamy and clayey soils

This map unit consists of nearly level soils in marshes and on flood plains. Slopes are plane and are 0 to 1 percent. Swan soils are in broad coastal marshes near bays that are flooded by daily tides. Aransas soils are on broad flood plains along rivers that adjoin the bays.

This map unit makes up about 3 percent of the county. It is about 37 percent Swan soils, 36 percent Aransas soils, and 27 percent other soils.

Typically, the surface layer of the Swan soils is very dark gray clay about 12 inches thick. It is overlain by a layer of dark olive gray mucky peat about 3 inches thick. The underlying material extends to a depth of 80 inches. From a depth of 15 to 30 inches, it is dark gray sandy clay loam; from a depth of 30 to 48 inches, it is gray sandy loam that has grayish mottles; from a depth of 48 to 63 inches, it is light brownish gray loamy sand that has grayish and greenish mottles; and from a depth of 63 to 80 inches, it is olive gray loamy sand that has grayish mottles. The soil is strongly saline and moderately alkaline throughout.

Typically, the surface layer of the Aransas soils extends to a depth of 40 inches. The upper part is slightly saline, moderately alkaline, black clay about 8 inches thick. The next part, from a depth of 8 to 28 inches, is moderately saline, moderately alkaline, very dark gray clay. The lower part, from a depth of 28 to 40 inches, is moderately saline, moderately alkaline, very dark gray clay that has brownish mottles. The underlying material, from a depth of 40 to 60 inches, is moderately saline, moderately alkaline dark gray clay.

Of minor extent in this map unit are the clayey Chicolete soils and the loamy Navidad soils. These minor soils are in the slightly higher positions on natural levees of flood plains.

The native range plants are dominantly gulf cordgrass, little bluestem, bulrushes, slim aster, switchgrass, knotroot bristlegrass, and bushy sea-ox-eye.

Because of the hazard of flooding, the Swan and Aransas soils are not suited to urban uses.

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 the heading "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, Laewest clay, 0 to 1 percent slopes, is a phase of the Laewest series.

Some map units are made up of two or more major soils. These map units are called soil complexes. 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. Texana-Cieno complex, 0 to 1 percent slopes, is an example.

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

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.

Ar—Aransas clay, saline, frequently flooded. This very deep, nearly level soil is on broad flood plains along streams that adjoin inland bays and coastal areas. It is at or near sea level. Slope is 0 to 1 percent. Areas are oval and range from 100 to 600 acres in size.

Typically, the upper part of the surface layer, to a depth of 8 inches, is slightly saline, moderately alkaline, black clay. The next part, from a depth of 8 to 28 inches, is moderately saline, moderately alkaline, very dark gray clay. The lower part, from a depth of 28 to 40 inches, is moderately saline, moderately alkaline, very dark gray clay that has brownish mottles. The underlying material, from a depth of 40 to 60 inches, is moderately saline, moderately alkaline, dark gray clay that has brownish mottles.

This soil is poorly drained. Permeability is very slow, and the available water capacity is low. Surface runoff is slow. The root zone is deep, but the content of clay impedes the movement of air and water and the penetration of roots. The soil is occasionally flooded by salt water and is frequently flooded by fresh water. The high tides that accompany tropical storms and hurricanes, generally in summer and fall, can result in flooding by salt water. This flooding occurs about 3 times every 10 years. Flooding by fresh water generally occurs after periods of heavy rainfall, generally in spring and fall. It occurs about 6 times every 10 years. In most years the soil is saturated for long periods and is seldom dry below a depth of 12 inches. A high water table is at a depth of 0.5 foot to 3.0 feet. The hazard of water erosion is slight except in areas subject to caving of streambanks.

Included with this soil in mapping are small areas of

Figure 5.—Gulf cordgrass in an area of Aransas clay, saline, frequently flooded.

Navidad, Placedo, and Swan soils. Placedo and Swan soils are in the lower landscape positions. Navidad soils are in the somewhat higher landscape positions on natural levees. Included soils make up less than 10 percent of the map unit.

The Aransas soil is used mainly as range or wildlife habitat. The characteristic native vegetation is dominantly gulf cordgrass (fig. 5).

The suitability of this soil for improved pasture, crops, and urban and recreational uses is severely limited by the frequent flooding, the salinity, the wetness, the high shrink-swell potential, the very slow permeability, the clayey texture, and the corrosivity to uncoated steel.

Areas of this soil provide habitat for a large variety and number of game birds, marine animals, and other animals. These areas provide the kind of habitat needed by alligators. Nesting areas for mottled ducks, tree ducks, and wood ducks are plentiful. Thousands of migratory ducks, geese, rails, coots, and cranes inhabit areas of this soil in fall and winter.

This soil is in capability subclass VIw and the Salty Bottomland range site.

Ch—Chicolete clay, frequently flooded. This very deep, nearly level soil is on natural levees of flood plains that are along rivers and streams. Slope is 0 to 1 percent. Areas are oblong and range from 30 to 150 acres in size.

Typically, the upper part of the surface layer, to a depth of 13 inches, is black clay. The next part, from a depth of 13 to 36 inches, is very dark gray sandy clay loam. The upper part of the subsoil, from a depth of 36 to 72 inches, is dark grayish brown fine sandy loam. The lower part, from a depth of 72 to 80 inches, is gray sandy clay that has brownish mottles. Clayey and sandy strata are common in the subsoil. The soil is moderately alkaline and calcareous throughout.

This soil is moderately well drained. Permeability and the available water capacity are moderate. Surface runoff is very slow. The hazard of water erosion is slight. The root zone is deep. Flooding occurs after periods of heavy rainfall, mainly in spring and fall. It occurs about 6 times every 10 years.

Included with this soil in mapping are small areas of Ganado, Navidad, and Zalco soils. Ganado soils are in the lower landscape positions. Navidad and Zalco soils are in landscape positions similar to those of the Chicolete soil. Also included are soils that have a surface layer that is lighter colored. Included soils make up less than 15 percent of the map unit.

The Chicolete soil is used mainly as range or pasture (fig. 6). A few areas are used as cropland. The characteristic native plant community consists of a wide variety of grasses, trees, and shrubs. Good management practices, such as a controlled grazing system, proper stocking rates, and brush control, help to maintain high productivity in areas of range.

The frequent flooding can slightly reduce yields in areas of improved pasture. The main improved pasture grasses are bermudagrass, bluestems, and kleingrass. Applications of fertilizer, a controlled grazing system, proper stocking rates, and brush control can help to maintain high productivity.

The suitability of this soil for crops and urban and recreational uses is severely limited by the frequent flooding.

Areas of this soil provide habitat for ducks and for deer, squirrel, swamp rabbit, and other furbearing animals. Nesting areas for quail, dove, and songbirds are plentiful.

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

DaA—Dacosta sandy clay loam, 0 to 1 percent slopes. This very deep, nearly level soil is on broad uplands. Areas are irregular in shape and range from 40 to 600 acres in size.

Typically, the surface layer is neutral, very dark gray sandy clay loam that has brownish mottles. It is about 9 inches thick. The subsoil extends to a depth of 80 inches. From a depth of 9 to 21 inches, it is slightly acid, very dark gray sandy clay that has brownish mottles; from a depth of 21 to 44 inches, it is neutral, gray sandy clay that has brownish mottles; from a depth of 44 to 62 inches, it is moderately alkaline, light brownish gray sandy clay that has grayish mottles; and from a depth of 62 to 80 inches, it is moderately alkaline, pale brown sandy clay loam that has yellowish mottles.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is high. Surface runoff is slow. The hazard of water erosion is slight. The root zone is deep, but the blocky structure of the subsoil impedes the movement of air and water and the penetration of roots. At times, the soil is seasonally wet, and at other times, it is droughty. It has cracks during dry periods. A perched water table is in the surface layer and the upper part of the subsoil for 1 to 2 weeks following extended periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter and spring.

Included with this soil in mapping are small areas of Laewest, Edna, Livco, and Telferner soils. Laewest and Edna soils are in landscape positions similar to those of the Dacosta soil. Telferner and Livco soils are in the slightly higher landscape positions. The included areas of Livco soils are only in the southern part of the county. Included soils make up less than 15 percent of the map unit.

This Dacosta soil is used as cropland, range, or pasture. The characteristic native plant community is open grassland dominated by mid and tall grasses.

This soil is well suited to crops. Grain sorghum, corn, and rice are the principal crops. Maintaining favorable soil structure and tilth is difficult. A crust can form on the surface of this soil. Plowpans are common in cultivated areas. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake (fig. 7). After heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, or other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface drainage system in areas where adequate outlets are available, and land leveling.

Figure 6.—An area of Chicolete clay, frequently flooded, used as range.

Applications of fertilizer are needed for maximum crop production.

This soil is well suited to improved pastures of Gordo bluestem and kleingrass. The main limitations are poor tilth and the periodic wetness. A simple drainage system helps to overcome the seasonal wetness in most areas. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The very slow permeability is a limitation on sites for septic tank absorption fields. The clayey texture, the high shrink-swell potential, and low strength are limitations affecting building foundations and streets and roads. The high corrosivity to uncoated steel is a limitation affecting the installation of public utilities. The very slow permeability and the clayey texture are limitations affecting recreational development.

Areas of this soil provide habitat for dove and quail. The Attwater prairie chicken inhabits a few well managed areas of range. Mottled ducks inhabit some areas, primarily for nesting cover.

This soil is in capability subclass IIw and the Blackland range site.

DaB—Dacosta sandy clay loam, 1 to 3 percent slopes. This very deep, very gently sloping soil is in long, narrow upland areas along drainageways. Areas are oblong and range from 40 to 120 acres in size.

Typically, the surface layer is neutral, black sandy clay loam that has brownish mottles. It is about 8 inches thick. The upper part of the subsoil, from a depth of 8 to 13 inches, is slightly acid, black sandy clay that has brownish mottles. The next part, from a depth of 13 to 27 inches, is slightly acid, black sandy clay that has brownish mottles. The lower part, from a depth of 27 to 42 inches, is moderately alkaline, very dark gray clay that has brownish mottles. Below this, from a depth of 42 to 80 inches, is moderately alkaline, light gray clay that has yellowish mottles.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is high.

Figure 7.—An area of Dacosta sandy clay loam, 0 to 1 percent slopes, where crop residue is being incorporated into the soil.

Surface runoff is medium. The hazard of water erosion is slight. The root zone is deep, but the blocky structure of the subsoil impedes the movement of air and water and the penetration of roots. At times, the soil is seasonally wet, and at other times, it is droughty. It has cracks during dry periods. A perched water table is in the surface layer and the upper part of the subsoil for several days following extended periods of heavy rainfall or during periods of above normal annual rainfall.

Included with this soil in mapping are small areas of Laewest, Edna, Marcado, and Telferner soils. Laewest and Edna soils are in landscape positions similar to those of the Dacosta soil. Telferner soils are in the slightly higher landscape positions. Marcado soils are in the slightly lower landscape positions. Included soils make up less than 20 percent of the map unit.

This Dacosta soil is used as cropland, range, or pasture. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is well suited to crops. Grain sorghum and corn are the principal crops. Maintaining favorable soil structure and tilth is difficult. A crust can form on the surface of this soil. Plowpans are common in cultivated areas. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake. Terracing and stable outlets are needed if row crops are grown. Applications of fertilizer are needed for maximum crop production.

This soil is well suited to improved pastures of Gordo bluestem and kleingrass. The main limitation is poor tilth. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The very slow permeability is a limitation on sites for septic tank absorption fields. The clayey texture, the high shrink-swell potential, and low strength are limitations affecting building foundations and streets and roads. The high corrosivity to uncoated steel is a limitation affecting the installation of public utilities. The very slow permeability and the clayey texture are limitations affecting recreational development.

Areas of this soil provide habitat for dove and quail. The Attwater prairie chicken inhabits a few well managed areas of range. Mottled ducks nest in some areas of range, generally near water.

This soil is in capability subclass IIIe and the Blackland range site.

EdA—Edna fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level soil is on broad uplands. Areas are irregular in shape and range from 20 to 500 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 10 inches thick. The upper part of the subsoil, from a depth of 10 to 15 inches, is dark gray clay that has brownish mottles. The next part, from a depth of 15 to 51 inches, is gray clay that has brownish and yellowish mottles. The lower part, from a depth of 51 to 80 inches, is light gray sandy clay loam that has yellow mottles. The soil is slightly acid in the surface layer. It is slightly acid in the upper part of the subsoil and moderately alkaline and calcareous in the lower part.

This soil is somewhat poorly drained. Permeability is very slow, and the available water capacity is high. Surface runoff is slow. The hazard of water erosion is slight. The root zone is deep, but the blocky structure of the subsoil impedes the movement of air and water and the penetration of roots. At times, the soil is seasonally wet, and at other times, it is droughty. It has cracks during dry periods. A perched water table is in the surface layer and the upper part of the subsoil for 2 to 4 weeks following extended periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter and spring.

Included with this soil in mapping are small areas of Cieno, Dacosta, Fordtran, and Telferner soils. Dacosta soils are in landscape positions similar to those of the Edna soil. Fordtran and Telferner soils are in the slightly higher landscape positions. Cieno soils are in small depressions. Included soils make up less than 20 percent of the map unit.

The Edna soil is used as range or cropland. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is moderately well suited to crops. Rice, grain sorghum, and corn are the principal crops. The low fertility and droughtiness are limitations affecting the production of crops. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. After heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, and other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface drainage system in areas where adequate outlets are available, and land leveling. Applications of fertilizer are needed for maximum crop production.

This soil is well suited to improved pastures of bermudagrass and Gordo bluestem. A simple drainage system helps to overcome the wetness in most areas. Applications of fertilizer, weed control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The main limitations are the shrink-swell potential and the very slow permeability. Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for dove and quail. The Attwater prairie chicken inhabits a few well managed areas of range. Mottled ducks nest in some areas of range, generally in the lower landscape positions near water.

This soil is in capability subclass IIIw and the Claypan Prairie range site.

FaB—Fordtran loamy fine sand, 0 to 2 percent slopes. This very deep, nearly level to very gently sloping soil is on broad uplands. Areas are irregular in shape and range from 50 to 200 acres in size.

Typically, the surface layer is slightly acid, dark brown loamy fine sand about 18 inches thick. The subsurface layer, from a depth of 18 to 25 inches, is slightly acid, light brownish gray loamy fine sand. The upper part of the subsoil, from a depth of 25 to 39 inches, is strongly acid, light brownish gray clay that has brownish mottles. The lower part, from a depth of 39 to 52 inches, is neutral, light gray sandy clay loam that has red mottles. Below this, from a depth of 52 to 80 inches, is neutral, light gray sandy clay loam that has reddish and yellowish mottles.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is moderate. The soil has good tilth. It can be worked within a wide range in moisture content. Surface runoff is slow. The hazard of water erosion is slight. The root zone is deep, but the blocky structure of the subsoil impedes the movement of air and water and the penetration of roots. At times, the soil is seasonally wet, and at other times, it is droughty. A perched water table is in the lower part of the surface layer and the upper part of the subsoil for 1 to 2 weeks following extended periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter and spring.

Included with this soil in mapping are small areas of Cieno, Telferner, and Texana soils. Telferner and Texana soils are in the slightly lower landscape positions. Cieno soils are in small depressions. Included soils make up less than 25 percent of the map unit.

The Fordtran soil is used as range and pasture. A few areas support grain sorghum. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is moderately well suited to improved pastures of kleingrass and Pensacola bahiagrass. Applications of fertilizer, weed control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is moderately well suited to most urban and recreational uses. The main limitation is the very slow permeability. This limitation can generally be overcome by proper design and careful installation.

Areas of this soil provide habitat for dove and quail. The Attwater prairie chicken inhabits a few well managed areas of range.

This soil is in capability subclass IIw and the Sandy Prairie range site.

FcA—Francitas clay, 0 to 1 percent slopes. This very deep, nearly level soil is on broad uplands near the coast. It is at an elevation of less than 15 feet above sea level. Areas are irregular in shape and range from 20 to 300 acres in size. Undisturbed areas have gilgai microrelief characterized by microknolls and microdepressions. Evidence of this microrelief is destroyed after a few years of cultivation.

Typically, the surface layer is neutral, very dark gray clay that has brownish mottles. It is about 14 inches thick. The upper part of the subsoil, from a depth of 14 to 44 inches, is moderately sodic, neutral, very dark gray clay. The next part, from a depth of 44 to 54 inches, is moderately sodic, very slightly saline, moderately alkaline, dark gray clay that has brownish mottles. The lower part, from a depth of 54 to 75 inches, is moderately sodic, very slightly saline, moderately alkaline, gray clay that has brownish mottles. The underlying material, from a depth of 75 to 80 inches, is slightly sodic, slightly saline, moderately alkaline, light olive gray and strong brown silty clay loam.

This soil is poorly drained. Permeability is very slow, and the available water capacity is high. During dry periods, deep, wide cracks extend to the surface. Water enters the soil rapidly when the soil has cracks but enters it very slowly when the soil is wet and does not have cracks. The root zone is deep, but the content of clay impedes the movement of air and water and the penetration of roots. Surface runoff is slow. The hazard of water erosion is slight. Because of the high content of clay and the very slow permeability, the soil has a perched water table in winter and spring following periods of heavy rainfall or during periods of above normal annual rainfall. A perched water table is in the surface layer and subsoil in the microdepressions and in the upper part of the subsoil in the microknolls for 2 to 5 weeks. A few areas are subject to rare flooding caused by very high storm surges. Flooding occurs about once every 10 years, generally during summer and fall.

Included with this soil in mapping are small areas of Livco and Palacios soils. These soils are in the slightly higher landscape positions. Included soils make up less than 10 percent of the map unit.

The Francitas soil is used as cropland, pasture, or range. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is moderately well suited to crops, mainly rice. The sodicity, which can result in droughtiness, is a limitation. Maintaining favorable soil structure and tilth is difficult. The soil can be cultivated only within a narrow range in moisture content. A crust can form on the surface of this soil. Plowpans are common in cultivated areas. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake. After periods of heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, and other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface drainage system in areas where adequate outlets are available, and land leveling. Applications of fertilizer are needed to increase yields.

The soil is moderately well suited to improved pastures of bermudagrass and Gordo bluestem. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The main limitations are the very high shrink-swell potential, wetness, and the clayey texture. The high corrosivity to uncoated steel is a limitation affecting the installation of public utilities. Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for dove and quail. Mottled ducks nest in some areas of range, generally near water.

This soil is in capability subclass IVw and the Salty Prairie range site.

Ga—Ganado clay, frequently flooded. This very deep, nearly level soil is on flood plains along rivers and streams. Slope is 0 to 1 percent. Areas are oblong and range from 30 to 250 acres in size. Undisturbed areas have gilgai microrelief characterized by microknolls and microdepressions. Evidence of this microrelief is destroyed after a few years of cultivation.

Typically, the surface layer in the center of the microdepressions is black clay about 6 inches thick. The upper part of the subsoil, from a depth of 6 to 50 inches, is black clay. The lower part, from a depth of 50 to 68 inches, is very dark gray clay. The underlying material, from a depth of 68 to 80 inches, is dark gray clay loam. The soil is moderately alkaline throughout. It is calcareous below a depth of 27 inches.

This soil is somewhat poorly drained. Permeability is very slow, and the available water capacity is high. Water enters the soil rapidly when the soil is dry and has cracks but enters it very slowly when the soil is wet and does not have cracks. The root zone is deep. Surface runoff is slow. The hazard of water erosion is slight except in areas subject to caving of streambanks. Flooding follows periods of heavy rainfall, mainly during spring and fall. It occurs about 6 times every 10 years. Because of the high content of clay and the very slow permeability, the soil has a perched water table in winter and spring following periods of heavy rainfall or during periods of above normal annual rainfall. A perched water table is in the surface layer of the microdepressions and the upper part of the subsoil in the microdepressions and microknolls for 2 to 4 weeks.

Included with this soil in mapping are small areas of Chicolete and Navidad soils. These soils are in the slightly higher landscape positions on natural levees. Also included are areas of soils that have a thin, grayish clayey layer in the upper part of the subsoil and a thin, brownish sandy and loamy layer in the lower part of the subsoil. Included soils make up less than 15 percent of the map unit.

The Ganado soil is used as range and pasture. The characteristic native vegetation is a savanna that has a canopy of about 5 percent, which is made up of pecan, elm, and live oak trees. The understory consists of mid and tall grasses.

The frequent flooding slightly reduces yields in areas of improved pasture and range. It is a severe limitation affecting crops. The soil is moderately well suited to improved varieties of bermudagrass, bluestem, kleingrass, and bahiagrass. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

The frequent flooding, the very high shrink-swell potential, the very slow permeability, the clayey texture, and corrosivity to uncoated steel are severe limitations affecting urban and recreational uses.

Areas of this soil provide habitat for ducks and for deer, squirrels, swamp rabbit, and other furbearing animals and for wild hogs. Nesting areas for quail, dove, and songbirds are plentiful.

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

InB—Inez fine sandy loam, 0 to 2 percent slopes. This very deep, nearly level to very gently sloping soil is on upland areas adjacent to streams. Areas are long and narrow and range from 40 to 600 acres in size.

Typically, the surface layer is slightly acid, grayish brown fine sandy loam that has brownish mottles. It is about 12 inches thick. The upper part of the subsoil, from a depth of 12 to 18 inches, is moderately acid, dark grayish brown sandy clay that has brownish mottles. The next part, from a depth of 18 to 47 inches, is moderately acid, grayish brown sandy clay that has brownish and reddish mottles. The lower part, from a depth of 47 to 80 inches, is calcareous, moderately alkaline, light gray sandy clay loam.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is high. The root zone is deep, but the content of clay impedes the movement of air and water and the penetration of roots. The soil has good tilth. It can be worked within a wide range in moisture content. Runoff is slow. The hazard of water erosion is slight. A perched water table is in the surface layer and the upper part of the subsoil for 1 to 2 weeks following extended periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter and spring.

Included with this soil in mapping are small areas of Cieno, Dacosta, Milby, and Telferner soils. Dacosta and Telferner soils are in the slightly lower landscape positions. Milby soils are in the slightly higher landscape positions. Cieno soils are in small depressions. Included soils make up less than 15 percent of the map unit.

The Inez soil is used as range, cropland, or pasture. The characteristic native vegetation is a savanna of post oak, blackjack oak, and live oak that has an understory of brushy vegetation and mid and tall grasses.

This soil is moderately well suited to crops. Rice, grain sorghum, and corn are the main crops. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to control erosion and maintain productivity and tilth. Applications of fertilizer are needed for maximum crop production. After periods of heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, and other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface drainage system in areas where adequate outlets are available, and land leveling.

This soil is moderately well suited to improved pastures of kleingrass and Pensacola bahiagrass. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The main limitations are the high shrink-swell potential and the very slow permeability. Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for deer, dove, turkey, quail, and squirrel. These areas provide good cover and browse, mast, seeds, and tender grazing throughout the year.

This soil is in capability subclass IIw and the Sandy Loam range site.

KuC—Kuy sand, 1 to 5 percent slopes. This very deep, gently sloping soil is on upland terraces near large streams. Areas are oval or oblong and range from 50 to 200 acres in size.

Typically, the surface layer is slightly acid, dark brown sand about 7 inches thick. The subsurface layer, from a depth of 7 to 52 inches, is slightly acid, yellowish brown and light gray sand. The upper part of the subsoil, from a depth of 52 to 59 inches, is slightly acid, yellowish brown sandy loam that has brownish and reddish mottles. The lower part, from a depth of 59 to 79 inches, is moderately acid, light brownish gray clay loam that has reddish mottles.

This soil is moderately well drained. Permeability is moderate, and the available water capacity is low. Surface runoff is very slow. The hazard of water erosion is slight. The root zone is deep. A perched water table is generally at a depth of 4 to 6 feet following periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter, spring, and summer.

Included with this soil in mapping are small areas of Milby, Morales, and Rupley soils. Milby and Rupley soils are in landscape positions similar to those of the Kuy soil. Morales soils are in the lower landscape positions. Included soils make up less than 20 percent of the map unit.

The Kuy soil is used as range (fig. 8). A few areas are used as pasture. The characteristic native vegetation is a savanna of live oak, blackjack oak, and post oak that has an understory of brushy vegetation and mid and tall grasses.

This soil is moderately well suited to improved pastures of lovegrass and Pensacola bahiagrass.

Figure 8.—An area of Kuy sand, 1 to 5 percent slopes, used as range.

Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is well suited to most urban and recreational uses.

Areas of this soil provide habitat for deer, dove, quail, and squirrel. These areas provide good cover and browse, mast, forbs, and seeds throughout the year.

This soil is in capability subclass IIIs and the Deep Sand range site.

LaA—Laewest clay, 0 to 1 percent slopes. This very deep, nearly level soil is on broad uplands. Areas are irregular in shape and range to as much as 3,000 acres in size. Undisturbed areas have gilgai microrelief characterized by microknolls and microdepressions. Evidence of this microrelief is destroyed after a few years of cultivation.

Typically, the surface layer in the center of the microdepressions is neutral, black clay about 18 inches thick. The subsoil extends to a depth of 54 inches. From a depth of 18 to 29 inches, it is neutral, black clay; from a depth of 29 to 37 inches, it is slightly alkaline, very dark gray clay; from a depth of 37 to 46 inches, it is moderately alkaline, dark gray clay; and from a depth of 46 to 54 inches, it is moderately alkaline, gray clay that has brownish mottles. Below this, from a depth of 54 to 80 inches, is moderately alkaline, light gray clay that has yellowish mottles.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is high. During dry periods, deep, wide cracks extend to the surface. Water enters the soil rapidly when the soil has cracks but enters it very slowly when the soil is wet and does not have cracks. The root zone is deep, but the content of clay impedes the movement of air and water and the penetration of roots. Surface runoff is slow. The hazard of water erosion is slight.

Because of the low runoff and the very slow permeability, the soil has a perched water table in the winter and spring following periods of heavy rainfall or during periods of above normal annual rainfall. A perched water table is in the surface layer and subsoil in the microdepressions and the upper part of the subsoil in the microknolls for 2 to 4 weeks.

Included with this soil in mapping are small areas of Dacosta soils. These soils are in landscape positions similar to those of the Laewest soil. Included soils make up less than 10 percent of the map unit.

The Laewest soil is used as cropland, pasture, or range. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is well suited to crops. Grain sorghum, rice, corn, and cotton are the main crops. Maintaining favorable soil structure and tilth is difficult. The soil can be cultivated only within a narrow range in moisture content. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake. After heavy rainfall or during extended periods of wet weather, tilling, planting, harvesting, and other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface drainage system in areas where adequate outlets are available, and land leveling. Applications of fertilizer are needed to increase yields.

This soil is well suited to improved pastures of bermudagrass and Gordo bluestem. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The very slow permeability is a limitation on sites for septic tank absorption fields. The clayey texture, the very high shrink-swell potential, and low strength are limitations affecting building foundations and streets and roads. The high corrosivity to uncoated steel is a limitation affecting the installation of public utilities. The very slow permeability and the clayey texture are limitations affecting recreational development. Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for dove and quail. The Attwater prairie chicken inhabits a few well managed areas of range. Mottled ducks inhabit some areas, primarily for nesting cover.

This soil is in capability subclass IIw and the Blackland range site.

LaB—Laewest clay, 1 to 3 percent slopes. This very deep, very gently sloping soil is on low ridges and in natural drainageways. Areas are oblong and range from 50 to 200 acres in size. Undisturbed areas have gilgai microrelief characterized by microknolls and microdepressions. Evidence of this microrelief is destroyed after a few years of cultivation.

Typically, the surface layer in the center of the microdepressions is neutral, black clay about 20 inches thick. The upper part of the subsoil, from a depth of 20 to 40 inches, is also neutral, black clay. The lower part, from a depth of 40 to 50 inches, is calcareous, moderately alkaline, very dark gray and light brownish gray clay that has brownish mottles. Below this, from a depth of 50 to 80 inches, is calcareous, moderately alkaline, light brownish gray clay that has yellowish mottles.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is high. During dry periods, deep, wide cracks extend to the surface. Water enters the soil rapidly when the soil has cracks but enters it very slowly when the soil is wet and does not have cracks. The root zone is deep, but the content of clay impedes the movement of air and water and the penetration of roots. Surface runoff is medium.

The hazard of water erosion is moderate.

Included with this soil in mapping are small areas of Dacosta and Marcado soils and small areas of eroded soils in drainageways. Dacosta soils are in landscape positions similar to those of the Laewest soil. Marcado soils are on narrow side slopes along creeks and rivers. Included soils make up less than 15 percent of the map unit.

This Laewest soil is used mainly as range or pasture. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is well suited to crops. Grain sorghum and corn are the main crops. Maintaining favorable soil structure and tilth is difficult. The soil can be cultivated only within a narrow range in moisture content. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake. Terracing, farming on the contour, and establishing protected terrace outlets are necessary management practices in places. Applications of fertilizer are needed to increase yields.

This soil is well suited to improved pastures of bermudagrass and Gordo bluestem. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The very slow permeability is a limitation on sites for septic tank absorption fields. The clayey texture, the very high shrink-swell potential, and low strength are limitations affecting building foundations and streets and roads. The high corrosivity to uncoated steel is a limitation affecting the installation of public utilities. The very slow permeability and the clayey texture are limitations affecting recreational development. Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for dove and quail. The Attwater prairie chicken inhabits a few well managed areas of range. Mottled ducks inhabit some areas, primarily for nesting cover.

This soil is in capability subclass IIe and the Blackland range site.

LaD3—Laewest clay, 5 to 8 percent slopes, eroded. This very deep, moderately sloping soil is in drainageways and coastal bays. Areas are long and narrow and range from 30 to 200 acres in size. Undisturbed areas have gilgai microrelief characterized by microknolls and microdepressions. In most areas some of the original surface layer has been removed by erosion. Most areas have rills and shallow gullies that are 5 to 15 inches deep, 3 to 10 feet wide, and 50 to 200 feet apart. Many areas that once had shallow gullies have been smoothed and planted to bermudagrass.

Typically, the surface layer in the center of the microdepressions is slightly alkaline, black clay about 12 inches thick. The subsoil extends to a depth of 64 inches. From a depth of 12 to 24 inches, it is calcareous, moderately alkaline, very dark gray clay; from a depth of 24 to 42 inches, it is calcareous, moderately alkaline, grayish brown clay that has brownish mottles; and from a depth of 42 to 64 inches, it is calcareous, moderately alkaline, light gray clay that has brownish mottles. Below this, from a depth of 64 to 80 inches, is calcareous, moderately alkaline, light brownish gray clay that has yellowish mottles.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is high. Water enters the soil rapidly when the soil is dry and has cracks but enters it very slowly when it is wet and does not have cracks. The root zone is deep, but the content of clay impedes the movement of air and water and the penetration of roots. Surface runoff is very high. The hazard of water erosion is severe.

Included with this soil in mapping are small areas of Dacosta and Marcado soils and areas of soils that have short, steep, narrow slopes. Dacosta soils are in the higher positions on the landscape. Marcado soils are in landscape positions similar to those of the Laewest soil. The short, steep, narrow slopes are 10 to 15 feet high. They are along bays and river channels. Included soils make up less than 20 percent of the map unit.

The Laewest soil is used mainly as range or pasture. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is poorly suited to crops. Careful management is needed to increase the rate of water intake and to help control runoff. Good management practices include leaving crop residue on the surface to control water erosion and conserve moisture. Terracing, farming on the contour, and establishing protected terrace outlets are necessary management practices. Applications of fertilizer are needed to increase yields.

This soil is well suited to improved pastures of bermudagrass and Gordo bluestem. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The clayey texture, the very high shrink-swell potential, and low strength are limitations affecting building foundations and streets and roads. The high corrosivity to uncoated steel is a limitation affecting the installation of public utilities. The very slow permeability and the clayey texture are limitations affecting recreational development. Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for dove and quail. The Attwater prairie chicken inhabits a few well managed areas of range. Mottled ducks inhabit a few areas, primarily for nesting cover.

This soil is in capability subclass IVe and the Blackland range site.

LvA—Livco fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level soil is on meander-belt ridges of broad coastal uplands. It is at an elevation of 15 to 40 feet above sea level. The landscape is plane to slightly convex and has numerous small, low mounds. Areas are irregular in shape and range from 30 to 300 acres in size.

Typically, the surface layer is slightly alkaline, dark grayish brown fine sandy loam about 8 inches thick. The upper part of the subsoil, from a depth of 8 to 15 inches, is moderately sodic, very slightly saline, moderately alkaline, dark grayish brown clay loam that has brownish mottles. The next part, from a depth of 15 to 60 inches, is moderately sodic, very slightly saline and slightly saline, moderately alkaline, grayish brown clay loam that has brownish mottles. The lower part, from a depth of 60 to 80 inches, is moderately sodic, slightly saline, moderately alkaline, light brownish gray clay loam that has brownish mottles.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is moderate. The root zone is deep, but the content of clay impedes the movement of air and water and the penetration of roots. Surface runoff is slow. The hazard of water erosion is slight. A perched water table is in the lower part of the surface layer and the upper part of the subsoil for several days following extended periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter and spring.

Included with this soil in mapping are small areas of Dacosta, Edna, Telferner, and Texana soils. Dacosta soils are in the lower landscape positions. Edna soils are in landscape positions similar to those of the Livco soils. Telferner and Texana soils are in the slightly higher landscape positions. Included soils make up less than 20 percent of the map unit.

The Livco soil is used as range, cropland, or pasture. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is moderately suited to crops. The main crop is rice. The sodicity, which can result in droughtiness, is a limitation affecting the production of crops. Maintaining favorable soil structure and tilth are difficult. A crust can form on the surface of this soil. Plowpans are common in cultivated areas. After periods of heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, and other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface drainage system in areas where adequate outlets are available, and land leveling. In areas that are leveled, the sodic, slightly saline subsoil may be at or near the surface. In these areas plants and fertilizers may react differently than in surrounding areas. The sodicity and the salinity in these areas can increase after many years of crop production, thus reducing yields. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake. Applications of fertilizer are needed to increase yields. Adding amendments that contain sulfur, such as gypsum, and leaching can help to overcome the sodicity.

This soil is moderately well suited to improved pastures of Angleton bluestem, bermudagrass, and Gordo bluestem. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The main limitations are the high shrink-swell potential and the clayey texture. The high corrosivity to uncoated steel is a limitation affecting the installation of public utilities. Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for dove and quail. Mottled ducks nest in some areas of range, generally near water.

This soil is in capability subclass IIIs and the Salty Prairie range site.

MaC—Marcado sandy clay loam, 3 to 8 percent slopes. This very deep, gently sloping to moderately sloping soil is on narrow side slopes along rivers and creeks. Areas are narrow and oblong and range from 50 to 400 acres in size. A few small gullies that are 2 to 20 feet wide and 6 to 12 inches deep are in some areas.

Typically, the surface layer is slightly acid, very dark gray sandy clay loam about 8 inches thick. The upper part of the subsoil, from a depth of 8 to 23 inches, is slightly alkaline, dark gray clay that has brownish mottles. The next part, from a depth of 23 to 40 inches, is moderately alkaline, light brownish gray clay that has brownish yellow mottles. The lower part, from a depth of 40 to 80 inches, is moderately alkaline, light gray clay that has brownish and yellowish mottles.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is high. The root zone is deep. Surface runoff is high to very high. The hazard of water erosion is severe.

Included with this soil in mapping are small areas of Dacosta, Inez, Laewest, and Milby soils. Also included are areas of soils that have a surface layer of fine sandy loam and areas of soils that have short, steep slopes. Dacosta, Inez, Laewest, and Milby soils are in the slightly higher landscape positions. The areas of soils that have a surface layer of fine sandy loam are on the upper and lower slopes. The short, steep slopes are along river channels and bays. They are 10 to 15 feet high. Included soils make up less than 20 percent of the map unit.

Most areas of the Marcado soil are used as range or pasture. The characteristic native vegetation is open grassland dominated by mid and tall grasses. Hardwood trees have encroached in some areas.

These soils are poorly suited to crops. The main limitations are erosion, droughtiness, runoff, and the very slow permeability. Careful management is needed to increase the rate of water intake and to help control runoff. Good management practices include leaving crop residue on the surface to control water erosion and conserve moisture. Other management practices include applying fertilizer, reducing tillage, and using cover crops. Terracing, farming on the contour, and establishing protected terrace outlets are necessary management practices. Applications of fertilizer are needed to increase yields.

This soil is moderately well suited to improved pastures of bermudagrass, Gordo bluestem, and kleingrass. The main limitations are droughtiness, runoff, the very slow permeability, and erosion. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

These soils are poorly suited to most urban and recreational uses. The very slow permeability is a limitation on sites for septic tank absorption fields. The high shrink-swell potential and low strength are limitations on sites for roads, streets, and dwellings. The corrosivity to uncoated steel is a limitation affecting the installation of public utilities. These limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for deer, dove, quail, turkey, and squirrel. These areas provide good cover and browse, mast, seeds, and tender grazing throughout the year.

This soil is in capability subclass IVe and the Blackland range site.

MbB—Milby sand, 0 to 2 percent slopes. This very deep, nearly level to very gently sloping soil is on uplands along streams. Areas are oval or oblong and range from 50 to 200 acres in size.

Typically, the surface layer is strongly acid, brown sand about 6 inches thick. The subsurface layer, from a depth of 6 to 30 inches, is slightly acid, pale brown and very pale brown sand. The upper part of the subsoil, from a depth of 30 to 35 inches, is very strongly acid, light yellowish brown sandy clay loam that has brownish and reddish mottles. The next part, from a depth of 35 to 44 inches, is very strongly acid, grayish brown sandy clay that has yellowish and reddish mottles. The lower part, from a depth of 44 to 70 inches, is strongly acid and very strongly acid, very pale brown sandy clay loam that has brownish, yellowish, and reddish mottles. The underlying material, from a depth of 70 to 80 inches, is strongly acid, light brownish gray sandy clay that has brownish and reddish mottles.

This soil is moderately well drained. Permeability is slow, and the available water capacity is moderate. Surface runoff is very slow. The hazard of water erosion is slight. The root zone is deep. A perched water table is in the lower part of the surface layer and subsurface layer and the upper part of the subsoil for 2 to 4 weeks following extended periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter, spring, and summer.

Included with this soil in mapping are small areas of Inez, Kuy, and Morales soils. Inez and Morales soils are in the slightly lower landscape positions. Kuy soils are in the slightly higher landscape positions. Included soils make up less than 10 percent of the map unit.

The Milby soil is used mainly as range or pasture. The characteristic native vegetation is a savanna of live oak, blackjack oak, and post oak that has an understory of brushy vegetation and mid and tall grasses.

This soil is moderately well suited to improved pastures of lovegrass and Pensacola bahiagrass. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is moderately well suited to most urban and recreational uses. The main limitations are the moderate shrink-swell potential and the slow permeability. Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for deer, dove, turkey, quail, and squirrel. These areas provide good cover and browse, mast, seeds, and tender grazing throughout the year.

This soil is in capability subclass IIIs and the Sandy range site.

MrA—Morales-Cieno complex, 0 to 1 percent slopes. These very deep, nearly level soils are on broad uplands. Areas are as much as 1,000 acres in size. The Morales soil makes up 80 to 85 percent of the unit. It commonly makes up about 82 percent. The Cieno soil makes up 5 to 10 percent of the unit. It commonly makes up about 8 percent. Other soils make up about 10 percent of the unit. The Morales and Cieno soils occur as areas so intricately mixed that mapping them separately is not practical at the scale used.

The Morales soil is on plane or slightly convex, nearly level uplands. The Cieno soil is in oval or oblong depressions that are 5 to 20 inches below the adjacent soils. These depressions are less than 1 acre to about 10 acres in size.

Typically, the surface layer of the Morales soil is slightly acid, yellowish brown fine sandy loam about 4 inches thick. The subsurface layer, from a depth of 4 to 8 inches, is moderately acid, light yellowish brown fine sandy loam. The subsoil extends to a depth of 76 inches. From a depth of 8 to 18 inches, it is very strongly acid or strongly acid, yellowish brown sandy clay loam that has reddish mottles and is mixed with small amounts of fine sandy loam; from a depth of 18 to 29 inches, it is slightly acid, grayish brown sandy clay that has red and brownish mottles; from a depth of 29 to 53 inches, it is moderately acid, light brownish gray sandy clay loam that has reddish and brownish mottles; and from a depth of 53 to 76 inches, it is slightly acid or neutral, light brownish gray sandy clay loam that has brownish and reddish mottles. The underlying material, from a depth of 76 to 80 inches, is neutral, light gray sandy clay loam that has yellowish and reddish mottles.

The Morales soil is somewhat poorly drained. Permeability is very slow, and the available water capacity is moderate. Surface runoff is very slow. The hazard of water erosion is slight. The root zone is deep, but the blocky structure of the subsoil impedes the movement of air and water and the penetration of roots. At times, the soil is seasonally wet, and at other times, it is droughty. A perched water table is in the lower part of the surface layer and the upper part of the subsoil for 1 to 2 weeks following extended periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter and spring.

Typically, the surface layer of the Cieno soil is neutral, dark gray sandy clay loam that has brownish mottles. It is about 12 inches thick. The subsoil extends to a depth of 80 inches. From a depth of 12 to 23 inches, it is moderately acid, dark grayish brown sandy clay loam that has brownish mottles; from a depth of 23 to 50 inches, it is slightly acid, mottled dark gray sandy clay loam that has brownish and yellowish mottles; from a depth of 50 to 66 inches, it is slightly acid, gray sandy clay loam that has brownish and yellowish mottles; and from a depth of 66 to 80 inches, it is neutral, gray and light brownish gray sandy clay loam that has yellowish mottles.

The Cieno soil is poorly drained. Permeability is very slow, and the available water capacity is high. In unleveled areas the soil receives runoff from surrounding soils and is ponded with water that is 1 to 2 feet deep for a period ranging from several weeks to 4 or 5 months during rainy seasons. The hazard of water erosion is slight. The root zone is deep. At times, the soil is seasonally wet, and at other times, it is droughty. A perched water table is in the surface layer and the upper part of the subsoil for a period ranging from a few weeks to 4 or 5 months.

Included with these soils in mapping are small areas of Inez, Milby, and Nada soils. Inez and Nada soils are in landscape positions similar to those of the Morales soil. Milby soils are in the slightly higher landscape positions. Included soils make up less than 10 percent of the map unit.

The Morales and Cieno soils are used as range or pasture. A few areas are used as cropland. The characteristic native vegetation is a savanna of post oak, blackjack oak, and live oak. The understory is brushy vegetation and mid and tall grasses in areas of the Morales soil and water-tolerant grasses and sedges in areas of the Cieno soil.

These soils are moderately well suited to crops, mainly rice (fig. 9). A crust can form on the surface of these soils. Plowpans are common in cultivated areas. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake. Land leveling is needed before rice can be irrigated. After periods of heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, or other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface

Figure 9.—Harvesting rice in an area of Morales-Cieno complex, 0 to 1 percent slopes.

drainage system in areas where adequate outlets are available, and land leveling. Because adequate outlets for surface water are not readily available, they need to be considered first when planning a surface drainage system. Applications of fertilizer are needed for maximum crop production.

These soils are moderately well suited to improved pastures of kleingrass and Pensacola bahiagrass. Applications of fertilizer, weed control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

These soils are poorly suited to most urban and recreational uses because of the wetness, the ponding, and the very slow permeability. These limitations generally can be overcome by proper design and careful installation.

Areas of these soils provide habitat for deer, dove, turkey, quail, and squirrel. Mottled ducks nest in some areas. Migratory ducks inhabit ponded areas if food is available. Areas of these soils provide good cover and browse, mast, seeds, and tender grazing throughout the year.

The Morales soil is in capability subclass IIw, and the Cieno soil is in capability subclass IVw. The Morales soil is in the Sandy Loam range site, and the Cieno soil is in the Lowland range site.

NcA—Nada-Cieno complex, 0 to 1 percent slopes. These very deep, nearly level soils are on broad uplands. Areas are as much as 2,000 acres in size. The Nada soil makes up 70 to 79 percent of the unit. It commonly makes up about 74 percent. The Cieno soil makes up 14 to 22 percent of the unit. It commonly makes up about 17 percent. Other soils make up about 10 percent of the unit. The Nada and Cieno soils occur as areas so intricately mixed that mapping them separately is not practical at the scale used.

The Nada soil is on plane or slightly convex, nearly level uplands. The Cieno soil is in oval or oblong depressions that are 5 to 20 inches below the adjacent soils. These depressions are less than 1 acre to about 15 acres in size.

Typically, the surface layer of the Nada soil is neutral, dark grayish brown sandy loam about 7 inches thick. The upper part of the subsoil, from a depth of 7 to 28 inches, is neutral, dark gray sandy clay loam that has brownish mottles. The next part, from a depth of 28 to 43 inches, is neutral, dark grayish brown sandy clay loam that has brownish mottles. The lower part, from a depth of 43 to 80 inches, is slightly alkaline to moderately alkaline, gray and light brownish gray, sandy clay loam that has brownish mottles.

The Nada soil is moderately well drained. Permeability is very slow, and the available water capacity is moderate. Surface runoff is slow. The hazard of water erosion is slight. The root zone is deep, but the blocky structure of the subsoil impedes the movement of air and water and the penetration of roots. At times, the soil is seasonally wet, and at other times, it is droughty. A perched water table is in the surface layer and the upper part of the subsoil for 1 to 2 weeks following extended periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter and spring.

Typically, the surface layer of the Cieno soil is neutral, dark gray sandy clay loam that has brownish mottles. It is about 10 inches thick. The upper part of the subsoil, from a depth of 10 to 39 inches, is neutral, dark gray sandy clay loam that has brownish mottles. The lower part, from a depth of 39 to 80 inches, is moderately alkaline, light brownish gray sandy clay loam and clay loam that has yellowish mottles.

The Cieno soil is poorly drained. Permeability is very slow, and the available water capacity is high. In unleveled areas the soil receives runoff from surrounding soils and is ponded with water that is 1 to 2 feet deep for a period ranging from several weeks to 4 or 5 months during rainy seasons. The hazard of water erosion is slight. The root zone is deep. At times, the soil is seasonally wet, and at other times, it is droughty. A perched water table is in the surface layer and the upper part of the subsoil for a period ranging from a few weeks to 4 or 5 months, mainly in winter and spring.

Included with these soils in mapping are small areas of Fordtran, Morales, and Telferner soils and a few scattered areas of mounds that are 40 to 100 feet wide and 12 to 24 inches high. The soils in areas of these mounds are similar to the Nada soil but have a surface layer that is 18 to 30 inches thick. Morales soils are in landscape positions similar to those of the Nada soil. Fordtran and Telferner soils are in the slightly higher landscape positions. Included soils make up less than 10 percent of the map unit.

The Nada and Cieno soils are used as cropland, range, or pasture. The characteristic native vegetation is open grassland. The vegetation is dominated by mid and tall grasses in areas of the Nada soil and by water-tolerant grasses and sedges in areas of the Cieno soil.

These soils are well suited to crops, mainly rice. A crust can form on the surface of these soils. Plowpans are common in cultivated areas. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake. Land leveling and installing levees are needed before rice can be irrigated (fig. 10). After periods of heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, and other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface drainage system in areas where adequate outlets are available, and land leveling. Because adequate outlets for surface water are not readily available, they need to be considered first when planning a surface drainage system. Applications of fertilizer are needed for maximum crop production.

These soils are moderately well suited to improved pastures of bermudagrass and Gordo bluestem. Applications of fertilizer, weed control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

These soils are poorly suited to most urban and recreational uses. The main limitations are the wetness, the ponding, and the very slow permeability. These limitations generally can be overcome by proper design and careful installation.

These soils support habitat for dove and quail during dry periods, mainly in summer and fall. Mottled ducks

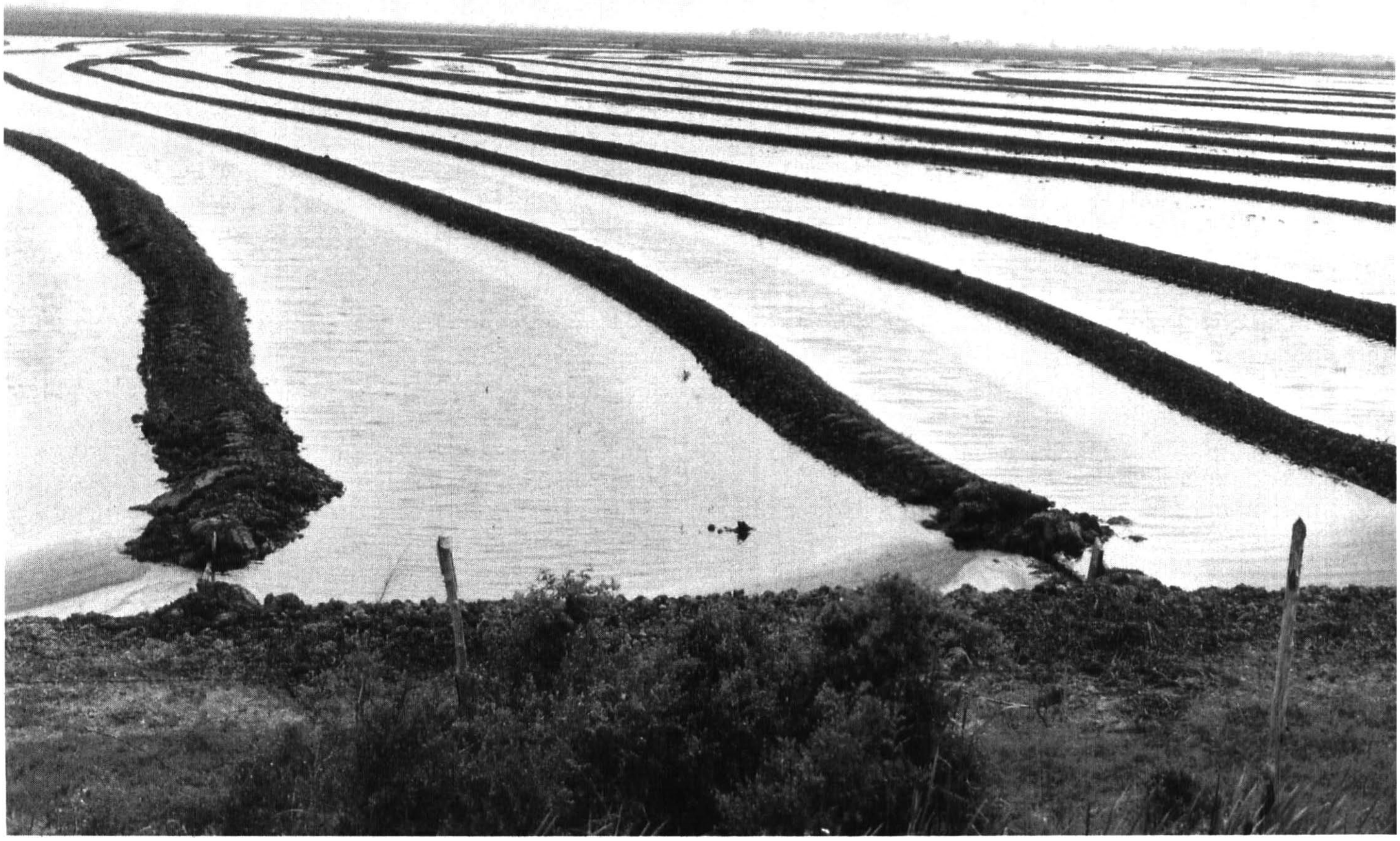


Figure 10.—A rice field that has been leveled and temporarily flooded in an area of Nada-Cieno complex, 0 to 1 percent slopes.

inhabit some areas, primarily for nesting cover. Migratory ducks inhabit ponded areas if food is available. The Attwater prairie chicken inhabits a few well managed areas of range.

The Nada soil is in capability subclass IIw, and the Cieno soil is in capability subclass IVw. The Nada soil is in the Claypan Prairie range site, and the Cieno soil is in the Lowland range site.

Nv—Navidad fine sandy loam, frequently flooded. This very deep, nearly level to gently sloping soil is on flood plains along rivers. Slope ranges from 0 to 2 percent but is mainly less than 1 percent. Areas are oblong and narrow and range from 100 to 300 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 33 inches thick. The underlying material extends to a depth of 80 inches. From a depth of 33 to 43 inches, it is dark grayish brown loamy fine sand; from a depth of 43 to 59 inches, it is grayish brown fine sand; from a depth of 59 to 70 inches, it is dark grayish brown sandy clay loam that has brownish mottles; and from a depth of 70 to 80 inches, it is dark brown sandy clay loam. The soil is moderately alkaline and calcareous throughout.

This soil is well drained. Permeability is moderately rapid, and the available water capacity is moderate. Surface runoff is very slow. The hazard of water erosion is slight except in areas subject to caving of streambanks. The root zone is deep. Flooding occurs after periods of heavy rainfall, mainly in spring and fall. It occurs about 6 times every 10 years.

Included with this soil in mapping are small areas of Chicolete, Ganado, and Zalco soils. Ganado soils are in the lower landscape positions. Chicolete and Zalco soils are in landscape positions similar to those of the Navidad soil. Included soils make up less than 15 percent of the map unit.

The Navidad soil is used as pasture or range. The characteristic native plant community consists of a wide variety of grasses, trees, and shrubs.

The frequent flooding can slightly reduce yields in areas of on improved pasture and range. It is a severe limitation affecting crops. The soil is moderately well suited to improved varieties of bermudagrass, bluestem, bahiagrass, and kleingrass. Applications of fertilizer, a controlled grazing system, proper stocking rates, and brush control help to maintain high productivity.

The frequent flooding is a severe limitation affecting urban and recreational uses.

Areas of this soil provide habitat for ducks and for deer, squirrel, swamp rabbit, and other furbearing animals. Nesting areas for quail, dove, and songbirds are plentiful.

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

PaA—Palacios loam, 0 to 1 percent slopes. This very deep, nearly level soil is on broad coastal uplands that are less than 15 feet above sea level. Areas are irregular in shape and range from 50 to 300 acres in size.

Typically, the surface layer is neutral, very dark grayish brown loam about 7 inches thick. The subsoil extends to a depth of 80 inches. From a depth of 7 to 14 inches, it is moderately sodic, very slightly saline, neutral, very dark gray clay; from a depth of 14 to 27 inches, it is dark gray clay that has brownish mottles; from a depth of 27 to 40 inches, it is light gray clay that has brownish mottles; from a depth of 40 to 70 inches, it is light brownish gray silty clay loam that has brownish mottles; and from a depth of 70 to 80 inches, it is light brownish gray silty clay loam that has yellowish mottles. The soil is moderately sodic, moderately saline, and moderately alkaline below a depth of 14 inches.

This soil is poorly drained. Permeability is very slow, and the available water capacity is moderate. The root zone is deep, but the content of clay impedes the movement of air and water and the penetration of roots. Surface runoff is slow. The hazard of water erosion is slight. A perched water table is in the surface layer and the upper part of the subsoil for 1 to 5 weeks following extended periods of heavy rainfall or during periods of above normal annual rainfall, mainly in winter and spring. A few areas are subject to rare flooding by very high storm surges. Flooding occurs about once in 10 years, mainly in summer and fall.

Included with this soil in mapping are areas of Dacosta, Francitas, and Telferner soils. Dacosta and Telferner soils are in the higher positions on the landscape. Francitas soils are in landscape positions similar to those of the Palacios soil. Included soils make up less than 15 percent of the map unit.

The Palacios soil is used as range, cropland, or pasture. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is moderately well suited to crops, mainly rice. The sodicity, which can result in droughtiness, is a limitation affecting the production of crops. Maintaining favorable soil structure and tilth is difficult. The soil can be cultivated only within a narrow range in moisture content. A crust can form on the surface of this soil. Plowpans are common in cultivated areas. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake. After periods of heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, and other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface drainage system in areas where adequate outlets are available, and land leveling. Applications of fertilizer are needed to increase yields. Adding amendments that contain sulfur, such as gypsum, and leaching can help to overcome the sodicity.

The soil is moderately well suited to improved pastures of Angleton bluestem, bermudagrass, and Gordo bluestem. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The main limitations are the high shrink-swell potential, wetness, and the clayey texture. The high corrosivity to uncoated steel is a limitation affecting the installation of public utilities. Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for dove and quail. Mottled ducks nest in some areas of range, generally near water.

This soil is in capability subclass IVw and the Salty Prairie range site.

Pd—Placedo clay, tide flooded. This very deep, nearly level soil is in narrow areas on flood plains along rivers. It is at or near sea level. Partially filled old stream channels and scour channels are in most areas. Areas are irregular in shape and range from 50 to 400 acres in size.

Typically, the upper part of the surface layer is dark olive gray mucky peat about 3 inches thick. The next part, from a depth of 3 to 21 inches is dark gray clay. The lower part, from a depth of 21 to 38 inches, is also dark gray clay. The upper part of the underlying material, from a depth of 38 to 55 inches, is dark gray clay that has reddish mottles. The lower part, from a depth of 55 to 80 inches, is dark gray fine sandy loam that has grayish and greenish mottles. The soil is moderately saline or strongly saline and moderately alkaline throughout.

This soil is very poorly drained. Permeability is very slow, and the available water capacity is low. Surface runoff is very slow, or the soil is ponded. The hazard of water erosion is slight except in areas subject to the caving of streambanks. The root zone is deep. The soil is frequently flooded by high tides from nearby coastal bays. This flooding occurs for periods ranging from several times a month to about once every 2 months. The frequency of flooding is influenced by elevation and the distance to coastal bays. Overflow from rivers causes flooding 2 to 4 times a year for 2 to 21 days. In most years the soil is saturated for long periods and is seldom dry below a depth of 12 inches. The water table is generally within a depth of 12 inches.

Included with this soil in mapping are areas of Swan and Aransas soils. Aransas soils are in the slightly higher landscape positions. Swan soils are in landscape positions similar to those of the Placedo soil. Included soils make up less than 10 percent of the map unit.

The Placedo soil is used as range and wildlife habitat. The characteristic native vegetation is salt- and water-tolerant grasses, sedges, and weeds.

The suitability of this soil for improved pasture, crops, and urban and recreational uses is severely limited by the frequent flooding, the salinity, the wetness, the high shrink-swell potential, the very slow permeability, the clayey texture, and corrosivity to uncoated steel.

Areas of this soil provide habitat for a large variety and number of game birds; marine animals, including the alligator; and other animals. Nesting areas for mottled ducks, tree ducks, and wood ducks are plentiful. Migratory ducks, geese, rails, coots, and cranes are common in fall and winter.

This soil is in capability subclass VIIw and the Salt Marsh range site.

RuC—Rupley sand, 1 to 5 percent slopes. This very deep, gently sloping soil is on hummocky uplands near the major tributaries of large rivers. Areas are round or oblong and range from 40 to 200 acres in size.

Typically, the surface layer is slightly acid, very pale brown sand about 6 inches thick. The upper part of the underlying material, from a depth of 6 to 48 inches, is slightly acid, very pale brown sand. The lower part, from a depth of 48 to 80 inches, is neutral, very pale brown sand that has brownish mottles.

This soil is somewhat excessively drained. Permeability is rapid, and the available water capacity is low. Surface runoff is very slow. The hazard of water erosion is slight. The root zone is deep. An apparent water table is generally at a depth of 5 to 6 feet during fall, winter, and spring.

Included with this soil in mapping are small areas of Kuy, Milby, and Morales soils. Kuy and Milby soils are in landscape positions similar to those of the Rupley soil. Morales soils are in the lower landscape positions. Included soils make up less than 20 percent of the map unit.

The Rupley soil is used as range and pasture. The characteristic native vegetation is a savanna of live oak and post oak that has an understory of brushy vegetation and mid and tall grasses.

This soil is poorly suited to improved pastures of lovegrass and Pensacola bahiagrass. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is well suited to most urban uses and is poorly suited to recreational uses. The main limitation affecting recreational uses is the sandy surface layer. This limitation can be overcome by proper design and careful installation.

Areas of this soil provide habitat for deer, dove, quail, and squirrel. These areas provide good cover and browse, mast, forbs, and seeds throughout the year.

This soil is in capability subclass VIs and the Deep Sand range site.

Sw—Swan clay, tide flooded. This very deep, nearly level soil is on broad flood plains and narrow areas along bays. Partially filled old stream channels and scour channels are in some areas. Areas are irregular in shape and range from 100 to more than 1,000 acres in size.

Typically, the upper part of the surface layer is dark olive gray mucky peat about 3 inches thick. The lower part is very dark gray clay about 12 inches thick. The underlying material extends to a depth of 80 inches. From a depth of 15 to 30 inches, it is dark gray sandy clay loam; from a depth of 30 to 48 inches, it is gray sandy loam that has dark gray and very dark gray mottles; from a depth of 48 to 63 inches, it is light brownish gray loamy sand that has gray, olive, and grayish green mottles; and from a depth of 63 to 80 inches, it is olive gray loamy sand that has gray mottles. The soil is moderately saline or strongly saline and moderately alkaline throughout.

This soil is very poorly drained. Permeability is very slow in the surface layer and moderately slow to rapid in the underlying material. The available water capacity is very low. Surface runoff is very slow, or the soil is ponded. The hazard of water erosion is slight except in areas subject to caving of streambanks. The root zone is deep. The soil is frequently flooded by high tides from nearby coastal bays. This flooding occurs for periods ranging from several times a month to about once every 2 months. The frequency of flooding is influenced by elevation and the distance to coastal bays. Overflow from rivers causes flooding 2 to 4 times a year for 2 to 21 days. In most years the soil is saturated for long periods and is seldom dry below a depth of 12 inches. The water table is generally within a depth of 12 inches.

Included with this soil in mapping are small areas of Aransas, Navidad, and Placedo soils. Aransas and Navidad soils are in the slightly higher landscape positions. Placedo soils are in landscape positions similar to those of the Swan soil. Included soils make up less than 10 percent of the map unit.

The Swan soil is used as range and wildlife habitat. The characteristic native vegetation consist of salt- and water-tolerant grasses, such as marshhay cordgrass (fig. 11), sedges, and reeds.

The suitability of this soil for improved pasture, crops, and urban and recreational uses is severely limited by the frequent flooding, the salinity, the wetness, the very slow permeability, the clayey texture, and the corrosivity to uncoated steel.

Areas of this soil provide habitat for a large variety of wetland wildlife, including the alligator. Nesting areas for mottled ducks, tree ducks, and wood ducks are plentiful. Thousands of migratory ducks, geese, rails, coots, and cranes inhabit areas of this soil in fall and winter.

This soil is in capability subclass VIIw and the Salt Marsh range site.

TfA—Telferner fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level soil is on broad uplands. Areas are irregular in shape and range from 80 to 200 acres in size.

Typically, the surface layer is slightly acid, dark grayish brown fine sandy loam that has brownish mottles. It is about 14 inches thick. The subsurface layer, from a depth of 14 to 18 inches, is slightly acid, grayish brown fine sandy loam that has brownish mottles. The subsoil extends to a depth of 74 inches. From a depth of 18 to 33 inches, it is moderately acid, very dark gray clay that has reddish mottles; from a depth of 33 to 41 inches, it is moderately alkaline, dark gray clay that has brownish mottles; from a depth of 41 to 55 inches, it is moderately alkaline, dark grayish brown sandy clay that has brownish mottles; and from a depth of 55 to 74 inches, it is moderately alkaline, brown sandy clay loam. The underlying material, from a depth of 74 to 80 inches, is moderately alkaline, very pale brown loamy sand.

This soil is moderately well drained. Permeability is very slow, and the available water capacity is moderate. Surface runoff is very slow. The hazard of water erosion is slight. The root zone is deep, but the blocky structure of the subsoil impedes the movement of air and water and the penetration of roots. A perched water table is in the lower part of the surface layer and the upper part of the subsoil for 1 to 2 weeks following extended periods of heavy rainfall, mainly in winter and spring but sometimes in fall.

Included with this soil in mapping are small areas of Cieno, Dacosta, Edna, Fordtran, and Texana soils. Dacosta and Edna soils are in the lower landscape positions. Texana soils are in landscape positions similar to those of the Telferner soil. Fordtran soils are in the slightly higher landscape positions. Cieno soils are in small depressions. Included soils make up less than 20 percent of the map unit.

The Telferner soil is used as range, pasture, or cropland. The characteristic native vegetation is open grassland dominated by mid and tall grasses.

This soil is moderately well suited to crops. Rice is the main crop. Grain sorghum and corn also are grown. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, and using proper crop rotations. Growing cover crops and soil-improving crops and incorporating crop residue into the soil help to control erosion and maintain productivity and tilth. After periods of heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, and other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope,

Figure 11.—Marshhay cordgrass in an area of Swan clay, frequently flooded. Grazing is limited because of daily flooding by tides.

installing a surface drainage system in areas where adequate outlets are available, and land leveling. Applications of fertilizer are needed for maximum crop production.

This soil is well suited to improved pastures of kleingrass and Pensacola bahiagrass. Applications of fertilizer, weed control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

This soil is poorly suited to most urban and recreational uses. The main limitations are the high shrink-swell potential and the very slow permeability.

Most of these limitations can be overcome by proper design and careful installation.

Areas of this soil provide habitat for dove and quail. The Attwater prairie chicken inhabits a few well managed areas of range. Mottled ducks inhabit some areas, primarily for nesting cover.

This soil is in capability subclass IIw and the Loamy Prairie range site.

TxA—Texana-Cieno complex, 0 to 1 percent slopes. These very deep, nearly level soils are on upland meander-belt ridges that have depressions. Areas are elongated and are as much as 10,000 acres in size. This unit consists of about 65 percent Texana soil, 25 percent Cieno soil, and 10 percent other soils. The Texana and Cieno soils occur as areas so intricately mixed that mapping them separately was not practical at the scale used.

The Texana soil is on plane or slightly convex meander-belt ridges. The Cieno soil is in oval or oblong depressions that are 5 to 20 inches below the adjacent soils. These depressions are less than 1 acre to about 90 acres in size.

Typically, the surface layer of the Texana soil is slightly acid, very dark grayish brown fine sandy loam about 10 inches thick. The subsurface layer, from a depth of 10 to 14 inches, is slightly acid, grayish brown fine sandy loam. The subsoil extends to a depth of 80 inches. From a depth of 14 to 17 inches, it is slightly acid clay mottled in shades of brown, gray, and yellow; from a depth of 17 to 33 inches, it is moderately alkaline clay mottled in shades of brown, gray, and yellow; from a depth of 33 to 69 inches, it is moderately alkaline clay loam or sandy clay loam mottled in shades of brown, gray, yellow, and red; and from a depth of 69 to 80 inches, it is neutral, yellowish brown fine sandy loam that has strong brown mottles.

The Texana soil is moderately well drained. Permeability is very slow, and the available water capacity is high. The soil has good tilth. It can be worked within a wide range in moisture content. Surface runoff is slow. The hazard of water erosion is slight. The root zone is deep, but the blocky structure of the subsoil impedes the movement of air and water and the penetration of roots. A perched water table is in the lower part of the surface layer and the upper part of the subsoil for a few days to 1 to 2 weeks following extended periods of heavy rainfall or during periods of above normal annual rainfall.

Typically, the surface layer of the Cieno soil is dark grayish brown sandy clay loam that has brownish mottles. It is about 8 inches thick. The upper part of the subsoil, from a depth of 8 to 25 inches, is dark grayish brown sandy clay loam that has brownish mottles. The next part, from a depth of 25 to 58 inches, is gray and light brownish gray sandy clay loam that has brownish mottles. The lower part, from a depth of 58 to 80 inches, is sandy clay loam mottled in shades of brown, yellow, and gray. The soil is neutral in the upper part and moderately alkaline in the lower part.

The Cieno soil is poorly drained. Permeability is very slow, and the available water capacity is high. In unleveled areas the soil receives runoff from surrounding soils and is ponded with water that is 1 to 2 feet deep for a period ranging from several weeks to more than 4 or 5 months during rainy seasons, mainly in winter and spring. The hazard of water erosion is slight. The root zone is deep. At times, the soil is seasonally wet, and at other times, it is droughty. A perched water table is in the surface layer and the upper part of the subsoil for a period ranging from a few weeks to 4 or 5 months, mainly in winter and spring.

Included with these soils in mapping are areas of Dacosta, Edna, Fordtran, and Telferner soils. Dacosta and Edna soils are in the lower landscape positions. Fordtran soils are in the slightly higher landscape positions. Telferner soils are in landscape positions similar to those of the Texana soils. Also included in some places in the southern part of the county are areas of Livco soils that have saline and sodic subsoils. Included soils make up less than 10 percent of the map unit.

The Texana and Cieno soils are used as cropland or range. The characteristic native vegetation is open grassland. The vegetation is dominated by mid and tall grasses in areas of the Texana soils and by water-tolerant grasses and sedges in areas of the Cieno soils.

These soils are moderately well suited to crops. Rice, grain sorghum, and corn are the principal crops. Good management practices include leaving crop residue on the surface, applying a system of timely and limited tillage, preparing a proper seedbed, and using proper crop rotations. Incorporating crop residue into the soil helps to maintain favorable soil structure and tilth and increases the rate of water intake. Land leveling and installing levees is needed before rice can be irrigated (fig. 12). After periods of heavy rainfall or during periods of above normal annual rainfall, planting, harvesting, and other practices may be delayed for several days to a few weeks because of the wetness. A well designed system of surface water management includes planting rows in the proper direction to take advantage of the natural slope, installing a surface drainage system in areas where adequate outlets are available, and land leveling. Because adequate outlets for surface water are not readily available, they need to be considered

Figure 12.—Levees used to distribute water for temporary flooding of a rice field in an area of Texana-Cieno complex, 0 to 1 percent slopes.

first when planning a surface drainage system. Applications of fertilizer are needed for maximum crop production.

These soils are well suited to improved pastures of kleingrass and Pensacola bahiagrass. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

These soils are poorly suited to most urban and recreational uses. The main limitations are the high shrink-swell potential, the wetness, the ponding, and the very slow permeability. The high shrink-swell potential is a limitation on sites for building foundations, streets, and roads. The very slow permeability and wetness are limitations on sites for septic tank absorption fields. Ponding is a limitation affecting recreational uses. Most of these limitations can be overcome by proper design and careful installation.

These soils support habitat for dove and quail. The Attwater prairie chicken inhabits a few well managed areas of range. Mottled ducks inhabit some areas, primarily for nesting cover. Migratory ducks inhabit ponded areas if food is available.

The Texana soil is in capability subclass IIw, and the Cieno soil is in capability subclass IVw. The Texana soil is in the Loamy Prairie range site, and the Cieno soil is in the Lowland range site.

Za—Zalco fine sand, frequently flooded. This very deep, nearly level soil in on flood plains along the major streams. The landscape in most areas has numerous low ridges and shallow scour channels. Areas are narrow and oblong or crescent-shaped and range from 40 to 200 acres in size. Slope is 0 to 1 percent.

Typically, this soil is moderately alkaline, calcareous, stratified sandy and loamy material throughout. The surface layer is brown fine sand about 5 inches thick. The upper part of the underlying material, from a depth of 5 to 20 inches, is pale brown fine sand. The next part, from a depth of 20 to 32 inches, is very pale brown fine sand. The lower part, to a depth of 60 inches, is very pale brown sand.

This soil is somewhat excessively drained. Permeability is rapid, and the available water capacity is low. Surface runoff is very slow. The hazard of water erosion is slight except in areas that are subject to caving of streambanks. The root zone is deep. Flooding occurs after periods of heavy rainfall, mainly in spring and fall. It occurs about 6 times every 10 years.

Included with this soil in mapping are areas of Chicolete and Navidad soils. These soils are in slightly lower landscape positions. Included soils make up less than 10 percent of the map unit.

The Zalco soil is used as range or pasture. The characteristic native vegetation is dominantly mid and tall grasses interspersed with a few hackberry, cottonwood, and live oak trees in some areas.

The frequent flooding can slightly reduce yields in areas of improved pasture and range. It is a severe limitation affecting crops. The soil is moderately well suited to improved pastures of lovegrass and Pensacola bahiagrass. Applications of fertilizer, weed and brush control, a controlled grazing system, and proper stocking rates help to improve and maintain productivity.

The frequent flooding is a severe limitation affecting urban and recreational uses.

Areas of this soil provide habitat for dove and for deer, squirrel, and other furbearing animals. Nesting areas for dove and songbirds are plentiful.

This soil is in capability subclass Vw and the Sandy Bottomland range site.

Prime Farmland

In this section, prime farmland is defined and discussed, and the soils in Jackson County that are considered prime farmland are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, State, and Federal levels, as well as individuals, must encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to food, feed, forage, fiber, and oilseed crops. Such soils have properties that favor the economic production of sustained high yields of crops. The soils need only to be treated and managed by acceptable farming methods. The moisture supply must be adequate, and the growing season must be sufficiently long. Prime farmland soils produce the highest yields with minimal expenditure of energy and economic resources. Farming these soils results in the least damage to the environment.

Prime farmland soils may presently be used as cropland, pasture, or woodland or for other purposes. They are used for food or fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water-control structures. Public land is land not available for farming in National forests, National parks, military reservations, and State parks.

Prime farmland soils usually receive an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not frequently flooded during the growing season. The slope ranges mainly from 0 to 3 percent.

About 255,750 acres, or nearly 48 percent of the land area in Jackson County, meets the requirements for prime farmland. Areas are scattered throughout the county. Approximately 240,500 acres of prime farmland is used for cultivated crops, mainly grain sorghum, corn, and rice.

A recent trend in land use in some parts of the county is the loss of some prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on marginal land, that generally is more erodible, droughty, and difficult to cultivate and less productive.

The following map units are considered prime farmland in Jackson County. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Some soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated in parentheses after the map unit name in the following list. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

The soils identified as prime farmland in Jackson County are:

DaA	Dacosta sandy clay loam, 0 to 1 percent slopes
DaB	Dacosta sandy clay loam, 1 to 3 percent slopes
LaA	Laewest clay, 0 to 1 percent slopes
LaB	Laewest clay, 1 to 3 percent slopes
TxA	Texana-Cieno complex, 0 to 1 percent slopes (where drained)

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 to prevent 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 behavioral 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 for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational 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 that is in harmony with nature.

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

Lester C. Hahn, district conservationist, Natural Resources Conservation Service, Edna, Texas, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified and the system of land capability classification used by the Natural Resources Conservation Service is explained. 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 the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Crops

In 1982, more than 287,000 acres in the county was used as cropland *(27)*. Of this total, about 141,000 acres was used for row crops, mainly grain sorghum and corn; about 26,000 acres was used for irrigated rice; about 3,000 acres was used for close-growing crops, mainly gulf ryegrass, wheat, and oats; 35,000 acres was used as pasture or hayland; and the rest of the acreage was temporarily idle cropland or summer fallow.

Land use is constantly changing in Jackson County. Rangeland is being converted to cropland, and some cropland is being converted to pasture. The total acreage of rangeland, pasture, and cropland has gradually been decreasing as more land is used as urban or built-up areas, small ranches, and rural subdivisions.

The potential of the soils in the county for the increased production of food is high. Many areas that have good to fair potential as cropland are currently used as rangeland, pasture, or hayland. The production of food could be increased if the latest technology for crop production was applied to all cropland in the county.

Surface drainage is the major concern on about 95 percent of the cropland in the county. The surface runoff rate is low to medium on most soils. Shallow surface field drains and large drainage outlets are needed to remove excess water during extended periods of heavy rainfall or during periods of above normal yearly rainfall in areas of the nearly level, poorly drained Cieno soils and the nearly level, somewhat poorly drained Edna and Francitas soils.

Soil erosion is a major concern on only about 1 percent of the cropland, pasture, and hayland in the county. Erosion is a potential hazard in areas where the slope is more than 1 percent. Dacosta, Laewest, and Marcado soils have slopes of 1 to 8 percent.

Loss of the surface layer because of erosion decreases productivity. Productivity is reduced as erosion removes the surface layer and part of the subsoil is incorporated into the plow layer. This loss of the surface layer is especially damaging to soils that have a clayey subsoil, such as Marcado soils. Erosion also reduces productivity on soils that tend to be droughty. Erosion also results in sediments entering streams. Controlling erosion minimizes the pollution of streams by sediments and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Erosion-control practices provide a protective surface cover, help to control runoff, and increase the rate of water infiltration. Most sloping areas are permanently vegetated with improved pasture grasses or native range.

In the sloping areas of cropland, a cropping system that keeps a plant cover on the soil for extended periods can hold soil losses to amounts that will not reduce the productive capacity of the soil. Field terraces and diversion terraces reduce the length of slope, reduce the runoff rate, and help to control erosion. They are most practical in areas of deep soils that have smooth slopes. Most deep, sloping soils in Jackson County are suitable for terraces and diversions. Contour farming is used on all the terraced land in the county.

Small areas have slopes that are so short and irregular that contour farming or terracing is not practical. In these areas, cropping systems that provide a substantial plant cover are needed for erosion control unless minimum tillage is used. Minimizing tillage and leaving crop residue on the surface increase the infiltration rate and help to control runoff and erosion. These practices can be used on most soils in the county but are more difficult to use successfully on the eroded soils.

Natural fertility is high in most of the soils that formed on flood plains. The soils on flood plains, except for the sandy Zalco soils, have a naturally higher content of plant nutrients than most of the soils on uplands.

The soils on uplands that formed under prairie vegetation have a moderately high to high content of plant nutrients. These soils have a loamy to clayey surface layer that ranges from moderately acid to moderately alkaline. The lower horizons range from neutral to moderately alkaline. The clayey soils generally have medium to high levels of phosphorus and potash. The loamy soils commonly have low to medium levels of phosphorus and potash. Lime is seldom needed.

Applications of nitrogen and phosphorus are needed in most areas of cropland and in all areas of improved pasture grasses. Frequent applications may be needed for very high yields of pasture and hay. The amount of lime and fertilizer added should be based on the results of soil tests, on the needs of the crops, and on the expected yields. The Cooperative Extension Service can help determine the kind and amount of fertilizer and lime to apply.

Tilth is important for good seed germination and water infiltration. Soils that have good tilth are granular and porous.

Tilth is a problem in areas of the dark, clayey Laewest soils because the soil often stays wet until late in spring. If these soils are plowed when wet, they tend to be very cloddy when dry and a good seedbed is difficult to prepare. Tilth is also a problem in areas of the dark, loamy Dacosta soils. These soils are hard when dry and tend to form a thick surface crust. The crust is hard and nearly impervious to water when dry. Surface crusting reduces the infiltration rate and increases the rate of runoff. Regularly adding crop residue, manure, and other organic material can help improve soil structure and minimize crusting. Plowing in the fall plowing generally results in good tilth in the spring.

The Edna, Telferner, Morales, and Nada soils have a loamy surface layer that is light in color and has a low content of organic matter. Generally, these soils have a weak structure. Intense rainfall can result in crusting. These soils often form a crust during the winter if they become dry. Many of these soils may be nearly as dense and hard after fall plowing as they were before plowing. Regularly adding crop residue, manure, and other organic material can help improve soil structure and minimize crusting. In areas where winters are very wet, plowing in the fall is necessary to have a prepared seedbed.

The field crops suited to the soils and climate of the county include many that are not now commonly grown. Grain sorghum and corn are the main row crops. Cotton, sunflowers, and soybeans can also be grown.

About 47,000 acres in Jackson County is planted to rice; however, an additional 150,000 acres is suited to this crop. Each year only about one-third of the acreage is planted to rice. The remaining acreage is grazed by livestock. When the rice is harvested, a mixture of gulf ryegrass and common bermudagrass is often seeded for livestock use. Residual fertilizer from the rice crop is used instead of additional fertilizer. Deep wells supply irrigation water. The number and strength of these wells determines how much rice is planted each year.

Gulf ryegrass, wheat, and oats are common close-growing crops.

Specialty crops grown commercially in the survey area include vegetables, tree fruits, and nursery plants. A small acreage is used for cucumbers, turnips, sweet corn, tomatoes, peas, beans, and other vegetables and for small fruits. Large areas are suited to other specialty crops, such as peaches, plums, and many vegetables.

About 5 percent of the acreage in the county is used as pasture or hayland. Areas of improved pasture include perennial warm-season species, such as bermudagrass, Gordo bluestem, and kleingrass. Pensacola bahiagrass, lovegrass, and King Ranch bluestem and cool-season legumes, such as Hubam clover, arrowleaf clover, and burclover, are grown in small areas. The legumes are generally planted in pure stands or with small grain. The most common species planted in areas of improved pasture are bermudagrass, which is suited to most soils in the county, and Gordo bluestem, which is suited to clays and clay loams.

The amount of forage produced in an area determines the amount of beef produced. A well-managed pasture supports one main grass species, is efficiently watered, and is free of weeds. Fertilizer should be applied according to the needs of the plant, the desired production, and the results of soil tests. Good management practices, such as mowing, shredding, or applying chemical herbicides, help to control most weeds. Pastures should be stocked according to the amount of forage available. Grazing heights should be managed for maximum productivity. A good cover of grasses can help control erosion, prevent winterkill, reduce compaction, and ensure rapid growth in the spring.

Areas of temporarily improved pasture are often used to supplement permanently improved areas of pasture. During the summer, sudangrass and sorghum-sudangrass hybrids are good species for supplemental improved pasture. Small grain provides good supplemental winter forage.

Bermudagrass and Gordo bluestem are the main species of hay in the county. A small acreage consists of mixed tall climax prairie grasses.

Good management in areas of hayland requires timely mowing to ensure high-quality plants, maximum production, and plant vigor. Hay should be cut to a height that is best for the plants. Mowing too low or too often damages the grasses. Mowing at the proper height helps to maintain plant vigor and leaves residue on the surface. This residue helps to control erosion and maintain the content of organic matter. Harvesting crops when the soil is wet can cause compaction, resulting in excessive runoff and poor growth of plants. Mowing, shredding, or applying herbicides can help control weeds.

If native hay is seriously damaged by drought, fire, or poor management practices, it should not be cut for a year or more so that the grasses can reestablish a strong root system and regain their vigor. Grasses that are damaged are subject to winterkill and invasion by weeds.

Well-managed, established native grasses generally can be kept vigorous without the use of fertilizer.

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. 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 land capability classification also is shown in the table.

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 ensures 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 Natural Resources 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 use as cropland. 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 criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include 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 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.

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 they 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 hazard is the risk of erosion unless a 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.

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

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in table 5.

Rangeland

James S. Alderson, range conservationist, Natural Resources Conservation Service, Victoria, Texas, helped prepare this section.

In areas of rangeland the native vegetation consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. This kind of vegetation is generally suitable for grazing and is found in sufficient amounts to justify grazing use. Rangeland receives no regular or frequent cultural treatment. The composition and production of the plant community is determined by the soils, climate, topography, overstory canopy, and grazing management.

About 41 percent of the county is rangeland. Most of the county was originally an open, treeless prairie. This prairie produced a wide variety of tall and mid grasses interspersed with abundant forbs. Tall grasses, forbs, post oak, blackjack oak, and live oak savannah were characteristic species in the northern part of the county.

The plant community in the county has changed drastically during the past 120 years. Because of heavy grazing, most of the grassland has deteriorated and much of the higher quality vegetation has been grazed out. A mixture of short to mid grasses, poor-quality forbs, and woody plants have replaced tall grasses. These grasses now flourish only in a few places. Remnants of the original plant community, however, still grow in most areas of protected grassland. In these areas, good grazing management can help reestablish the high-quality plants.

The areas used as rangeland in Jackson County range from small stock farms to a few large ranches. Most of the rangeland is used for cow-calf production. Areas of improved pasture and small grain often supplement forage production on small- to medium-sized ranches. About 75 percent of the total acreage used as range is in units of 640 acres or less. Supplemental feeding of protein concentrate and hay is needed in winter. Phosphorus and other minerals need to be fed to livestock throughout the year.

Approximately 70 percent of the annual growth occurs in April, May, and June, when rainfall and moderate temperatures are favorable. A second period of growth usually occurs in September and October during periods of autumn rainfall and gradually cooling temperatures.

Range management requires a knowledge of the kinds of soil and of the climax vegetation. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the climax vegetation on a particular range site. The more closely the existing community resembles the climax vegetation, the better the range condition.

A primary objective of good range management is keeping the range in excellent or good condition and thus conserving water, improving yields, and protecting the soil. The main management concern is recognizing important changes that occur in the kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Plant growth that occurs because of heavy rainfall can lead to the conclusion that the range is in good condition when the plant community actually has a large percentage of weeds and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods under careful supervision may have a degraded appearance that temporarily conceals its quality and ability to recover.

Range Sites and Condition Classes

A *range site* is a distinctive kind of rangeland that produces a characteristic vegetation that differs from the climax vegetation on other range sites in kind, amount, or proportion of range plants. Soils that produce about the same kinds and amounts of forage make up a range site. 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.

The climax vegetation on the range site is the stabilized plant community that reproduces itself and changes very little as long as the environment remains unchanged. Throughout the county the climax vegetation consists of the plants that grew in the area before settlement. The most productive combination of forage plants on a range site is generally the climax vegetation.

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

Increasers are plants in the climax vegetation that increase in relative amount as the more desirable decreasers are reduced by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders are plants that increase in abundance as the decreasers and increasers decline. They cannot compete with the climax vegetation for moisture, nutrients, and light. They have little value for grazing.

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 in relation to the native vegetation that could grow there. A range 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.

If range is subject to years of prolonged overuse, it loses the seed sources for desirable vegetation. Under these conditions, the vegetation must be reestablished before management can be effective. The condition of the range can be improved by controlling brush, range seeding, fencing, developing water sources, or applying other mechanical treatment to revitalize stands of native plants. Thereafter, deferred grazing, proper grazing use, and a planned grazing system can help to maintain or improve the range.

Good management results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs.

Table 6 shows, for each soil, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are suited to use as rangeland are listed.

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

Fourteen range sites have been identified in Jackson County. They are Blackland, Clayey Bottomland, Claypan Prairie, Deep Sand, Loamy Bottomland, Loamy Prairie, Lowland, Salt Marsh, Salty Bottomland, Salty Prairie, Sandy, Sandy Bottomland, Sandy Loam, and Sandy Prairie.

Blackland range site. The Dacosta, Laewest, and Marcado soils in map units DaA, DaB, LaA, LaB, LaD3, and MaC are in this site. The climax vegetation is a true prairie. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

Little bluestem and indiangrass make up about 70 percent of the climax vegetation. Other major grasses include switchgrass, eastern gamagrass, Virginia wildrye, Texas wintergrass, longtom, and meadow dropseed. Forbs include sensitive briar, Maximilian sunflower, bundleflower, and dotted gayfeather.

If regression occurs because of heavy grazing, little bluestem, indiangrass, switchgrass, and Maximilian sunflower are replaced by brownseed paspalum and meadow dropseed. If heavy grazing continues for many years, woody plants, such as huisache, baccharis, Macartney rose, and sennabean, and understory plants, such as bushybeard bluestem, broomsedge bluestem, vaseygrass, carpetgrass, smutgrass, buffalograss, and fogfruit, increase significantly in extent.

Clayey Bottomland range site. The Ganado and Chicolete soils in map units Ga and Ch are in this site. The climax vegetation is a tall grass savanna. The composition, by weight, is about 75 percent grasses, 20 percent woody plants, and 5 percent forbs.

Switchgrass, indiangrass, eastern gamagrass, little bluestem, big bluestem, and Florida paspalum make up about 55 percent of the climax vegetation. Other grasses include Virginia wildrye, beaked panicum, rustyseed paspalum, buffalograss, broadleaf uniola, knotroot bristlegrass, and low panicums. Woody plants include oak, elm, cottonwood, water elm, hackberry, black willow, pecan, hawthorn, and woody vines. Forbs include perennial legumes, tickclover, gayfeather, and spiny aster.

If regression occurs because of heavy grazing, switchgrass, indiangrass, eastern gamagrass, little bluestem, big bluestem, and Florida paspalum are replaced by Virginia wildrye, sedges, beaked panicum, and rustyseed paspalum. If heavy grazing continues for many years, woody plants, such as oak, elm, cottonwood, and water elm, form a dense stand. The understory plants include broomsedge bluestem, bushy bluestem, smutgrass, carpetgrass, bitter sneezeweed, baccharis, sennabean, palmetto, and spiny aster.

Claypan Prairie range site. The Edna and Nada soils in map units EdA and NcA are in this site. The climax vegetation is a true prairie. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

Little bluestem, switchgrass, and indiangrass make up about 60 percent of the climax vegetation. Other grasses include eastern gamagrass, Florida paspalum, big bluestem, brownseed paspalum, low panicums, low paspalums, longtom, knotroot bristlegrass, and sedges. Forbs include bundleflower, sensitive briar, button snakeroot, yellow neptunia, croton, and ragweed.

If regression occurs because of heavy grazing, little bluestem, switchgrass, indiangrass, big bluestem, eastern gamagrass, and Florida paspalum are replaced by brownseed paspalum, low paspalums, low panicums, knotroot bristlegrass, and sedges. If heavy grazing continues for many years, smutgrass, carpetgrass, common bermudagrass, bushybeard bluestem, broomsedge bluestem, vaseygrass, and spiny aster and woody species, such as Macartney rose, sennabean, huisache, and baccharis, increase significantly in extent.

Deep Sand range site. The Kuy and Rupley soils in map units KuC and RuC are in this site. The climax vegetation is a tall grass, post oak, and live oak savanna that has a canopy of about 20 percent. The composition, by weight, is about 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

Little bluestem and indiangrass make up about 60 percent of the climax vegetation. Other grasses include switchgrass, crinkleawn, purpletop, southwestern bristlegrass, brownseed paspalum, and Pan American balsamscale. Woody plants include post oak and live oak. Forbs include snoutbean, wildbean, and tickclover.

If regression occurs because of heavy grazing, little bluestem and indiangrass are replaced by purpletop, southwestern bristlegrass, and brownseed paspalum. If heavy grazing continues for many years, red lovegrass, yankeeweed, bullnettle, and Pan American balsamscale increase significantly in extent. Oak, yaupon, hawthorns, greenbriar, American beautyberry, wax-myrtle, and berry vines may form dense thickets.

Loamy Bottomland range site. The Navidad soils in map unit Nv are in this site. The climax vegetation is a tall grass savanna. The composition, by weight, is about 75 percent grasses, 20 percent woody plants, and 5 percent forbs.

Eastern gamagrass, indiangrass, switchgrass, rustyseed paspalum, Virginia wildrye, beaked panicum, and sedges make up about 65 percent of the climax vegetation. Other grasses include little bluestem, big bluestem, broadleaf uniola, longtom, and knotroot bristlegrass. Woody plants include pecan, hackberry, oak, elm, and cottonwood. Forbs include snoutbean, lespedeza, wildbean, and tickclover.

If regression occurs because of heavy grazing, eastern gamagrass, indiangrass, switchgrass, and big bluestem are replaced by little bluestem, snoutbean, wildbean, and Virginia wildrye. If heavy grazing continues for many years, woody plants, such as oaks, pecans, and hackberry, form a dense stand. The understory plants include common bermudagrass, rustyseed paspalum, sedges, low panicums, low paspalums, blood ragweed, cocklebur, white crownbeard, sumpweed, and spiny aster.

Loamy Prairie range site. The Telferner and Texana soils in map units TfA and TxA are in this site. The climax vegetation is a true prairie. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

Little bluestem makes up about 60 percent of the climax vegetation. Other grasses include indiangrass, switchgrass, Florida paspalum, big bluestem, brownseed paspalum, Pan American balsamscale, fringeleaf paspalum, longtom, sedges, low panicums, and knotroot bristlegrass. Forbs include bundleflower, sensitive briar, and yellow neptunia.

If regression occurs because of heavy grazing, little bluestem and Florida paspalum are replaced by brownseed paspalum, slender bluestem, low panicums, knotroot bristlegrass, common bermudagrass, sedges, and longspike tridens. If heavy grazing continues for many years, smutgrass, carpetgrass, Pan American balsamscale, broomsedge bluestem, and common bahiagrass and woody plants, such as Macartney rose, running live oak, huisache, and sennabean, increase significantly in extent.

Lowland range site. The Cieno soil in map units NcA, MrA, and TxA are in this site. The climax vegetation is a wet prairie. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

Switchgrass, indiangrass, Florida paspalum, little bluestem, big bluestem, and eastern gamagrass make up about 80 percent of the climax vegetation. Other grasses include brownseed paspalum, knotroot bristlegrass, longtom, sedges, low panicums, low paspalums, broomsedge, and bushybeard bluestem. Forbs include sensitive briar, bundleflower, and button snakeroot.

If regression occurs because of heavy grazing, switchgrass, indiangrass, eastern gamagrass, little bluestem, and big bluestem are replaced by longtom, brownseed paspalum, broomsedge bluestem, bushy bluestem, knotroot bristlegrass, sedges, and low panicums. If heavy grazing continues for many years, vaseygrass, carpetgrass, smutgrass, common bahiagrass, baccharis, and sennabean increase significantly in extent.

Salty Bottomland range site. The Aransas soil in map unit Ar is in this site. The climax vegetation is an open, wet grassland. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent bulrushes.

Gulf marshhay and smooth cordgrasses make up about 65 percent of the climax vegetation. Other grasses include common reedgrass, seashore saltgrass, switchgrass, eastern gamagrass, indiangrass, longtom, knotroot bristlegrass, seashore dropseed, and seashore paspalum. Olney bulrush and salt marsh bulrush are in potholes where water stands and along streambanks. Common forbs include bushy sea-oxeye, wolfberry, and sumpweed. Higher areas where the soil is drier may support western ragweed.

If regression occurs because of heavy grazing, common reedgrass, gamagrass, switchgrass, indiangrass, smooth cordgrass, marshhay cordgrass, and seashore saltgrass are replaced by gulf cordgrass, longtom, and seashore paspalum. If heavy grazing continues for many years, bulrushes, sea-oxeye, and wolfberry will initially increase in extent before being gradually replaced by spiny aster and bigleaf sumpweed.

Salt Marsh range site. The Placedo and Swan soils in map units Pd and Sw are in this site. The climax vegetation is an open marshland. The composition, by weight, is about 85 percent grasses, 10 percent bulrushes, and 5 percent forbs.

Marshhay cordgrass makes up about 75 percent of the climax vegetation. Other grasses include common reed, seashore paspalum, switchgrass, seashore saltgrass, knotroot bristlegrass, longtom, and smooth cordgrass. Forbs include slim aster, sumpweed, and bushy sea-oxeye.

If regression occurs because of heavy grazing, marshhay cordgrass, switchgrass, and common reedgrass are replaced by gulf cordgrass, seashore paspalum, and seashore saltgrass. Under continuous heavy grazing for many years, common invaders, such as spiny aster, alligatorweed, and sennabean, will dominate the site.

Salty Prairie range site. The Francitas, Livco, and Palacios soils in map units FcA, LvA, and PaA are in this site. The climax vegetation is a salty prairie. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

Gulf cordgrass makes up about 65 percent of the climax vegetation. Other grasses include switchgrass, indiangrass, little bluestem, common reedgrass, knotroot bristlegrass, longtom, seashore saltgrass, and shoregrass. Forbs include bushy sea-oxeye and slim aster.

If regression occurs as a result of heavy grazing, bluestem, switchgrass, indiangrass, and common reedgrass are replaced by gulf cordgrass, bermudagrass, red lovegrass, pickleweed, croton, bitter sneezeweed, and matrimonyvine.

Sandy range site. The Milby soil in map unit MbB is in this site. The climax vegetation is a tall grass savanna that has a canopy of 25 percent. The composition, by weight, is about 70 percent grasses, 25 percent trees, and 5 percent forbs.

Little bluestem, switchgrass, Florida paspalum, indiangrass, and purpletop make up about 60 percent of the climax vegetation. Other grasses include brownseed paspalum, tall dropseed, silver bluestem, low panicums, low paspalums, and sedges. Woody plants include post oak, live oak, blackjack oak, yaupon, American beautyberry, and greenbriar. Forbs include partridge pea, bundleflower, snoutbean, wildbean, and sensitive briar.

If regression occurs because of heavy grazing, little bluestem, indiangrass, purpletop, and switchgrass are replaced by brownseed paspalum, smutgrass, and broomsedge bluestem and woody plants, such as running live oak, post oak, and blackjack oak. Oak, elm, American beautyberry, greenbriar, yaupon, and other woody plants generally increase in abundance until the site resembles a scrub forest. The understory consists of shade-tolerant herbaceous plants, such as sedges and low panicums. If heavy grazing continues for many years, smutgrass, bushybeard bluestem, red lovegrass, sandbur, wild indigo, bitter sneezeweed, yankeeweed, and sennabean increase significantly in extent.

Sandy Bottomland range site. The Zalco soil in map unit Za is in this site. The climax vegetation is a tall grass savanna. The composition, by weight, is about 75 percent grasses, 20 percent woody plants, and 5 percent forbs.

Switchgrass, little bluestem, big bluestem, indiangrass, Virginia wildrye, purpletop, and knotroot bristlegrass make up about 75 percent of the climax vegetation. Woody plants include cottonwood, hackberry, live oak, and willows. Forbs include partridge pea, American snoutbean, and sensitive briar.

If regression occurs because of heavy grazing, switchgrass, little bluestem, indiangrass, Virginia wildrye, and purpletop are replaced by balsamscale, knotroot bristlegrass, and red lovegrass. If heavy grazing continues for many years, mesquite, grassbur, bullnettle, willows, and hairy grama increase significantly in extent.

Sandy Loam range site. The Inez and Morales soils in map units InB and MrA are in this site (fig. 13). The climax vegetation is a tall grass savanna that has a canopy of 20 to 25 percent. The composition, by weight, is about 70 percent grasses, 25 percent woody plants, and 5 percent forbs.

Little bluestem, switchgrass, Florida paspalum, indiangrass, and purpletop make up about 55 percent of the climax vegetation. Other grasses include brownseed paspalum, tall dropseed, silver bluestem, low panicums, low paspalums, Texas wintergrass, and sedges. Woody plants include post oak, live oak, blackjack oak, yaupon, American beautyberry, and greenbriar. Forbs include partridge pea, bundleflower, snoutbean, wildbean, and sensitive briar.

If regression occurs because of heavy grazing, little bluestem, indiangrass, purpletop, and switchgrass are replaced by brownseed paspalum and woody plants, such as running live oak, post oak, and blackjack oak. Oak, elm, American beautyberry, greenbriar, yaupon, and other woody plants generally increase in extent until the site resembles a scrub forest that has an understory of shade-tolerant, herbaceous plants, such as sedges and low panicums. If heavy grazing continues for many years, broomsedge bluestem, red lovegrass, sandbur, wild indigo, bitter sneezeweed, yankeeweed, and sennabean increase significantly in extent.

Sandy Prairie range site. The Fordtran soil in map unit FaB is in this site. The climax vegetation is a true prairie. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

Little bluestem, indiangrass, crinkleawn, and big bluestem make up about 75 percent of the climax vegetation. Other grasses include eastern gamagrass, Florida paspalum, switchgrass, brownseed paspalum, knotroot bristlegrass, low panicums, fringeleaf paspalum, sedges, slender bluestem, and Pan American balsamscale. Forbs include sensitive briar, bundleflower, and yellow neptunia.

If regression occurs because of heavy grazing, little bluestem, indiangrass, crinkleawn, switchgrass, big bluestem, and eastern gamagrass are replaced by

Figure 13.—An area of Morales-Cieno complex, 0 to 1 percent slopes, used as range. The lighter areas are Morales soils, which are in the Sandy Loam range site. The darker areas are Cieno soils, which are in the Lowland range site.

brownseed paspalum, knotroot bristlegrass, low panicums, slender bluestem, and sedges. If heavy grazing continues for many years, smutgrass, carpetgrass, red lovegrass, broomsedge bluestem, balsamscale, yankeeweed, and bitter sneezeweed and woody plants, such as Macartney rose, huisache, sennabean, and running live oak, increase significantly in extent.

Recreation

In table 7, the soils of the survey area are rated according to the 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 recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational 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 gentle 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, 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 and horseback riding 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

Wildlife provides an important source of recreation and income in Jackson County. Most of the land that supports wildlife populations is leased for hunting. Hunting for waterfowl and fishing rank as major sporting activities engaged in by both residents and nonresidents of the county.

Most of the nationally recognized wetland types and wetland systems are in Jackson County. The wetland areas, including tidal marshes and estuaries, provide habitat for various waterfowl, shore birds, wading birds, gulls, terns, rails, cranes, reptiles, and amphibians. During migration, waterfowl use the wetland areas and adjacent cropland for resting and feeding. Snow geese, white-fronted geese, Canada geese, pintails, widgeons, gadwalls, green-winged teals, mallards, and sandhill cranes use these areas. Several threatened or endangered species use these areas in the winter or throughout the year. These species include the Attwater prairie chicken, whooping crane, southern bald eagle, brown pelican, reddish egret, American peregrine falcon, and American alligator.

Upland areas provide habitat for numerous species of openland and rangeland wildlife. Mammals inhabiting these areas include white-tailed deer, javelina, raccoon, opossum, cottontail, jackrabbit, skunk, armadillo, bobcat, wild hogs, bats, squirrels, and coyote. Birds that inhabit these areas include the Rio Grande turkey, bobwhite quail, mourning dove, sandhill crane, Attwater prairie chicken, vermillion flycatcher, and western kingbird. Numerous species of hawks, owls, woodpeckers, flycatchers, swallows, thrashers, thrushes, warblers, buntings, and sparrows also are in the area.

Fish, reptiles, and amphibians are numerous in wet areas. Many ponds are stocked with channel catfish, black bass, and sunfish. The Lavaca and Navidad Rivers and Lake Texana contain numerous freshwater fish, such as catfish, black bass, carp, walleye, sunfish, and gar. Shrimp, sea trout, flounder, redfish, and other salt water species inhabit the bays and estuarine areas.

Information about the soils in Jackson County can help in locating suitable habitats for specific types of wildlife and can help determine the type of management needed.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

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

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

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, prairie senna, snoutbean, indiangrass, paspalum, and panicum.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are Russian-olive, wild plum, and mustang grape.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, sesbania, maidencane, baccharis, longtom, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

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

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants.

Seed crops, such as corn and grain sorghum, provide food for dove, quail, and other birds. Geese and deer consume small grain if suitable cover is nearby. Leaving crop residue on the surface provides forage for numerous species of wildlife. Small areas of unharvested grain provide food and cover.

Waterways in areas of cropland can be managed to provide cover for small mammals and birds. Leaving fence rows untrimmed can provide additional cover. Disking field borders greatly increases the food supply for wildlife. Brushy areas in pastures are an important source of food and cover. Improved grasses, such as kleingrass, provide seed and cover for birds.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants.

This habitat can be improved by using management practices that increase sources of food and provide adequate cover. A good vegetative cover is necessary for quail and turkey habitat and is used by deer for fawning. Grasses, if allowed to mature, provide seed for dove, quail, and turkey. Clearing brush in strips and patterns creates diverse food sources for various species of wildlife. Disking and planting food also benefit wildlife.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for 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 should 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 or 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 kinds 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 evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and 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. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. Depth to 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 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, depth to 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, depth to a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 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 landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and that 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, depth to 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, depth to a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in 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 should 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, depth to a 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 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 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 to 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, a 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 a 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 have a water table at a depth of 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. They 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 are factors that affect excavation of the material.

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

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

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

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

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

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

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high 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 releases a variety of plant nutrients as it decomposes.

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

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

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

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

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

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 the potential for frost action. Excavating and grading and the stability of ditchbanks 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. 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 control 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 soil blowing 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 soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

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 20.

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 to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, 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 the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If 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 *(3)* and the system adopted by the American Association of State Highway and Transportation Officials *(2)*.

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 20.

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.

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, or component, 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 the shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of movement of water through the soil 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 and septic tank absorption fields.

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 in each major soil layer is stated in inches of water per inch of soil. 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 classes are *low*, a change of less than 3 percent;

moderate, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, more 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. Losses are expressed in tons per acre per year. These 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 for soils in Jackson County range from 0.17 to 0.49. 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 over a sustained period without affecting crop productivity. The rate is expressed in tons per acre per year.

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

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

2. Loamy coarse sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

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

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcarous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of the rock fragments on the surface or because of surface wetness.

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 in 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 are assigned to one of four groups. They are grouped according to the infiltration 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 covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

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 generally is expressed as *none, rare, occasional,* or *frequent. None* means that flooding is not probable. *Rare* means that flooding is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year). *Occasional* means that flooding occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year). *Frequent* means that flooding occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that floods are most likely to occur is expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding 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 little or no horizon development.

Also considered is 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.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table, that is, *perched or apparent;* and the months of the year that the water table commonly is highest. A water table that is seasonally high for less than 1 month is not indicated in table 15.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

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 results in a severe hazard of corrosion. 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 the amount of sulfates in the saturation extract.

Physical, Chemical, and Mineralogical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 16, the results of chemical analysis in table 17, and the results of mineralogical analysis in table 18. The data are for soils sampled at carefully selected sites. The pedons are typical of the series unless otherwise indicated and are described in the section "Soil Series and Their Morphology." Soil samples were analyzed by the Soil Survey Laboratory Staff, Natural Resources Conservation Service, Lincoln, Nebraska, and the Soil Characterization Laboratory, Texas Agricultural Experiment Station, College Station, Texas.

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 *(26)*.

Sand—(0.05-2.0 mm fraction) weight percentages of material less than 2 mm (3A1).

Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all material less than 2 mm (3A1).

Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of material less than 2 mm (3A1).

Water retained—pressure extraction, percentage of ovendry weight of less than 2 mm material; ⅓ or 1/10 bar (4B1), 15 bars (4B2).

Bulk density—of less than 2 mm material, saran-coated clods field moist (4A1a), ⅓ bar (4A1d), ovendry (4A1h).

Organic carbon—wet combustion. Walkley-Black modified acid-dichromate, ferric sulfate titration (6A1c).

Exchangeable sodium percentage (ESP)—ammonium acetate pH 7.0 (5D2).

Extractable cations—ammonium acetate pH 7.0, atomic absorption; calcium (6N2e), magnesium (6D2d), sodium (6P2b), potassium (6Q2b).

Base saturation—ammonium acetate, pH 7.0 (5C1).

Reaction (pH)—1:1 water dilution (8C1f).

Reaction (pH)—calcium chloride (8C1f).

Electrical conductivity—saturation extract (8A3a).

Sodium adsorption ratio (5E).

Clay mineralogy (7A2).

Temperature and Water Table Characteristics of Selected Soils

John Jacob, soil scientist, Natural Resources Conservation Service, helped prepare this section.

The temperature and moisture status of soils are important factors affecting decisions for agronomic and engineering land uses. Seed germination and plant viability are directly related to soil temperature. The presence or absence of a high water table affects crop selection, plant growth, and trafficability and compactibility of the soil. Soils that have a high water table are moderately to severely limited as sites for roads and streets, sanitary landfills, septic tank absorption fields, and structures.

Methods and Procedures

From 1980-86, during the soil survey of Jackson County, a special field study of soil temperatures and water table characteristics in representative areas of Dacosta, Kuy, and Telferner soils was made. Thermocouples for making temperature measurements were placed at depths of 20, 40, and 80 inches. Slotted PVC pipes for making water table observations were placed at various depths. The upper depth for making these observations in the Dacosta, Kuy, and Telferner soils was at the top of the subsoil. Observations were made at an intermediate depth of 30 inches in the subsoils of the Dacosta and Telferner soils. The lowest depth that these observations were made corresponded to a strongly contrasting change in texture in the Telferner and Kuy soils. The Dacosta soil has no strongly contrasting change in texture; therefore, observations were made at a depth of 119 inches because the maximum depth for this study was 10 feet. The measurements made at each depth indicated the presence or absence of a water table. All measurements were generally made on the 15th of the month. The air temperatures and rainfall amounts during the study period were within usual annual variations, based on records from the National Weather Service at Victoria, Texas.

Soil Temperature

The study of soil temperatures provided information about annual temperature variations (fig. 14). The Kuy soil has a light-colored sandy surface layer and an overstory of woody species, such as live oak, blackjack oak, and post oak. It is generally cooler than the Dacosta and Telferner soils, which support open prairie vegetation of mid and tall grasses. The Dacosta soil has a surface layer of dark sandy clay loam. It is generally warmer than the Telferner soil, which has a light-colored surface layer of sandy loam.

Figure 14 shows the mean annual temperatures for each soil at the depths where measurements were made. It also shows that annual variability of the soil temperature decreases with increasing depth.

The mean annual temperature for the Dacosta soil was 70 degrees at a depth of about 20 inches and 71 degrees at depths of 40 and 80 inches. The mean annual temperature for the Telferner soil was 69 degrees at depths of 20 and 40 inches and 70 degrees at a depth of about 80 inches. The mean annual temperature for the Kuy soil was 68 degrees at depths of 20, 40, and 80 inches. The average annual air temperature in Jackson County is 70 degrees.

The coldest soil temperatures usually occur in January at depths of 20 and 40 inches and in February at a depth of about 80 inches. The warmest soil temperatures occur in August at depths of 20, 40, and 80 inches.

Dacosta, Telferner, and Kuy soils have a nearly uniform temperature at the observed depths in March, September, and October. This temperature varies slightly depending on soil type but is about 62 degrees in March and 76 or 77 degrees in October.

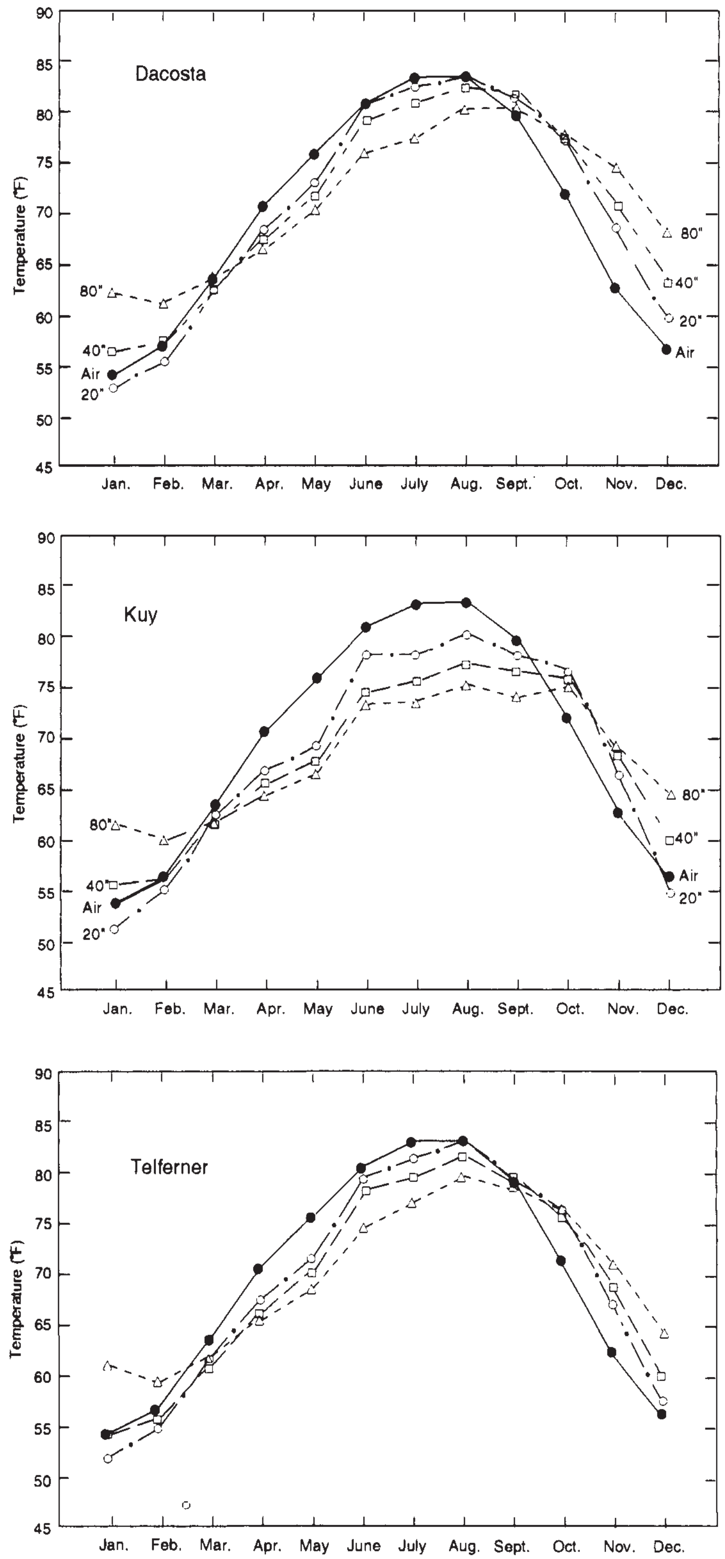


Figure 14.—Annual temperature variations, by month, in the Dacosta, Kuy, and Telferner soils.

Water Table

The results of the water table study are shown in table 19. This table shows the probability of a water table at a given depth and month in at least 6 of 10 consecutive years. These probabilities were taken from a standard table of the binomial distribution *(13)*, using data collected during the 7-year study.

The probability of a water table in the upper part of the solum of the Kuy soil is very low because the thick, sandy surface layer and subsurface layer allow rapid infiltration of water. Water accumulates in the lower part of the less permeable subsoil and forms a perched water table.

The Telferner soil has an abrupt change in texture between the surface soil of fine sandy loam and the subsoil of clay. This abrupt change in texture slows the movement of water into the subsoil. During periods of heavy rainfall, the surface soil becomes saturated. This results in the temporary formation of a perched water table in the upper part of the soil. A water table does not form in the lower part of the Telferner soil because the very slowly permeable subsoil limits the amount of water entering the underlying material.

The Dacosta soil does not have an abrupt change in texture between the surface soil and subsoil. Water moves slowly into and through the surface soil of sandy clay loam and very slowly into the clay subsoil. This results in the formation of a temporary perched water table near the surface. During periods of heavy rainfall, the subsoil may become saturated and water is retained for longer periods in the solum. Generally, the Dacosta soil is wetter than the Kuy and Telferner soils.

Water table measurements in this study were made only once a month; therefore, the duration of the water table was not measured. Field observations made by soil scientists during the course of the soil survey, however, indicate that the duration of a perched water table in the Dacosta and Telferner soils is 1 to 2 weeks and in the Kuy soils is 4 to 8 weeks. The perched water table typically occurs following periods of heavy rainfall.

Engineering Index Test Data

Table 20 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 422 (ASTM), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 4318 (ASTM); Specific gravity—T 100 (AASHTO), D 854 (ASTM); and 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 *(25)*. 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 on laboratory measurements. Table 21 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven 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 Alfisol.

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 Aqualf (*Aqu*, meaning water, plus *alf*, from Alfisol).

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 Epiaqualf (*Epi*, meaning saturated with water near the surface, plus *aqualf*, the suborder of the Alfisols that has an aquic 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 *Typic* identifies the subgroup that typifies the great group. An example is Typic Epiaqualfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, 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-loamy, siliceous, hyperthermic Typic Epiaqualfs.

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. There can be some variation in the texture of the surface layer or of the underlying material within a series.

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. 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" *(28)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(20)*. 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."

Aransas Series

The Aransas series consists of very deep, very slowly permeable, poorly drained clayey soils on flood plains. These soils formed in saline, calcareous, clayey alluvium. Slope is 0 to 1 percent.

Typical pedon of Aransas clay, saline, frequently flooded; from the intersection of Farm Road 616 and Farm Road 234 in Vanderbilt, 1 block northeast on Farm Road 616, about 0.5 mile southeast on a paved street, 0.4 mile northeast on a paved road, 0.3 mile southeast on a shell road, and 0.1 mile southwest, 0.2 mile southeast, and 40 feet southwest in an area of rangeland:

A1—0 to 8 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure; extremely hard, very firm, very sticky and plastic; many fine and common medium roots; slightly saline; calcareous; moderately alkaline; clear wavy boundary.

A2—8 to 28 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate and strong coarse blocky structure; extremely hard, very firm, very sticky and plastic; common fine and few medium roots; few fine soft powdery masses of calcium carbonate; moderately saline; calcareous; moderately alkaline; clear wavy boundary.

A3—28 to 40 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; common fine faint dark grayish brown (10YR 4/2) mottles; weak medium blocky structure; extremely hard, firm, very sticky and plastic; few fine roots; moderately saline; calcareous; moderately alkaline; clear smooth boundary.

Cg—40 to 60 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common fine faint very pale brown (10YR 7/3) mottles; massive; extremely hard, very firm, very sticky and plastic; moderately saline; moderately alkaline; clear smooth boundary.

The clayey alluvium is more than 80 inches thick. During dry periods cracks more than 0.4 inch wide extend from the surface to a depth of more than 20 inches. Salinity is slight or moderate throughout the profile. Reaction is moderately alkaline or strongly alkaline throughout the profile.

The A horizon is black or very dark gray. It ranges from 24 to more than 40 inches in thickness. Most pedons have few fine brownish mottles and few films and threads of calcium carbonate in the lower part of the horizon.

The Cg horizon is dark gray, gray, or light gray. Most pedons have few or common fine faint brownish mottles and few films and threads of calcium carbonate.

Chicolete Series

The Chicolete series consists of very deep, moderately permeable, moderately well drained clayey soils on flood plains. These soils formed in calcareous, loamy alluvium. Slope is 0 to 1 percent.

Typical pedon of Chicolete clay, frequently flooded; from the intersection of U.S. Highway 59 and Farm Road 822 in Edna, 5.2 miles northwest on Farm Road 822 to the intersection with Hill Road, 0.3 mile northwest on Farm Road 822, about 0.9 mile southwest on a private road, and 0.3 mile southeast in an area of cropland:

Ap—0 to 5 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; very hard, very firm, sticky and plastic; common fine and very fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

A1—5 to 13 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; common fine and very fine roots; calcareous; moderately alkaline; clear wavy boundary.

A2—13 to 36 inches; very dark gray (10YR 3/1) sandy clay loam, dark gray (10YR 4/1) dry; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and plastic; few fine and very fine roots; calcareous; moderately alkaline; clear smooth boundary.

Bw—36 to 72 inches; dark grayish brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky; few fine and very fine roots; few fine dark concretions; few fine threads of calcium carbonate along root channels; calcareous; moderately alkaline; gradual smooth boundary.

Bg—72 to 80 inches; gray (10YR 5/1) sandy clay, gray (10YR 6/1) dry; few fine prominent yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; very hard, friable, sticky; few fine dark concretions; few fine pitted concretions of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. Mollic colors extend from the surface to a depth of 24 to more than 70 inches. Texture is sandy clay loam, clay loam, or fine sandy loam that averages 18 to 35 percent clay in the 10- to 40-inch control section. Some pedons have thin sandy or clayey strata in the control section. The number of dark concretions ranges from none to few throughout the profile. Reaction ranges from neutral to moderately alkaline. Most pedons are calcareous throughout, but the content of calcium carbonate varies with increasing depth.

The A horizon is black or very dark gray. It is clay in the upper part and sandy clay loam or fine sandy loam in the lower part.

The Bw horizon is dark brown, brown, pinkish gray, dark grayish brown, grayish brown, light brownish gray, or pale brown. It is sandy clay loam, clay loam, or fine sandy loam. Some pedons have few brownish, yellowish, or reddish mottles. The number of pitted concretions and fine threads of calcium carbonate ranges from none to few.

The Bg horizon, if it occurs, is dark gray, gray, dark grayish brown, grayish brown, or light brownish gray. It is sandy clay loam, clay loam, or fine sandy loam. Most pedons have few or common brownish, yellowish, or reddish mottles. The number of pitted concretions of calcium carbonate ranges from none to few.

Some pedons have a C horizon below a depth of 60 inches. The horizon is grayish, yellowish, or brownish and is mottled in shades of brown, yellow, or red. Texture is sandy clay loam, clay loam, or fine sandy loam. The number of pitted concretions of calcium carbonate ranges from none to few.

Cieno Series

The Cieno series consists of very deep, very slowly permeable, poorly drained loamy soils in concave depressions (fig. 15). These soils formed in loamy sediments. Slope is 0 to 1 percent.

Typical pedon of Cieno sandy clay loam, in an area of Nada-Cieno complex, 0 to 1 percent slopes; from the intersection of U.S. Highway 59 and Farm Road 530 about 3.7 miles east of Edna, 12.8 miles north on Farm Road 530, about 0.1 mile east and 0.4 mile north on a county road, 1.3 miles east on a field road, and 195 feet north in an area of cropland:

Ap—0 to 6 inches; dark gray (10YR 4/1) sandy clay loam, gray (10YR 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; very hard, firm, slightly sticky and plastic; few fine roots; few fine pores; uncoated sand grains on faces of some peds; neutral; abrupt wavy boundary.

A—6 to 10 inches; dark gray (10YR 4/1) sandy clay loam, gray (10YR 5/1) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; uncoated sand grains on faces of some peds; neutral; diffuse wavy boundary.

Btg1—10 to 39 inches; dark gray (10YR 4/1) sandy clay loam, gray (10YR 5/1) dry; few fine faint dark brown (10YR 4/3) mottles; moderate medium blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; uncoated sand grains on faces of some peds; neutral; gradual wavy boundary.

Btg2—39 to 55 inches; light brownish gray (10YR 6/2) sandy clay loam; few fine faint dark brown (10YR 4/3) mottles; weak medium blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; uncoated sand grains on faces of some peds; few fine dark concretions; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Bg—55 to 78 inches; light brownish gray (10YR 6/2) sandy clay loam, light gray (10YR 7/2) dry; few fine distinct brownish yellow (10YR 6/6) mottles; weak medium prismatic structure parting to weak medium blocky; extremely hard, very firm, sticky and plastic; uncoated sand grains on faces of some peds; few fine dark concretions; common fine and medium concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

BC—78 to 80 inches; light brownish gray (2.5Y 6/2) clay loam, light gray (2.5Y 7/2) dry; few fine distinct brownish yellow (10YR 6/6) mottles; weak fine prismatic structure parting to weak medium blocky; extremely hard, very firm, slightly sticky and plastic; few fine dark concretions; moderately alkaline.

The solum is more than 80 inches thick. The coefficient of linear extensibility in the upper part of the Btg horizon is 0.02 to 0.08. The depth to free carbonates is 30 to 50 inches. Few or common crawfish krotovinas are mainly in the upper 60 inches of the profile. These krotivinas are 1 to 6 centimeters in diameter and commonly contain less clay than the Btg horizon. Uncoated sand grains are on the faces of some peds. The number of interfingers of uncoated sand 2 to 4 centimeters long and about 1 centimeter wide ranges from none to few throughout the Btg horizon. These interfingers make up less than 5 percent of the matrix. The number of fine or medium dark concretions ranges from none to few throughout the profile.

The A horizon is dark gray, dark grayish brown, or very dark grayish brown. It has no mottles or few brownish or yellowish mottles. Reaction ranges from moderately acid to neutral.

The Btg horizon is dark gray, gray, dark grayish brown, or grayish brown. The number of mottles in shades of brown or yellow ranges from none to common. Texture is sandy clay loam, sandy clay, or clay loam. The weighted average content of clay in the upper 20 inches is 27 to 35 percent. Reaction is slightly acid or neutral in the upper part and slightly acid to moderately alkaline in the lower part.

The Bg and BC horizons are gray, light gray, grayish brown, or light brownish gray. They have few or common mottles in shades of yellow or brown. They are sandy clay loam or clay loam. Some pedons have few or common fine and medium threads, soft masses, and concretions of calcium carbonate. Reaction is slightly alkaline or moderately alkaline.

Dacosta Series

The Dacosta series consists of very deep, very slowly permeable, moderately well drained loamy soils on uplands (fig. 16). These soils formed in loamy and clayey sediments. Slope ranges from 0 to 3 percent.

Typical pedon of Dacosta sandy clay loam, 0 to 1 percent slopes; from the intersection of Farm Road 530 and U.S. Highway 59 about 3.7 miles east of Edna, 10.3 miles north on Farm Road 530 to Cordele, 1.1 miles west on a gravel road, 0.9 mile north on a gravel road, 213 feet east on a field road, and 48 feet south in an area of cropland:

Ap—0 to 9 inches; very dark gray (10YR 3/1) sandy clay loam, dark gray (10YR 4/1) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; weak fine and medium subangular blocky structure; very hard, firm, sticky and slightly plastic; many fine roots; few fine pores; neutral; clear smooth boundary.

Bt1—9 to 21 inches; very dark gray (10YR 3/1) sandy clay, dark gray (10YR 4/1) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; very hard, very firm, sticky and plastic; few very fine roots; few fine pores; slightly acid; clear smooth boundary.

Bt2—21 to 44 inches; gray (10YR 5/1) sandy clay, gray (10YR 6/1) dry; common medium prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; few fine roots; few fine pores; few pressure faces; few fine dark concretions; neutral; clear smooth boundary.

Bt3—44 to 62 inches; grayish brown (10YR 5/2) sandy clay, light gray (10YR 7/2) dry; common medium faint light gray (10YR 7/2) mottles; weak fine subangular blocky structure; hard, very firm, sticky and plastic; few fine roots; few pressure faces; few thin gray clay films on faces of peds; few fine dark concretions; moderately alkaline; gradual smooth boundary.

BCt—62 to 80 inches; pale brown (10YR 6/3) sandy clay loam, very pale brown (10YR 7/3) dry; common medium prominent reddish yellow (7.5YR 6/6) mottles; weak fine subangular blocky structure; few thin patchy clay films; slightly hard, firm, sticky and slightly plastic; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. During dry periods cracks 0.4 inch to about 2 inches wide extend from the surface to a depth of more than 20 inches. The coefficient of linear extensibility in the upper part of the Btg horizon ranges from 0.09 to 0.10. The number of concretions of calcium carbonate ranges from none to few below a depth of 24 inches. The number of soft masses, films, or threads of calcium carbonate ranges from none to common below a depth of 42 inches.

The A horizon is black, very dark gray, or very dark grayish brown. It has no mottles or has few mottles in shades of brown or yellow. Reaction is slightly acid or neutral.

The Bt1 horizon is very dark gray, very dark grayish brown, or dark gray. It is sandy clay, clay, or clay loam. The number of brownish mottles ranges from none to common. Reaction is slightly acid or neutral.

The Bt2 and Bt3 horizons are black, dark gray, gray, light brownish gray, very dark grayish brown, or dark grayish brown. They are sandy clay, clay, or clay loam. They have common or many mottles in shades of brown, yellow, and gray. Reaction ranges from slightly acid to moderately alkaline.

The BCt horizon is pale brown, grayish brown, light brownish gray, or light gray. It is sandy clay loam, sandy clay, or clay loam. It has common mottles in shades of red, brown, yellow, and gray.

Edna Series

The Edna series consists of very deep, very slowly permeable, somewhat poorly drained loamy soils on uplands. These soils formed in clayey sediments. Slope is 0 to 1 percent.

Typical pedon of Edna fine sandy loam, 0 to 1 percent slopes; from the intersection of U.S. Highway 59 and Farm Road 234 about 6.0 miles west of Edna, 5.0 miles northwest on Farm Road 234, about 1.1 miles northwest on a gravel road, and 50 feet west in a pasture:

A—0 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; massive; hard, friable; many fine and common very fine roots; few fine pores; slightly acid; abrupt wavy boundary.

Bt1—10 to 15 inches; dark gray (10YR 4/1) clay, light gray (10YR 6/1) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; very hard, firm, sticky and plastic; common fine and few very fine roots; few fine pores; slightly acid; clear wavy boundary.

Bt2—15 to 25 inches; gray (10YR 6/2) clay, light gray (10YR 7/2) dry; common fine and medium prominent brownish yellow (10YR 6/8) and yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few pressure faces; moderately acid; clear smooth boundary.

Bt3—25 to 51 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; few fine and medium distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few pressure faces; few fine dark concretions; neutral; gradual smooth boundary.

BCk—51 to 80 inches; light gray (10YR 7/2) sandy clay loam, white (10YR 8/2) dry; few fine distinct yellow (10YR 7/6) mottles; weak fine subangular blocky structure; very hard, firm, sticky and slightly plastic; few fine dark concretions; many fine and medium soft masses of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The coefficient of linear extensibility in the upper 20 inches of the Bt horizon ranges from 0.09 to 0.11. Some pedons have few or common, fine to medium concretions of calcium carbonate below a depth of 40 inches. The number of fine dark concretions ranges from none to few throughout the profile.

The A horizon ranges from 5 to 10 inches in thickness in more than 50 percent of the pedons but may be as much as 20 inches thick. It is dark grayish brown or very dark grayish brown. Some pedons that have a thicker A horizon have a thin, discontinuous E horizon of higher value. Reaction in the A horizon ranges from moderately acid to neutral.

The Bt horizons are dark gray, dark grayish brown, grayish brown, or gray. They have few or common mottles in shades of brown, yellow, and red. They are clay loam or clay. The content of clay ranges from 35 to 50 percent. Coatings of darker colors are on the faces of some peds. Reaction ranges from moderately acid to neutral.

The BCk horizon is dark gray, gray, light gray, light brownish gray, brown, very pale brown, or light olive brown. It has few or common mottles in shades of red, brown, or yellow. It is clay loam or sandy clay loam.

Fordtran Series

The Fordtran series consists of very deep, very slowly permeable, moderately well drained sandy soils on uplands. These soils formed in loamy and clayey sediments. Slope ranges from 0 to 2 percent.

Typical pedon of Fordtran loamy fine sand, 0 to 2 percent slopes; from the intersection of Farm Road 1822 and U.S. Highway 59 in Edna, 2.6 miles south on Farm Road 1822, about 0.6 mile northeast on a paved road, 0.4 mile northwest on a paved road, and 400 feet west in a pasture:

A—0 to 18 inches; dark brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak fine and medium granular structure; soft, very friable; common fine roots; slightly acid; clear wavy boundary.

E—18 to 25 inches; light brownish gray (10YR 6/2) loamy fine sand, light gray (10YR 7/2) dry; massive; soft, very friable; common very fine and fine roots; slightly acid; abrupt wavy boundary.

Bt1—25 to 31 inches; light brownish gray (10YR 6/2) clay, light gray (10YR 7/2) dry; common medium prominent yellowish brown (10YR 5/8) mottles; weak fine and medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; strongly acid; clear smooth boundary.

Bt2—31 to 39 inches; light brownish gray (10YR 6/2) clay loam, light gray (10YR 7/2) dry; many medium prominent yellowish brown (10YR 5/8) mottles; moderate fine and medium subangular blocky structure; extremely hard, firm, sticky and plastic; few fine roots; strongly acid; clear smooth boundary.

Bt3—39 to 52 inches; light gray (10YR 7/1) sandy clay loam, white (10YR 8/1) dry; many medium prominent red (2.5YR 4/6) mottles; moderate fine subangular blocky structure; extremely hard, firm, sticky and plastic; few fine roots; neutral; clear smooth boundary.

BCt1—52 to 68 inches; light gray (10YR 7/2) sandy clay loam, light gray (10YR 7/2) dry; many medium prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few patchy clay films; neutral; clear smooth boundary.

BCt2—68 to 80 inches; light gray (10YR 7/2) sandy clay loam, white (10YR 8/2) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; weak fine subangular blocky structure; very hard, firm, sticky and plastic; few patchy clay films; neutral.

The thickness of the solum ranges from 50 to more than 80 inches.

The combined thickness of the A and E horizons ranges from 22 to 35 inches. The A horizon is dark brown, dark grayish brown, grayish brown, or dark yellowish brown. The E horizon is pale brown, brown, or light brownish gray.

The Bt horizons are light gray, gray, grayish brown, or light brownish gray. They have mottles in shades of red, reddish yellow, dark reddish brown, yellowish brown, and strong brown. They are sandy clay or clay. The content of clay ranges from 35 to 50 percent.

Reaction ranges from strongly acid to neutral.

The BCt horizons are light gray or light brownish gray. They have few to many mottles in shades of red. They are sandy clay loam or clay loam. Reaction is neutral or slightly alkaline.

Francitas Series

The Francitas series consists of very deep, very slowly permeable, poorly drained clayey soils on uplands. These soils formed in clayey sediments. Slope is 0 to 1 percent.

Typical pedon of Francitas clay, 0 to 1 percent slopes; from the intersection of Texas Highway 35 and Farm Road 1862 about 6.0 miles east of Weedlayer, 1.55 miles south on a county road, 0.5 mile west on a county road, 0.95 mile south on a county road, and 100 feet west in an area of cropland:

Ap—0 to 5 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; common fine prominent reddish brown (5YR 4/4) mottles; weak coarse blocky structure; extremely hard, very firm, very sticky and plastic; common fine roots; few fine pores; uncoated fine sand grains on faces of some peds; few fine dark masses; neutral; abrupt smooth boundary.

A—5 to 14 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few fine prominent reddish brown (5YR 4/4) mottles; strong coarse blocky structure; extremely hard, very firm, very sticky and plastic; common fine roots; uncoated fine sand grains on faces of some peds; few fine dark masses; neutral; gradual smooth boundary.

Bss—14 to 44 inches; very dark gray (10YR 3/1) clay, very dark gray (10YR 3/1) dry; moderate coarse blocky structure parting to moderate medium subangular blocky; extremely hard, very firm, very sticky and plastic; common fine roots; few intersecting slickensides; few fine dark masses; moderately sodic; neutral; gradual wavy boundary.

Bssg1—44 to 54 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; few fine prominent yellowish brown (10YR 5/6) and light olive brown (2.5YR 5/4) mottles; moderate coarse blocky structure parting to moderate medium subangular blocky; extremely hard, very firm, very sticky and plastic; few fine roots; few intersecting slickensides; few fine dark masses; few fine concretions of calcium carbonate; moderately sodic; very slightly saline; moderately alkaline; gradual wavy boundary.

Bssg2—54 to 75 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common medium distinct brown (10YR 5/3) and dark yellowish brown (10YR 4/6) mottles; massive; extremely hard, very firm, very sticky and plastic; few fine roots; few intersecting slickensides; few fine dark masses; few fine concretions of calcium carbonate; moderately sodic; very slightly saline; moderately alkaline; clear wavy boundary.

2C—75 to 80 inches; mottled strong brown (7.5YR 5/8) and light olive gray (5Y 6/2) silty clay loam, reddish yellow (7.5YR 6/8) and light gray (5Y 7/2) dry; massive; hard, firm, sticky and plastic; few fine roots; few fine dark masses; few fine concretions of calcium carbonate; slightly sodic; slightly saline; calcareous; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. In undisturbed areas gilgai microknolls are 6 to 10 inches higher than the microdepressions. The center of the microknolls is 5 to 11 feet from the center of the microdepressions. During dry periods cracks 1 inch to 2 inches wide extend from the surface to a depth of more than 20 inches. Intersecting slickensides begin at a depth of 24 to 36 inches. The number of mottles in shades of brown ranges from none to common throughout the profile.

The Ap and A horizons range from 7 inches in thickness in the microknolls to 24 inches in thickness in the microdepressions. They average more than 12 inches in thickness in more than 60 percent of the pedons. They are very dark gray or black. Some pedons have a few uncoated sand grains on the faces of some peds. Reaction ranges from neutral to moderately alkaline.

The Bss and Bssg horizons are dark gray or gray. The number of fine concretions of calcium carbonate ranges from none to few.

The C horizon has few or common fine and medium concretions of calcium carbonate.

The 2C horizon, if it occurs, is loam or silty clay loam. It is in shades of gray, brown, or red. It has no mottles or has mottles in shades of gray, brown, red, or yellow.

The salinity level of the Francitas soils in this county is usually less than 2 millimhos per centimeter in the upper part of the control section in the microdepressions and less than 4 millimhos per centimeter in the microknolls. Sodium adsorption ratios, however, generally are more than 13 within some part of the 10- to 40-inch control section.

Ganado Series

The Ganado series consists of very deep, very slowly permeable, somewhat poorly drained clayey soils on flood plains. These soils formed in clayey alluvium. Slope is 0 to 1 percent.

Typical pedon of Ganado clay, frequently flooded;

from the intersection of U.S. Highway 59 and Texas Highway 111 in Edna, 1.2 miles southwest on U.S. Highway 59, about 0.75 mile west on a gravel road to a gate, and 0.2 mile north in a pasture:

Ap—0 to 6 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; strong medium subangular blocky structure; very hard, very firm, sticky and plastic; many fine and common coarse roots; few pressure faces; moderately alkaline; abrupt smooth boundary.

Bss1—6 to 27 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; strong medium angular blocky structure; very hard, very firm, sticky and plastic; common fine and few coarse roots; common intersecting slickensides below a depth of 10 inches; few fine shell fragments; moderately alkaline; gradual wavy boundary.

Bss2—27 to 50 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; strong medium angular blocky structure; very hard, very firm, sticky and plastic; few fine roots; common intersecting slickensides; calcareous; moderately alkaline; gradual wavy boundary.

Bss3—50 to 68 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; strong medium angular blocky structure; very hard, very firm, sticky and plastic, few fine roots; common intersecting slickensides; few fine pitted concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

2Bkss—68 to 80 inches; dark gray (10YR 4/1) clay loam, gray (10YR 5/1) dry; moderate medium blocky structure; very hard, very firm, sticky and plastic; few intersecting slickensides; few medium pitted concretions of calcium carbonate; calcareous; moderately alkaline.

The solum is more than 60 inches thick. The depth to the C horizon or to horizons that have a loamy texture is 60 to more than 80 inches. The content of clay in the 10- to 40-inch control section is 40 to 60 percent. In areas that have never been cultivated, gilgai microrelief consists of microknolls that are 5 to 10 inches higher than the microdepressions. The center of the microknolls is 5 to 20 feet from the center of the microdepressions. During dry periods cracks 1 inch to 2 inches wide extend from the surface to a depth of 40 inches or more. During most years the cracks remain open less than 90 cumulative days. Intersecting slickensides begin at a depth of 10 to 36 inches. Most pedons are calcareous below a depth of 24 inches. Many pedons are calcareous throughout the profile. Most pedons have few or common concretions and soft masses of calcium carbonate below a depth of 30 inches.

The A horizon is black or very dark gray. Reaction is neutral to moderately alkaline.

The Bss horizon is black, very dark gray, dark gray, very dark brown, very dark grayish brown, and dark grayish brown. The number of yellowish, brownish, or reddish mottles ranges from none to few. Reaction is neutral to moderately alkaline.

The 2Bkss horizon is black, very dark gray, dark gray, very dark brown, very dark grayish brown, and dark grayish brown. It has few or common masses, concretions, and threads of calcium carbonate. Reaction is slightly alkaline or moderately alkaline.

The C horizon is at a depth of less than 80 inches in some pedons. It is dark grayish brown, grayish brown, dark brown, or brown. Some pedons have few yellowish, brownish, or reddish mottles. Texture is sandy clay, sandy clay loam, clay loam, or silty clay loam. Reaction is slightly alkaline or moderately alkaline.

Inez Series

The Inez series consists of very deep, very slowly permeable, moderately well drained loamy soils on uplands. These soils formed in clayey and loamy sediments. Slope ranges from 0 to 2 percent.

Typical pedon of Inez fine sandy loam, 0 to 2 percent slopes; from the intersection of Farm Road 234 and U.S. Highway 59, about 2.0 miles southwest of El Toro, 4.9 miles northwest on Farm Road 234 to a gravel road, and 1.55 miles southwest and 280 feet northwest in an area of rangeland:

A—0 to 12 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; weak fine and medium granular structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; few fine pores; slightly acid; abrupt wavy boundary.

Bt1—12 to 18 inches; dark grayish brown (10YR 4/2) sandy clay, grayish brown (10YR 5/2) dry; common fine distinct strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; very hard, firm, sticky and plastic; common fine roots; few fine pores; moderately acid; clear smooth boundary.

Bt2—18 to 47 inches; grayish brown (10YR 5/2) sandy clay, light brownish gray (10YR 6/2) dry; common fine prominent red (2.5YR 4/6) and common fine distinct yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; few very fine and fine roots; few fine pores; moderately acid; clear smooth boundary.

Bk—47 to 80 inches; light gray (10YR 7/2) sandy clay loam, white (10YR 8/2) dry; weak fine subangular blocky structure; hard, firm, sticky and slightly plastic; common medium and coarse dark masses; common medium and coarse pitted concretions and soft masses of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The depth to layers that have secondary calcium carbonate ranges from 38 to 60 inches.

The combined thickness of the A horizon and the E horizon, if it occurs, ranges from 10 to 20 inches. The A horizon is dark grayish brown, grayish brown, light brownish gray, or light gray. The E horizon is gray or light gray. Some pedons have few or common mottles in shades of brown. Reaction ranges from moderately acid to neutral.

The Bt horizon is dark gray, dark grayish brown, gray, grayish brown, light gray, or light brownish gray. It has common or many mottles in shades of red or brown. It is sandy clay or clay. The content of clay is 35 to 50 percent. Reaction ranges from strongly acid to neutral.

The Bk horizon is gray, light gray, or light brownish gray. Some pedons have few or common mottles in contrasting shades of red or brown. Texture is clay loam or sandy clay loam. Reaction ranges from neutral to moderately alkaline.

Kuy Series

The Kuy series consists of very deep, moderately permeable, moderately well drained sandy soils on uplands. These soils formed in thick sandy and loamy deposits. Slope ranges from 1 to 5 percent.

Typical pedon of Kuy sand, 1 to 5 percent slopes (fig. 17); from the intersection of Highway 59 and Farm Road 822 in Edna, 9.6 miles northwest on Farm Road 822, about 0.7 mile southwest and 4.3 miles northwest on Robinson Ranch Road to a ranch road south of Chicolete Creek, 0.45 mile southwest on the ranch road, and 100 feet north in an area of rangeland:

A—0 to 7 inches; dark brown (10YR 4/3) sand, pale brown (10YR 6/3) dry; single grained; loose; common fine and few medium roots; slightly acid; gradual smooth boundary.

E1—7 to 27 inches; yellowish brown (10YR 5/4) sand, white (10YR 8/2) dry; single grained; loose; few fine and medium roots; slightly acid; gradual smooth boundary.

E2—27 to 52 inches; light gray (10YR 7/2) sand, white (10YR 8/2) dry; single grained; loose; few fine and medium roots; common faint yellowish brown (10YR 5/4) lamella in lower 12 inches; slightly acid; clear wavy boundary.

Bt—52 to 59 inches; yellowish brown (10YR 5/6) sandy loam, yellow (10YR 7/6) dry; many coarse prominent strong brown (7.5YR 5/8) and few fine prominent red (2.5YR 4/8) mottles; weak fine subangular blocky structure; hard, friable; few fine roots; few fine pores; 10 to 15 percent, by volume, skeletons of light gray (10YR 7/2) fine sand and silt; slightly acid; gradual wavy boundary.

Btg—59 to 79 inches; light brownish gray (2.5Y 6/2) clay loam, light gray (2.5Y 7/2) dry; many medium and coarse prominent red (2.5YR 4/6) mottles; moderate very fine angular blocky structure; very hard, very firm; few fine roots; common pressure faces; moderately acid; distinct wavy boundary.

BC—79 to 86 inches; strong brown (7.5YR 5/6) sandy loam, reddish yellow (7.5YR 6/6) dry; common coarse faint strong brown (7.5YR 5/8) vertically oriented mottles; weak coarse subangular blocky structure; very hard, firm; very few clay films on faces of peds; common vertical streaks of light brownish gray (2.5Y 6/2) on faces of peds; strongly acid; abrupt wavy boundary.

2C—86 to 103 inches; strata that are 10 to 15 centimeters thick of reddish yellow (7.5YR 6/8) fine sand, reddish yellow (7.5YR 7/8) dry and yellowish red (5YR 5/6) fine sandy loam, reddish yellow (5YR 6/6) dry; massive; hard, friable; very strongly acid.

The solum is more than 80 inches thick. Some pedons have a few rounded siliceous pebbles. The number of dark concretions 2 to 6 millimeters in diameter ranges from none to few throughout the profile.

The A and E horizons are dark brown, grayish brown, brown, pale brown, light brownish gray, yellowish brown, or light yellowish brown. Some pedons have brownish or yellowish mottles. Some pedons have a few lamellae in the lower 18 inches. Reaction ranges from moderately acid to neutral.

The Bt horizon is grayish brown, yellowish brown, gray, light brownish gray, or light gray. It has few to many reddish, yellowish, grayish, and brownish mottles. It is sandy loam, sandy clay loam, or clay loam. The content of clay in the Bt and Btg horizons is 20 to 35 percent. Reaction ranges from strongly acid to slightly acid.

The BC and 2C horizons are below a depth of 80 inches. They are sand or clay. They have strata in shades of red and yellow to a depth of 142 inches.

Sand is at a depth of 142 to 170 inches. These horizons have 2 to 3 percent, by volume, rounded siliceous pebbles at a depth of 168 to 170 inches.

Laewest Series

The Laewest series consists of very deep, very slowly permeable, moderately well drained clayey soils on uplands. These soils formed in clayey sediments. Slope ranges from 0 to 8 percent.

Typical pedon of Laewest clay, 0 to 1 percent slopes (fig. 18); from the intersection of Farm Road 234 and Farm Road 616 in Vanderbilt, 1.1 miles southwest on Farm Road 616, about 0.2 mile south on a paved private road, and 200 feet west of the road in a microdepression in an area of rangeland:

A1—0 to 10 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; very hard, firm; common very fine and few fine and medium roots; common fine and few medium pores; neutral; clear wavy boundary.

A2—10 to 18 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine and medium angular blocky structure; very hard, firm; common very fine and few fine and medium roots; common fine and few medium pores; common pressure faces; few dark gray worm casts; neutral; gradual wavy boundary.

Bss1—18 to 29 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate medium and coarse angular blocky structure; very hard, firm; few very fine, fine, and medium roots; common fine and medium pores; many pressure faces and common intersecting slickensides; few dark gray worm casts; neutral; gradual wavy boundary.

Bss2—29 to 37 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate medium and coarse angular blocky structure; very hard, very firm; few very fine and fine roots; few fine and medium pores; many pressure faces and common intersecting slickensides; few fine concretions of iron and manganese; few gray worm casts; slightly alkaline; clear wavy boundary.

Bkss1—37 to 46 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; moderate coarse angular blocky structure parting to moderate fine and medium angular blocky; very hard, very firm; few very fine and fine roots; few fine and medium pores; many pressure faces and intersecting slickensides; few fine concretions of iron and manganese; about 3 percent concretions of calcium carbonate mainly less than 0.25 inch in diameter; few gray worm casts; slightly effervescent; moderately alkaline.

Bkss2—46 to 54 inches; gray (10YR 5/1) clay, light gray (10YR 6/1) dry; common medium faint grayish brown (10YR 5/2) mottles; moderate coarse angular blocky structure parting to weak fine and medium angular blocky; very hard, very firm; few fine roots; few fine and medium pores; common pressure faces and intersecting slickensides; few fine concretions of iron and manganese; about 2 percent concretions of calcium carbonate 0.13 to 0.25 inch in diameter; few dark gray worm casts; slightly effervescent; moderately alkaline.

BCkss—54 to 80 inches; light gray (10YR 7/2) clay, white (10YR 8/2) dry; common fine and medium distinct yellow (10YR 7/6) mottles; weak medium and coarse angular blocky structure; very hard, very firm; few fine roots; few fine pores; common pressure faces and intersecting slickensides; few fine concretions of iron and manganese; about 2 percent concretions of calcium carbonate 0.13 to 0.25 inch in diameter; few dark gray worm casts; slightly effervescent; moderately alkaline.

The thickness of the solum is 60 to more than 80 inches. The content of clay in the control section is 45 to 60 percent. The content of silt in the control section is more than 28 percent. The number of concretions of iron and manganese, mainly less than 0.25 inch in diameter, ranges from none to few throughout the profile. These concretions, however, are commonly in the lower part of the profile. In undisturbed areas gilgai microknolls are 6 to 12 inches higher than the microdepressions. The center of the microknolls is 4 to 16 feet from the center of the microdepressions. The microknoll makes up about 20 percent of the surface area; the intermediate area, between the knoll and the depression, about 50 percent; and the microdepression, about 30 percent. The waviness between the mollic colored materials in the upper part of the solum and the higher value colors in the lower part ranges from about 12 to 50 inches. The chimneys consisting of high value materials on the microknolls make up less than 3 percent of the surface area. They are mainly 2 to 8 feet long and 0.5 foot to 2 feet wide. During dry periods cracks 0.5 inch to 2 inches wide are at the surface. During the summer cracks 0.5 inch wide extend to a depth of 4 feet. During most years the cracks remain open less than 90 cumulative days. Intersecting slickensides begin at a depth of 12 to 24 inches and extend throughout the solum. They are at an angle of 10 to 65 degrees. The angle is generally more vertical in the microknolls than in the microdepressions.

The A horizon is very dark gray or black. The number of mottles in shades of yellow or brown ranges from none to common. Reaction is neutral or slightly alkaline.

The Bss horizon is black, very dark gray, dark gray, or gray. The number of mottles in shades of yellow or brown ranges from none to common. The number of hard, pitted concretions of calcium carbonate ranges from none to few. Reaction is neutral or slightly alkaline.

The Bkss horizon is very dark gray, dark gray, or gray. Some parts have few or common mottles in shades of yellow, brown, or gray. The number of spots of very dark gray or black soil material from horizons above ranges from none to few. This horizon has 2 to 10 percent concretions, threads, and soft masses of calcium carbonate. Effervescence ranges from very slight to strong.

The BCkss horizon is dark gray, light gray, or very pale brown. It has few to many mottles in shades of yellow, brown, or gray. It has 2 to 10 percent concretions, threads, and soft masses of calcium carbonate. Effervescence ranges from very slight to strong.

Some pedons have a 2C horizon. This horizon is in shades of red, brown, or gray. Texture ranges from loam to clay. Effervescence ranges from very slight to violent.

Livco Series

The Livco series consists of very deep, very slowly permeable, moderately well drained loamy soils on upland meander-belt ridges. These soils formed in loamy alluvium. Slope is 0 to 1 percent.

Typical pedon of Livco fine sandy loam, 0 to 1 percent slopes; from the intersection of a paved county road and Farm Road 616 in Francitas, 0.7 mile south on a county road, 0.45 mile west on a shell road, 0.1 mile south on a private farm road, and 200 feet east on a low mound in an area of cropland:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak medium and coarse subangular blocky structure; very hard, firm; common fine roots; common fine pores; slightly alkaline; abrupt smooth boundary.

A—5 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak medium and coarse subangular blocky structure; very hard, firm; few fine roots; few fine pores; slightly alkaline; abrupt wavy boundary.

Btn1—8 to 15 inches; dark grayish brown (10YR 4/2) clay loam, light brownish gray (10YR 6/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; very hard, very firm; few very fine roots; few thin clay films on faces of peds; moderately sodic; very slightly saline; moderately alkaline; clear wavy boundary.

Btn2—15 to 30 inches; grayish brown (2.5Y 5/2) clay loam, light gray (2.5Y 7/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak fine and medium subangular blocky; very hard, very firm; few thin clay films on surface of peds; moderately sodic; very slightly saline; moderately alkaline; gradual wavy boundary.

Btkn—30 to 60 inches; grayish brown (2.5Y 5/2) clay loam, light gray (2.5Y 7/2) dry; common coarse prominent yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; very hard, very firm; few thin clay films on surface of peds; few fine concretions and masses of calcium carbonate; moderately sodic; slightly saline; moderately alkaline; gradual smooth boundary.

BCkn—60 to 80 inches; light brownish gray (2.5Y 6/2) clay loam, white (2.5Y 8/2) dry; many coarse prominent brownish yellow (10YR 6/6) and yellowish brown (10YR 5/8) mottles; weak coarse subangular blocky structure; very hard, very firm; few thin discontinuous clay films on faces of peds; few concretions of iron and manganese; common medium and coarse concretions and masses of calcium carbonate; moderately sodic; slightly saline; moderately alkaline.

The solum is more than 80 inches thick. The salinity in the A and Ap horizons is less than 2 millimhos per centimeter. The salinity in the upper part of the Bt horizon is 2 to 8 millimhos per centimeter and is 4 to 16 millimhos per centimeter in the lower part. The sodium adsorption ratio ranges from 2 to 6 in the A and Ap horizons, from 13 to 30 in the upper 16 inches of the Bt horizon, and from 13 to 40 in the Bt and BC horizons, to a depth of 80 inches. The depth to layers that have secondary carbonates ranges from 20 to 60 inches. The number of concretions of iron and manganese that are 1 to 7 millimeters in diameter ranges from none to few throughout the profile.

The A horizon is dark gray or dark grayish brown. It is hard or very hard when dry. Some pedons have few brownish or yellowish mottles. Reaction is slightly acid to slightly alkaline.

The Btn and Btkn horizons are dark gray, dark grayish brown, gray, grayish brown, or light brownish gray. They are clay loam or clay. The content of clay in the Btn horizon is 35 to 45 percent and in the Btnk horizon is 30 to 45 percent. Most pedons have few to many mottles in shades of brown or yellow. These horizons have 0 to 5 percent, by volume, concretions, masses, and threads of calcium carbonate. Reaction ranges from slightly alkaline to moderately alkaline. In

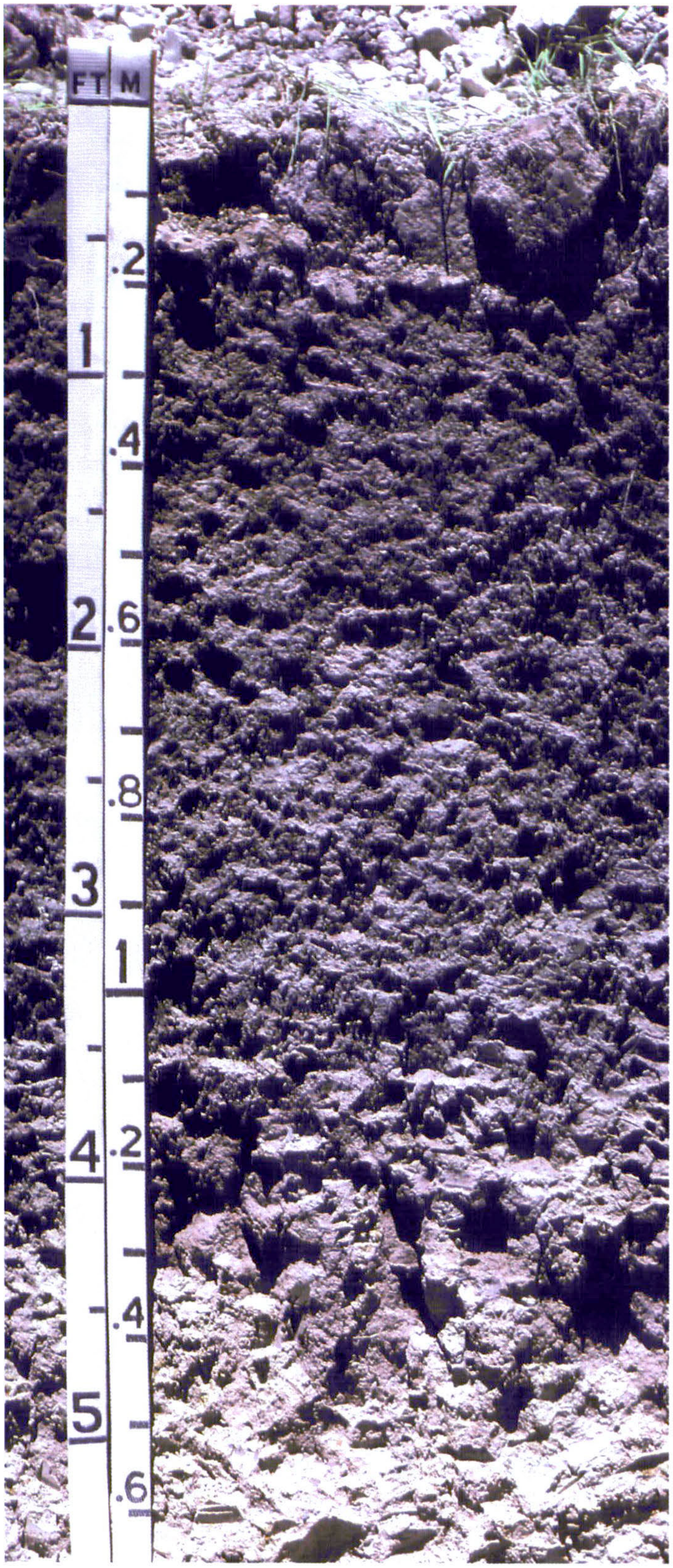


Figure 15.—Profile of Cieno sandy clay loam.

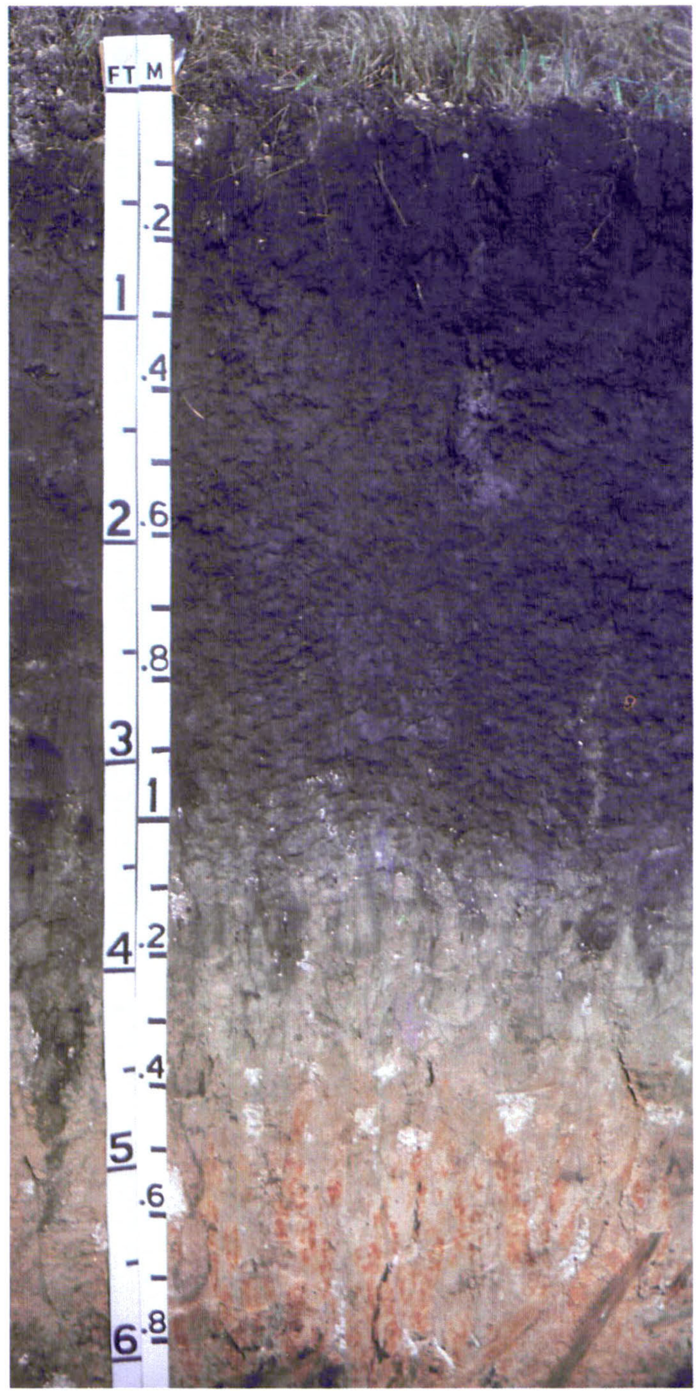


Figure 16.—Profile of Dacosta sandy clay loam, 0 to 1 percent slopes.

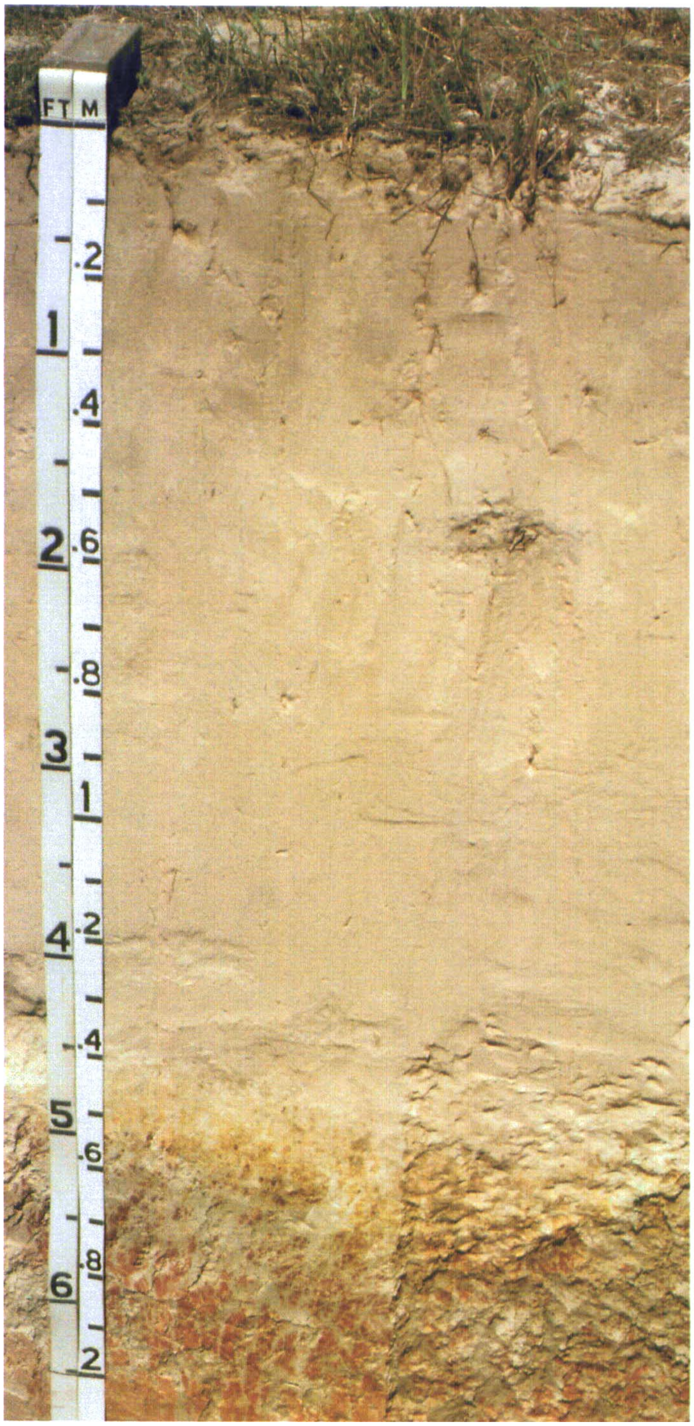


Figure 17.—Profile of Kuy sand, 1 to 5 percent slopes.

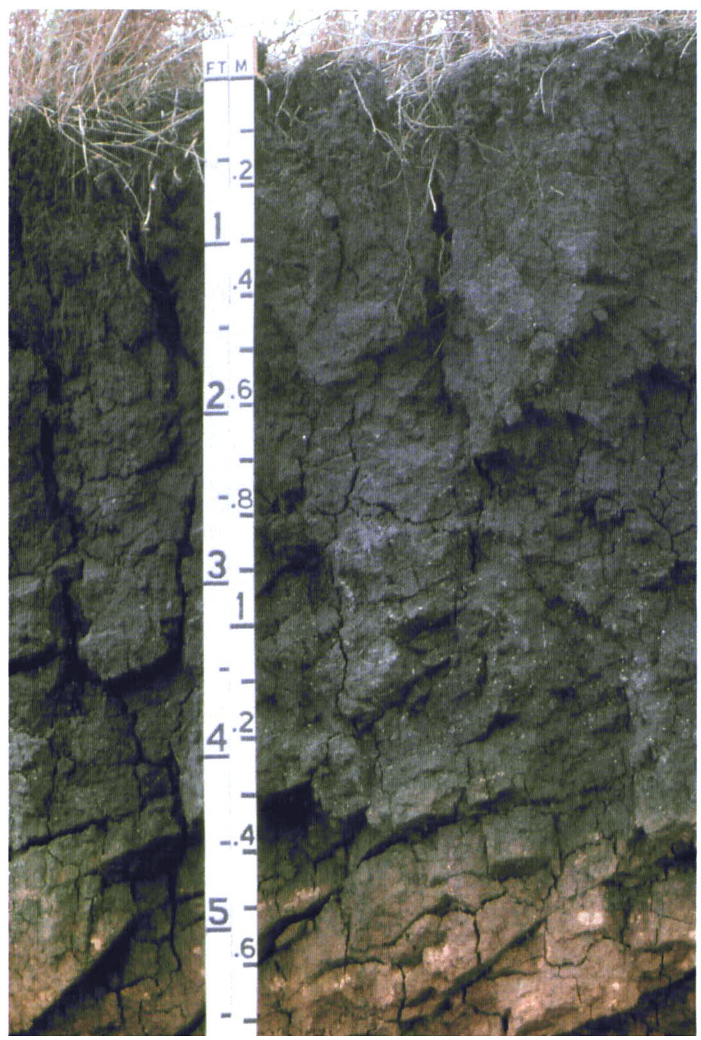


Figure 18.—Profile of Laewest clay, 0 to 1 percent slopes.

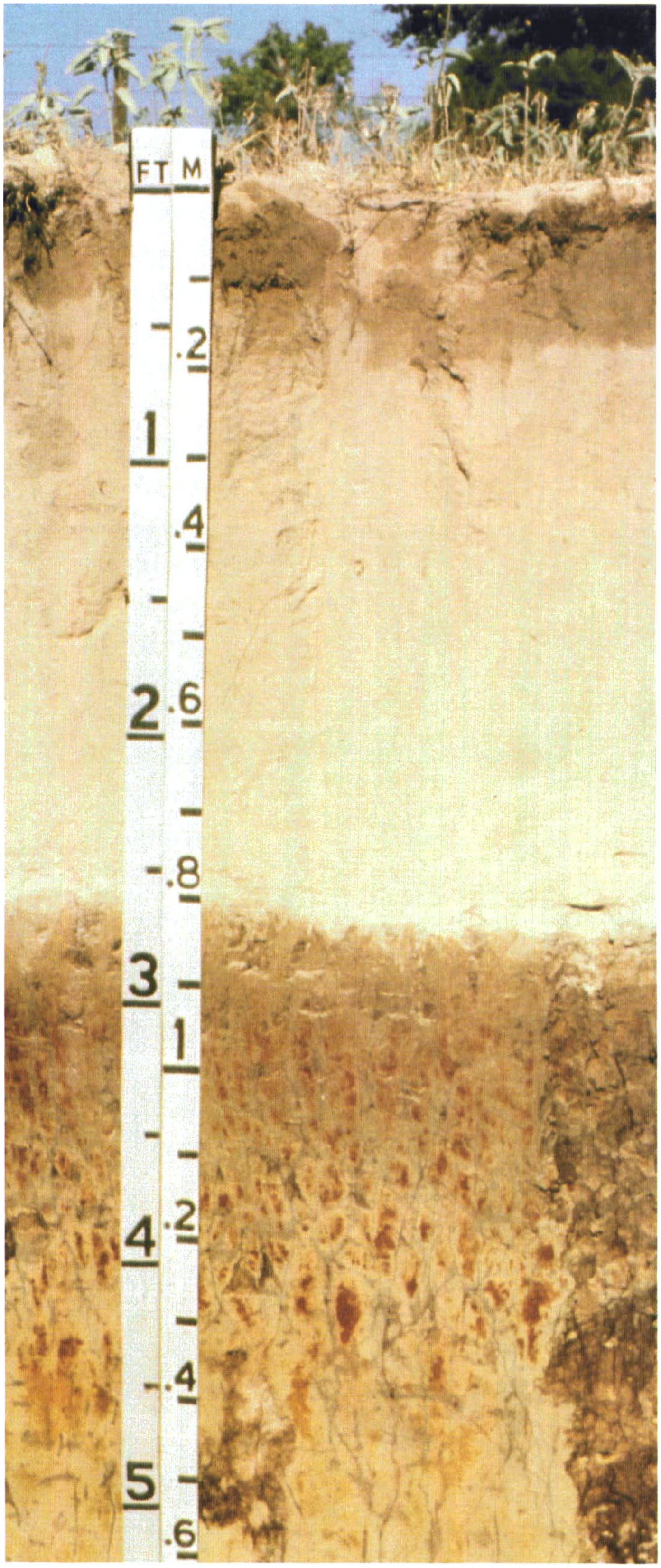


Figure 19.—Profile of Milby sand, 0 to 2 percent slopes.

Figure 20.—Profile of Morales fine sandy loam.

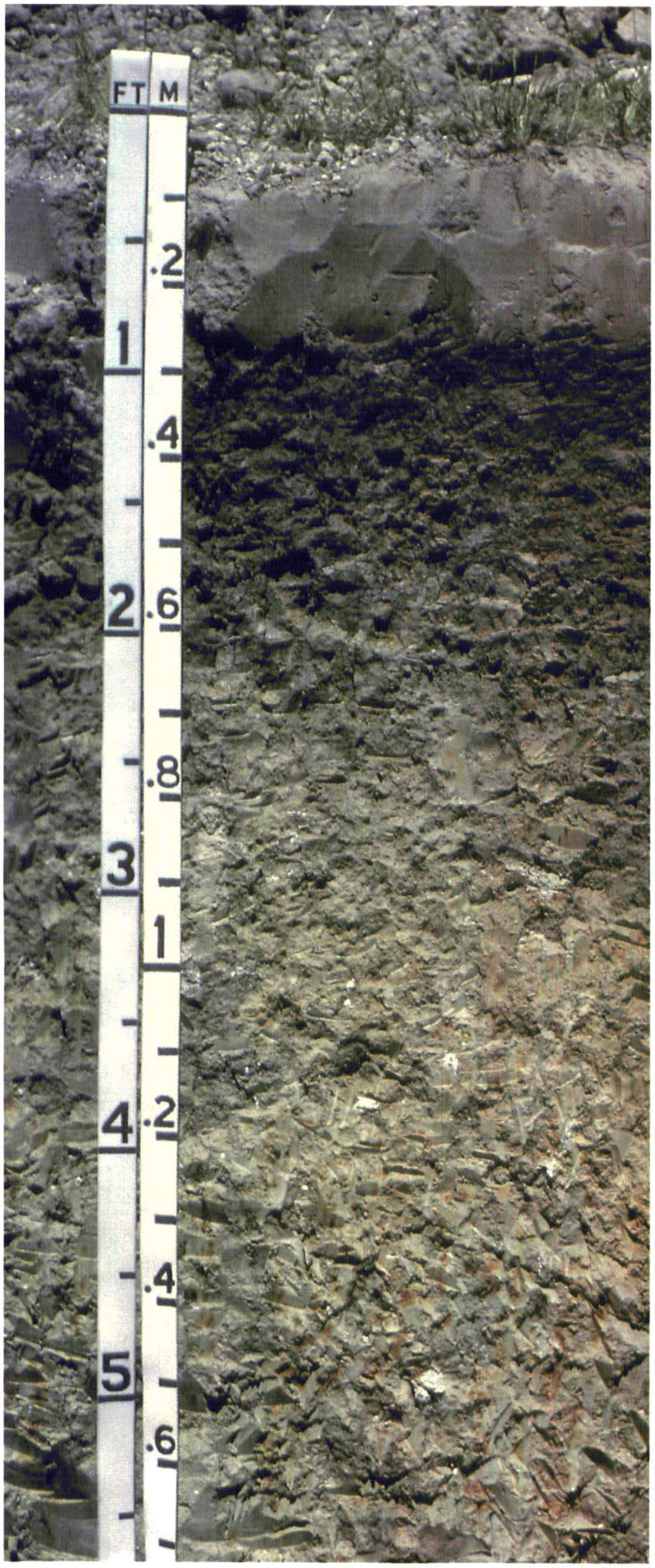


Figure 21.—Profile of Nada sandy loam.

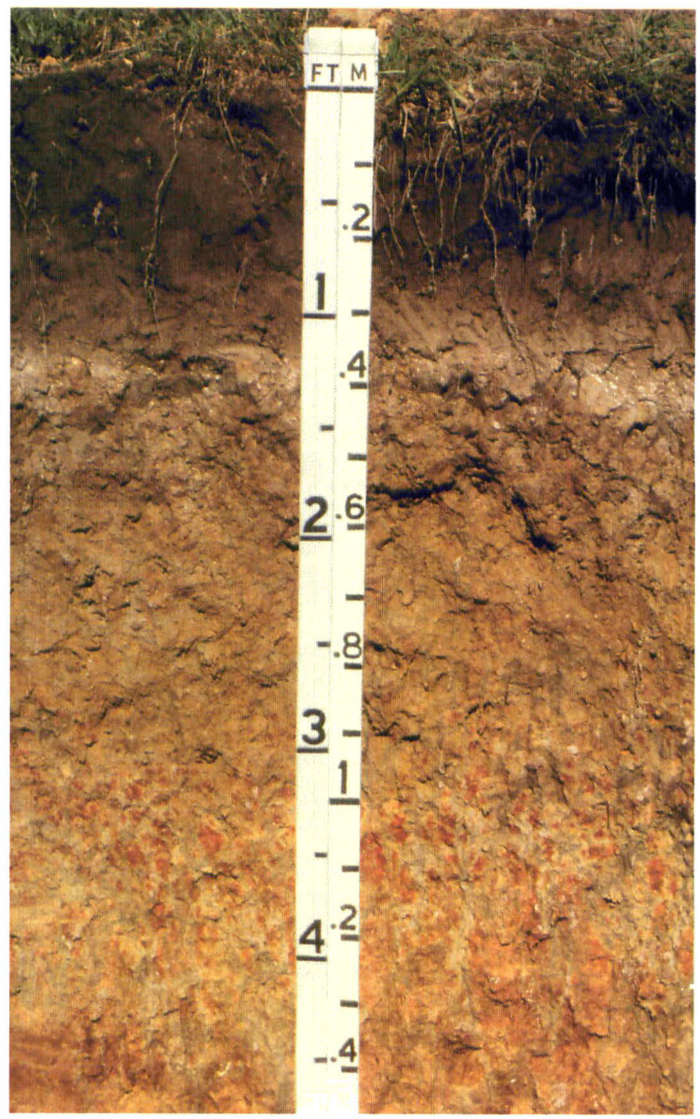


Figure 22.—Profile of Texana sandy loam.

some pedons the upper part of the Btn horizon is neutral.

The BCn or BCkn horizon is in shades of brown, yellow, or gray. The number of mottles in shades of red, yellow, brown, or gray ranges from none to common. This horizon is clay loam, sandy clay loam, or clay. The number of concretions or masses of calcium carbonate ranges from none to few. Reaction ranges from slightly alkaline to moderately alkaline.

Marcado Series

The Marcado series consists of very deep, very slowly permeable, moderately well drained soils on slopes that are adjacent to streams and rivers. These soils formed in clayey alluvium. Slope ranges from 3 to 8 percent.

Typical pedon of Marcado sandy clay loam, 3 to 8 percent slopes; from the intersection of U.S. Highway 59 and Farm Road 822 in Edna, 3.3 miles north on Farm Road 822, about 0.3 mile southwest along a fence, and 200 feet northwest in a pasture:

A—0 to 8 inches; very dark gray (10YR 3/1) sandy clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate fine granular; hard, friable; common fine and few medium roots; slightly acid; clear wavy boundary.

Bt—8 to 23 inches; dark gray (10YR 4/1) clay, grayish brown (10YR 5/2) dry; few fine distinct light yellowish brown (10YR 6/4) mottles; weak fine prismatic structure parting to moderate medium subangular blocky; very hard, firm; few medium and fine roots; few pressure faces; few patchy clay films on faces of peds; slightly alkaline; gradual wavy boundary.

Btk—23 to 40 inches; light brownish gray (10YR 6/2) clay, light gray (10YR 7/2) dry; common medium distinct brownish yellow (10YR 6/6) mottles that have few fine dark brown (7.5YR 4/4) centers; weak fine prismatic structure parting to moderate medium subangular blocky; very hard, firm; few fine roots; few pressure faces; few patchy clay films on faces of peds; about 5 percent fine and medium rounded, stained, and pitted concretions of calcium carbonate; few medium rounded dark concretions; calcareous; moderately alkaline; gradual smooth boundary.

BCk1—40 to 75 inches; light gray (10YR 7/2) clay, white (10YR 8/2) dry; common fine distinct brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; very hard, very firm; few slickensides; about 5 percent medium and coarse rounded, stained, and pitted concretions of calcium carbonate; few fine and medium rounded dark nodules and soft masses; calcareous; moderately alkaline; gradual smooth boundary.

BCk2—75 to 80 inches; light gray (2.5Y 7/2) clay, white (2.5Y 8/2) dry; many fine and medium distinct brown (7.5YR 5/4) and light brown (7.5YR 6/4) mottles; weak fine subangular blocky structure; very hard, very firm; few slickensides; about 7 percent medium and coarse stained and pitted concretions of calcium carbonate; common fine dark nodules and stains; few fine gypsum crystals; calcareous; moderately alkaline.

The thickness of the solum ranges from 70 to more than 80 inches. The content of clay in the control section ranges from 40 to 60 percent. In the summer, cracks at least 0.5 inch wide extend from the surface to a depth of more than 30 inches. Low chroma colors in the argillic horizon are probably relict.

The A horizon is black, very dark gray, dark gray, very dark brown, very dark grayish brown, and dark grayish brown. Reaction is slightly acid or neutral.

The Bt horizon is dark gray, gray, dark grayish brown, and grayish brown. It has few or common mottles in shades of yellow, brown, and red. It has less than 10 percent pitted concretions of calcium carbonate at a depth of 20 or more inches. Reaction ranges from neutral to moderately alkaline.

The BCk horizon is grayish brown, light brownish gray, light gray, white, brown, pale brown, very pale brown, yellowish brown, light yellowish brown, very pale brown, light olive brown, and pale yellow. It has few or common mottles in shades of yellow, brown, and red. It has less than 10 percent pitted concretions of calcium carbonate. The lower part of some pedons has few fine crystals of gypsum.

Milby Series

The Milby series consists of very deep, slowly permeable, moderately well drained sandy soils on uplands. These soils formed in sandy and loamy alluvial terrace deposits that were probably reworked by the wind. Slope ranges from 0 to 2 percent.

Typical pedon of Milby sand, 0 to 2 percent slopes (fig. 19); from the intersection of U.S. Highway 59 and Farm Road 822 in Edna, 11.9 miles northwest on Farm Road 822, about 250 feet southwest along a fence, and 35 feet southeast in a pasture:

A—0 to 6 inches; brown (10YR 5/3) sand, very pale brown (10YR 7/3) dry; weak fine subangular blocky structure; loose, very friable; many fine and medium roots; strongly acid; clear wavy boundary.

E1—6 to 16 inches; pale brown (10YR 6/3) sand, light gray (10YR 7/2) dry; single grained; loose, very friable; common fine and few medium roots; few fine pores; slightly acid; gradual wavy boundary.

E2—16 to 30 inches; very pale brown (10YR 7/4) sand, white (10YR 8/2) dry; single grained; loose, very friable; common fine and few medium roots; few fine pores; slightly acid; abrupt smooth boundary.

Bt/E—30 to 35 inches; light yellowish brown (10YR 6/4) sandy clay loam, very pale brown (10YR 7/4) dry; common fine prominent yellowish red (5YR 5/8) mottles; weak medium and coarse blocky structure; hard, firm; few fine and medium roots; common very fine and few fine pores; about 25 percent, by volume, clean grains of sand and silt in the upper 2 inches (E); very strongly acid; abrupt smooth boundary.

Btg—35 to 44 inches; grayish brown (10YR 5/2) sandy clay, light brownish gray (10YR 6/2) dry; many fine distinct yellowish brown (10YR 5/8), common fine prominent yellowish red (5YR 5/8), and few medium and coarse prominent dark red (2.5YR 3/6) mottles; moderate medium and coarse prismatic structure parting to moderate medium blocky; very hard, firm; few fine and medium roots along faces of prisms; few small slickensides; dark grayish brown (10YR 4/2) clay films on faces of prisms; very strongly acid; gradual wavy boundary.

Bt—44 to 53 inches; very pale brown (10YR 7/3) sandy clay loam, very pale brown (10YR 8/3) dry; many coarse faint light gray (10YR 7/1) and many medium and coarse prominent yellowish brown (10YR 5/6) and dark red (2.5YR 3/6) mottles; moderate medium and coarse prismatic structure parting to moderate medium angular blocky; very hard, firm; few fine and medium roots on faces of prisms; brown (10YR 5/3) clay films on faces of prisms; very strongly acid; gradual wavy boundary.

BC—53 to 70 inches; very pale brown (10YR 8/4) sandy clay loam, very pale brown (10YR 8/4) dry; many medium and coarse distinct grayish brown (10YR 5/2) and brownish yellow (10YR 6/6) vertical streaks and mottles; moderate medium and coarse prismatic structure parting to moderate medium angular blocky; very hard, firm; few fine and medium roots on faces of prisms; strongly acid; abrupt wavy boundary.

2C—70 to 90 inches; light brownish gray (2.5Y 6/2) sandy clay, light gray (2.5Y 7/2) dry; few fine and medium distinct light olive brown (2.5Y 5/4) and few medium prominent pale red (2.5YR 6/2) mottles; massive with conchoidal cleavage planes; extremely hard, very firm; few very fine roots on faces of cleavage planes; few slickensides; few dark brown (10YR 4/3) stains on surfaces of cleavage planes; strongly acid.

The thickness of the solum ranges from 60 to more than 80 inches. The combined thickness of the A and E horizons is 20 to 40 inches. The content of clay in the control section ranges from 27 to 35 percent. In most pedons, the upper part of the argillic horizon has clean sand grains and the lower part has few dark concretions and masses.

The A horizon is brown, pinkish gray, dark grayish brown, grayish brown, light brownish gray, dark brown, brown, pale brown, dark yellowish brown, yellowish brown, light brown, or light yellowish brown. Reaction ranges from strongly acid to neutral.

The E horizon is pinkish gray, light brownish gray, light gray, pale brown, very pale brown, light brown, pink, light yellowish brown, or very pale brown. Reaction ranges from moderately acid to neutral.

The Bt/E horizon is a mixture of E and Bt horizon soil material. Typically, the E horizon material grades into the Bt horizon. The E horizon material is white, light gray, or very pale brown. The Bt horizon material is yellowish or brownish. It has no mottles or common mottles. Texture of the Bt/E horizon is sandy clay loam or clay loam. Reaction is strongly acid or moderately acid.

The Btg and Bt horizons are dark grayish brown, grayish brown, light brownish gray, light gray, brown, very pale brown, dark yellowish brown, yellowish brown, light yellowish brown, and very pale brown. They are sandy clay, clay loam, or sandy clay loam. They have few to many mottles in shades of brown, yellow, or red, or they are mottled in these colors and do not have a dominant matrix color. Reaction ranges from very strongly acid to slightly acid.

The BC or C horizon is brown, pinkish gray, pinkish white, light brown, and pink. It is sandy loam, sandy clay loam, or clay loam. It has few to many mottles in shades of gray, brown, or red, or it is mottled in these colors and does not have a dominant matrix color. Reaction ranges from strongly acid to slightly acid.

The 2C horizon, if it occurs, is in shades of gray or brown. It is sandy clay or clay. Some pedons have brown, yellow, or red mottles. Reaction ranges from strongly acid to neutral.

Morales Series

The Morales series consists of very deep, slowly permeable, moderately well drained loamy soils on uplands. These soil formed in loamy sediments. Slope is 0 to 1 percent.

Typical pedon of Morales fine sandy loam, in an area of Morales-Cieno complex, 0 to 1 percent slopes (fig. 20); from the intersection of U.S. Highway 59 and State Highway 111 in Edna, 12.4 miles north on State

Highway 111 to a private road northwest of Morales, 0.15 mile west on the private road, and 100 feet north of the road in an area of rangeland:

A—0 to 4 inches; yellowish brown (10YR 5/4) fine sandy loam, light gray (10YR 7/2) dry; weak fine subangular blocky structure; slightly hard, friable; common fine and few medium and coarse roots; slightly acid; clear smooth boundary.

E—4 to 8 inches; light yellowish brown (10YR 6/4) fine sandy loam, white (10YR 8/2) dry; many fine faint yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; massive when dry; hard, very friable; common fine and few medium and coarse roots; common fine and medium pores; moderately acid; clear smooth boundary.

Bt/E1—8 to 15 inches; yellowish brown (10YR 5/8) sandy clay loam (B), brownish yellow (10YR 6/6) dry; few fine distinct yellowish red (5YR 5/8) mottles; weak fine and medium subangular blocky structure; hard, very friable; few fine, medium, and coarse roots; few fine and medium pores; about 15 percent, by volume, streaks and small pockets of albic material (E); strongly acid; gradual smooth boundary.

Bt/E2—15 to 18 inches; yellowish brown (10YR 5/6) sandy clay loam (B), brownish yellow (10YR 6/6) dry; few fine distinct yellowish red (5YR 5/8) mottles; moderate fine and medium subangular blocky structure; hard, friable; few patchy clay films on faces of peds and along root channels; few fine, medium, and coarse roots; few fine and medium pores; about 25 percent, by volume, streaks and small pockets of albic material (E); very strongly acid; abrupt smooth boundary.

Bt1—18 to 29 inches; grayish brown (10YR 5/2) sandy clay, light brownish gray (10YR 6/2) dry; common fine and medium prominent dark red (2.5YR 3/6) and distinct yellowish brown (10YR 5/8) mottles in the interior of the peds; weak coarse prismatic structure parting to moderate medium and coarse blocky; very hard, firm; few fine, medium, and coarse roots vertically oriented on faces of prisms; brown sand grains and gray clay films coating faces of most prisms; 3 to 5 percent, by volume, tongues of albic material 10 to 20 millimeters wide; slightly acid; gradual smooth boundary.

Bt2—29 to 53 inches; light brownish gray (10YR 6/2) sandy clay loam, light gray (10YR 7/2) dry; common medium and coarse prominent red (2.5YR 4/6) and dark red (2.5YR 3/6) and few fine faint yellowish brown (10YR 5/8) mottles in the interior of the peds; moderate medium and coarse prismatic structure parting to moderate medium and coarse blocky; very hard, firm; few fine, medium, and coarse roots vertically oriented on faces of prisms; brown sand grains and gray clay films coating faces of most prisms; coarse organic stains on faces of some prisms; less than 3 percent, by volume, tongues of albic material 5 to 15 millimeters wide; few fine black concretions; few fine masses of barite in lower part; moderately acid; gradual smooth boundary.

Bt3—53 to 62 inches; light brownish gray (10YR 6/2) sandy clay loam, light gray (10YR 7/2) dry; many fine and medium distinct brownish yellow (10YR 6/8) and few fine prominent yellowish red (5YR 4/6) mottles; moderate coarse prismatic structure parting to moderate coarse blocky; very hard, firm; few fine and medium roots vertically oriented along faces of prisms; brown sand grains and gray clay films coating faces of some prisms; coarse organic stains of faces of some prisms; few fine black concretions; few fine and medium masses of barite; slightly acid; gradual smooth boundary.

BC—62 to 76 inches; light brownish gray (10YR 6/2) sandy clay loam, light gray (10YR 7/2) dry; common medium and coarse distinct brownish yellow (10YR 6/8) and few fine prominent yellowish red (5YR 4/6) mottles; weak coarse prismatic structure parting to weak coarse angular blocky; very hard, firm; many black specks mainly less than 2 millimeters in diameter; brown sand grains and gray clay films coating faces of prisms; few fine and medium masses of barite; neutral; gradual smooth boundary.

C—76 to 90 inches; light gray (10YR 7/1) sandy clay loam, white (10YR 8/1) dry; common fine distinct yellow (10YR 7/8) and few fine prominent yellowish red (10YR 6/8) mottles; weak coarse prismatic structure; massive matrix; extremely hard, firm; common fine and medium black concretions; few fine and medium masses of barite; neutral.

The thickness of the solum ranges from 60 to more than 80 inches. The content of clay in the control section ranges from 25 to 35 percent. Most pedons have few dark masses and concretions and few fine or medium masses of barite in the lower part.

The A horizon is dark grayish brown, dark brown, dark yellowish brown, grayish brown, brown, yellowish brown, light brownish gray, pale brown, or light yellowish brown. Reaction ranges from moderately acid to neutral.

The E horizon is brown, yellowish brown, pale brown, or light yellowish brown. The number of mottles in shades of brown or red ranges from none to many. Reaction is strongly acid or moderately acid.

The B part of the Bt/E horizons is dark yellowish brown, yellowish brown, light yellowish brown, brownish yellow, dark brown, strong brown, brown, light brown, and reddish yellow and the E part is dark gray, dark grayish brown, gray, grayish brown, light brownish gray, and light gray. The Bt/E horizons have few or common mottles in shades of red, yellow, or brown. They are sandy clay loam, loam, or clay loam. These horizons have 15 to 30 percent, by volume, streaks and small pockets of albic material. Reaction ranges from very strongly acid to neutral.

The Bt horizons are dark gray, dark grayish brown, gray, grayish brown, and light brownish gray. They have few or many mottles in shades of red, yellow, or brown. They are sandy clay, clay loam, or sandy clay loam. They have 3 to 15 percent, by volume, tongues of albic material, mainly in the upper and middle parts. Reaction ranges from strongly acid to moderately alkaline.

The BC and C horizons are gray, grayish brown, and light brownish gray. They have few to many mottles in shades of red, yellow, or brown. They are sandy clay loam or clay loam. Reaction ranges from slightly acid to moderately alkaline.

Nada Series

The Nada series consists of very deep, very slowly permeable, moderately well drained loamy soils on uplands. These soils formed in loamy sediments. Slope is 0 to 1 percent.

Typical pedon of Nada sandy loam, in an area of Nada-Cieno complex, 0 to 1 percent slopes (fig. 21); from the intersection of U.S. Highway 59 and Farm Road 530 about 3.7 miles east of Edna, 12.8 miles north on Farm Road 530, about 0.1 mile east and 0.4 mile north on a county road, 1.2 miles east on a private road, and 450 feet north in an area of cropland:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; hard, friable; common fine roots; common fine pores; neutral; abrupt smooth boundary.

Btg1—7 to 28 inches; dark gray (10YR 4/1) sandy clay loam, gray (10YR 6/1) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine blocky structure; extremely hard, very firm, sticky and plastic; many fine roots; uncoated sand grains on faces of some peds; neutral; clear smooth boundary.

Btg2—28 to 43 inches; dark grayish brown (10YR 4/2) sandy clay loam, light brownish gray (10YR 6/2) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium blocky structure; extremely hard, very firm, sticky and plastic; common fine roots; uncoated sand grains on faces of some peds; neutral; diffuse wavy boundary.

Btg3—43 to 58 inches; gray (10YR 5/1) sandy clay loam, light gray (10YR 6/1) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; uncoated sand grains on faces of some peds; slightly alkaline; gradual wavy boundary.

Bg—58 to 78 inches; light brownish gray (10YR 6/2) sandy clay loam, light gray (10YR 7/2) dry; common fine distinct yellowish brown (10YR 5/4) mottles; weak medium blocky structure; extremely hard, very firm; few fine roots; moderately alkaline; diffuse wavy boundary.

BC—78 to 80 inches; light brownish gray (10YR 6/2) sandy clay loam, light gray (10YR 7/2) dry; few fine faint yellowish brown (10YR 5/5) mottles; weak medium prismatic structure parting to moderate medium blocky; extremely hard, very firm; few fine and medium dark masses and concretions; moderately alkaline.

The solum is more than 80 inches thick. The coefficient of linear extensibility in the Btg horizon ranges from 0.02 to 0.08. Uncoated sand grains are on the faces of some peds. The number of interfingers of uncoated sand grains 2 to 4 centimeters long and about 1 centimeter wide ranges from none to few throughout the Btg horizon. These interfingers make up less than 5 percent of the matrix. Most pedons have few fine dark concretions and masses. The number of crawfish krotovinas ranges from none to common.

The A horizon is typically less than 10 inches thick but may range from 5 to 13 inches in thickness. It is dark grayish brown, dark gray, or grayish brown. The number of brownish or yellowish mottles ranges from none to common. Reaction ranges from moderately acid to neutral.

The Btg horizons are very dark gray, dark gray, dark grayish brown, gray, or grayish brown. They have few to many mottles in shades of brown or yellow. They are sandy clay loam, sandy clay, or clay loam. The weighted average content of clay in the control section ranges from 27 to 35 percent. Some pedons have few fine concretions or soft masses of calcium carbonate in the lower part. Uncoated sand grains are on the surface of some peds. Reaction ranges from moderately acid to neutral in the upper part of the Btg horizons and from neutral to moderately alkaline in the lower part.

The Bg horizon is light brownish gray, gray, or light gray. It has few or common mottles in shades of brown or yellow. It is sandy clay loam or clay loam. The number of fine and medium concretions and soft masses of calcium carbonate ranges from none to few. Reaction is slightly alkaline or moderately alkaline.

The BC horizon is grayish brown, gray, or light brownish gray. The number of brownish or yellowish mottles ranges from none to common. The number of fine and medium concretions and soft masses of calcium carbonate ranges from none to common. Reaction is slightly alkaline or moderately alkaline.

Navidad Series

The Navidad series consists of very deep, moderately rapidly permeable, well drained loamy soils on flood plains. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

Typical pedon of Navidad fine sandy loam, frequently flooded; from the intersection of U.S. Highway 59 and Farm Road 822 in Edna, 9.6 miles northwest on Farm Road 822 to Robinson Ranch Road, 0.7 mile southwest and 1.9 miles northwest on Robinson Ranch Road, 0.1 mile northeast on a private gravel road, and 60 feet southeast in a pasture:

A1—0 to 10 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure parting to weak fine granular; slightly hard, friable; many very fine and fine roots; calcareous; moderately alkaline; clear wavy boundary.

A2—10 to 33 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; slightly hard, friable; common fine roots; calcareous; moderately alkaline; clear wavy boundary.

C1—33 to 43 inches; dark grayish brown (10YR 4/2) loamy fine sand, grayish brown (10YR 5/2) dry; single grained; loose, very friable; few fine roots; calcareous; moderately alkaline; gradual wavy boundary.

C2—43 to 59 inches; brown (10YR 5/3) fine sand, pale brown (10YR 6/3) dry; single grained; loose, very friable; few fine roots; calcareous; moderately alkaline; abrupt wavy boundary.

C3—59 to 70 inches; dark grayish brown (10YR 4/2) sandy clay loam, grayish brown (10YR 5/2) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable; few fine roots; calcareous; moderately alkaline; gradual wavy boundary.

C4—70 to 80 inches; dark brown (10YR 4/3) sandy clay loam, brown (10YR 5/3) dry; massive; slightly hard, friable; few fine roots; calcareous, moderately alkaline.

The loamy and sandy sediments are more than 80 inches thick. The control section is fine sandy loam, loamy fine sand, or loam. It has a weighted average content of clay that is less than 18 percent. The content of fine sand is more than 15 percent. Some pedons have thin strata and lenses of loam, sandy clay loam, or clay loam. Reaction ranges from neutral to moderately alkaline. Most pedons are calcareous throughout the profile.

The A horizons range from 20 to 47 inches in thickness. They are very dark gray, very dark grayish brown, or dark brown.

The C horizons are dark grayish brown, dark brown, dark yellowish brown, grayish brown, brown, yellowish brown, light brownish gray, pale brown, light yellowish brown, light gray, or very pale brown. The number of yellowish and brownish mottles ranges from none to few. These horizons range from fine sand to sandy clay loam. They have no strata or few thin strata of sandy, loamy, or clayey materials.

Palacios Series

The Palacios series consists of very deep, very slowly permeable, poorly drained loamy soils on uplands. These soils formed in saline clayey sediments. Slope is 0 to 1 percent.

Typical pedon of Palacios loam, 0 to 1 percent slopes; from the intersection of Farm Road 172 and State Highway 35 in Weedhaven, 8.4 miles east on State Highway 35, about 2.0 miles south on Farm Road 3280, about 1.3 miles west on a private road, and 25 feet south in a pasture:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; massive; very hard, firm, slightly sticky and slightly plastic; many very fine and common fine roots; common fine pores; neutral; clear wavy boundary.

Btng1—7 to 14 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; weak coarse columnar structure parting to moderate medium subangular blocky; very hard, very firm, sticky and plastic; common very fine and few fine roots; few fine pores; common thin clay films on faces of peds; moderately sodic; very slightly saline; neutral; clear smooth boundary.

Btng2—14 to 27 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; few fine faint brownish mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; very hard, very firm, sticky and plastic; common very fine roots; few fine pores; many thin clay films on faces of peds; common fine dark concretions; moderately sodic; moderately saline; moderately alkaline; gradual smooth boundary.

Btng3—27 to 40 inches; gray (10YR 5/1) clay, gray (10YR 6/1) dry; few fine dark brown (10YR 4/3) mottles; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine pores; common thin clay films; moderately sodic; moderately saline; moderately alkaline; gradual smooth boundary.

BCtng—40 to 70 inches; grayish brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; common fine faint light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few patchy clay films; many fine dark concretions; moderately sodic; moderately saline; moderately alkaline; gradual smooth boundary.

BCkng—70 to 80 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (2.5Y 7/2) dry; many medium distinct olive yellow (2.5Y 6/6) mottles; weak fine subangular blocky structure; hard, firm, sticky and slightly plastic; common fine and medium concretions of calcium carbonate; moderately sodic; moderately saline; calcareous; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The sodium adsorption ratio ranges from 2 to 6 in the A or Ap horizon, from 13 to 30 in the upper 16 inches of the Bt horizon, and from 13 to 40 in the Bt and BC horizons, to a depth of 80 inches. The salinity in the A horizon is less than 2 millimhos per centimeter. The salinity in the upper part of the Bt horizon is 2 to 8 millimhos per centimeter and in the lower part is 4 to 16 millimhos per centimeter. The depth to soft masses or concretions of calcium carbonate is more than 28 inches. The number of dark concretions 1 to 7 millimeters in diameter ranges from none to few throughout the profile.

The A or Ap horizon is very dark grayish brown, very dark gray, black, or very dark brown. It has no mottles or has few brownish or yellowish mottles. It is hard or very hard and massive when dry. Reaction ranges from slightly acid to slightly alkaline.

The Bt horizons are in shades of gray and brown. They are clay, silty clay, silty clay loam, or clay loam. The content of clay ranges from 35 to 50 percent. Some pedons have brownish or yellowish mottles. These horizons have 0 to 5 percent, by volume, concretions of calcium carbonate below a depth of 28 inches. Reaction ranges from neutral to moderately alkaline.

The BCtng horizon is in shades of gray, brown, or yellow. It is silty clay, silty clay loam, clay, or clay loam. Most pedons have brownish, grayish, or yellowish mottles. This horizon has 0 to 5 percent, by volume, concretions of calcium carbonate. Reaction is slightly alkaline or moderately alkaline.

The BCkng horizon is in shades of brown, yellow, pink, or red. The number of mottles in shades of brown, yellow, pink, red, or gray ranges from none to common. Texture is mainly clay or silty clay. The number of concretions of calcium carbonate ranges from none to common throughout the profile. Reaction is slightly alkaline or moderately alkaline.

Some pedons have a 2C horizon below a depth of 60 inches that is in shades of red, brown, or gray. This horizon is very fine sandy loam, silt loam, or silty clay loam. Reaction is slightly alkaline or moderately alkaline.

Placedo Series

The Placedo series consists of very deep, very slowly permeable, very poorly drained clayey soils on flood plains. These soils formed in saline, calcareous, clayey alluvium. Slope is 0 to 1 percent.

Typical pedon of Placedo clay, tide flooded; from the intersection of Farm Road 234 and Farm Road 616 in Vanderbilt, 1.15 miles southwest on Farm Road 616, about 0.95 mile south-southeast on a paved road, 3.35 miles east and southeast on a shell road to the headquarters of a ranch, 0.75 mile south-southeast and 1.8 miles south-southwest on a shell road, 0.85 mile west on a shell road, and 50 feet south in an area of rangeland:

Oe—0 to 3 inches; dark olive gray (5Y 3/2) mucky peat (herbaceous), olive gray (5Y 4/2) dry; massive; soft, very friable; many fine and medium roots; strongly saline; moderately alkaline; clear smooth boundary.

Ag1—3 to 21 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; weak fine granular structure; very hard, firm, sticky and plastic; many fine and few medium roots; strongly saline; calcareous; moderately alkaline; clear smooth boundary.

Ag2—21 to 38 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; weak medium blocky structure; very hard, firm, sticky and plastic; common fine and few medium roots; few fine lenses of pale brown (10YR 6/3) silt loam; strongly saline; calcareous; moderately alkaline; clear wavy boundary.

Cg1—38 to 55 inches; dark gray (5Y 4/1) clay, gray (5Y 5/1) dry; few fine prominent yellowish red (5YR 4/6) mottles; massive; very hard, firm, sticky and plastic; few fine roots; few fine dark masses; strongly saline; calcareous; moderately alkaline; clear wavy boundary.

2Cg—55 to 80 inches; dark gray (5Y 4/1) fine sandy loam, light gray (5Y 6/1) dry; few medium prominent dark greenish gray (5G 4/1) and grayish green (5G 4/2) mottles; massive; very hard, firm, sticky and plastic; few fine dark masses; few fine distinct horizontal layers of darker material; strongly saline; calcareous; moderately alkaline.

The clayey and loamy alluvium is more than 60 inches thick. Most pedons have a surface layer of dark olive gray mucky peat less than 3 inches thick. Salinity is moderate to strong. The soil is calcareous and moderately alkaline throughout the profile.

The Ag horizons are dark gray or gray. They have no mottles or have few mottles in shades of brown.

The Cg and 2Cg horizons are gray or dark gray fine sandy loam, clay loam, or clay. They have no mottles or have few mottles. Some pedons have strata in shades of red, brown, yellow, or gray.

Rupley Series

The Rupley series consists of very deep, rapidly permeable, somewhat excessively drained sandy soils on uplands. These soils formed in sandy eolian material. Slope ranges from 1 to 5 percent.

Typical pedon of Rupley sand, 1 to 5 percent slopes; from the intersection of Farm Road 822 and U.S. Highway 59 in Edna, 9.6 miles northwest on Farm Road 822, about 0.7 mile southwest and 3.35 miles northwest and southwest on Robinson Ranch road, 0.5 mile southeast on a private road, 550 feet north in a pasture:

A1—0 to 6 inches; brown (10YR 5/3) sand, very pale brown (10YR 7/3) dry; single grained; loose; common fine roots; slightly acid; gradual smooth boundary.

C1—6 to 48 inches; pale brown (10YR 6/3) sand, very pale brown (10YR 7/3) dry; single grained; loose; few fine roots; slightly acid; gradual smooth boundary.

C2—48 to 80 inches; very pale brown (10YR 7/3) sand, very pale brown (10YR 8/3) dry; single grained; few fine faint reddish brown (5YR 4/4) mottles; loose; few fine roots; neutral.

The combined thickness of the A and C horizons is more than 80 inches.

The A horizon is brown, pale brown, light brownish gray, grayish brown, or dark grayish brown. Reaction is slightly acid or neutral.

The C horizons are light brownish gray, pale brown, light gray, and very pale brown. They have few brownish mottles in the lower part of some pedons. They are loamy sand or sand. Reaction ranges from moderately acid to neutral. Some pedons have few fine black masses or concretions.

Swan Series

The Swan series consists of very deep, slowly permeable, very poorly drained clayey soils on bottom land. These soils formed in saline, calcareous, loamy and clayey alluvium. Slope is 0 to 1 percent.

Typical pedon of Swan clay, tide flooded; from the intersection of Farm Road 234 and Farm Road 616 in Vanderbilt, 1.14 miles southwest on Farm Road 616 to a private paved road, 0.95 mile south-southeast on the private paved road to a shell road, 3.35 miles southeast on the shell road to the headquarters of a ranch, 0.75 mile south-southeast and 1.8 miles south-southwest on a shell road, 0.27 mile west on a shell road to an oil well levee, and 0.1 mile north-northeast in an area of rangeland:

Oe—0 to 3 inches; dark olive gray (5Y 3/2) mucky peat (herbaceous), olive gray (5Y 4/2) dry; massive; soft, very friable; many fine and medium roots; strongly saline; moderately alkaline; clear smooth boundary.

Ag—3 to 15 inches; very dark gray (N 3/0) clay, dark gray (N 4/0) dry; many fine faint black (10YR 2/1) mottles; weak fine prismatic structure parting to moderate fine blocky; very hard, firm; few medium and common fine roots; few fine fragments of snail shells; strongly saline; calcareous; moderately alkaline; clear wavy boundary.

Cg1—15 to 30 inches; dark gray (5Y 4/1) sandy clay loam, gray (5Y 5/1) dry; massive; hard, friable; few fine roots; few fine fragments of snail shells; strongly saline; calcareous; moderately alkaline; clear wavy boundary.

Cg2—30 to 48 inches; gray (5Y 6/1) sandy loam, light gray (5Y 7/1) dry; common coarse distinct very dark gray (5Y 3/1) and dark gray (5Y 4/1) mottles; massive; soft, very friable; few fine roots; few fine fragments of snail shells; strongly saline; calcareous; moderately alkaline; clear wavy boundary.

Cg3—48 to 63 inches; light brownish gray (10YR 6/2) loamy sand, light gray (10YR 7/2) dry; many coarse prominent gray (5Y 5/1), common coarse prominent olive (5Y 5/3), and few medium prominent grayish green (5G 5/2) mottles; massive; slightly hard, loose; few fine fragments of seashells; strongly saline; calcareous; moderately alkaline; clear wavy boundary.

Cg4—63 to 80 inches; olive gray (5Y 5/2) loamy sand, light olive gray (5Y 6/2) dry; many medium faint gray (5Y 5/1) mottles; massive; slightly hard, loose; few fine fragments of seashells; strongly saline; calcareous; moderately alkaline.

The alluvial sediments are more than 80 inches thick. The weighted average content of clay in the 10- to 40-inch control section is 18 to 35 percent. Most pedons are calcareous throughout. Reaction is moderately alkaline or strongly alkaline. The salinity ranges from 8 to 25 millimhos per centimeter in most pedons.

The Oe horizon ranges from 0 to 5 inches in thickness. It is in shades of gray or black. The remains of sedges, reeds, cattails and other herbaceous plants are apparent. Much of this material, however, has undergone decomposition and cannot be recognized. The content of mineral soil material is 0 to 25 percent, by volume. Most pedons have an Oe horizon. Areas where fire has occurred, however, may not have an Oe horizon.

The Ag horizon ranges from 10 to 20 inches in thickness. It is in shades of black, gray, and brown. Most pedons have mottles in shades of brown or yellow in the lower part of the horizon.

The Cg horizons are in shades of gray and brown. They have few to many mottles in shades of brown, yellow, gray, or green. They are sandy loam, loam, clay loam, or sandy clay loam. Most pedons have a sandy horizon below the 40-inch control section. Some pedons have a thin, buried A horizon. These horizons have few to many mottles in shades of brown, yellow, gray, or green. Some pedons have a few concretions of calcium carbonate and small seashells.

Telferner Series

The Telferner series consists of very deep, very slowly permeable, moderately well drained loamy soils on uplands. These soils formed in clayey and loamy sediments. Slope is 0 to 1 percent.

Typical pedon of Telferner fine sandy loam, 0 to 1 percent slopes; from the intersection of U.S. Highway 59 and State Highway 111 in Edna, 1.0 mile north on State Highway 111, about 0.12 mile west along a fence, and 1 foot north in a pasture:

A—0 to 14 inches; dark grayish brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; common fine distinct dark yellowish brown (10YR 3/4) mottles; weak fine subangular blocky structure; extremely hard, friable; common very fine and fine roots; slightly acid; clear wavy boundary.

E—14 to 18 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; extremely hard, friable; common very fine and fine roots; slightly acid; abrupt wavy boundary.

Bt1—18 to 33 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; common fine prominent red (2.5YR 4/6) mottles; weak fine and moderate medium subangular blocky structure; extremely hard, extremely firm, sticky and plastic; few fine roots; slightly acid; clear wavy boundary.

Bt2—33 to 41 inches; dark gray (10YR 4/1) clay, gray (10YR 5/1) dry; common medium distinct brown (10YR 5/3) mottles; weak fine and medium subangular blocky structure; extremely hard, extremely firm, sticky and plastic; few fine roots; moderately alkaline; clear smooth boundary.

Bt3—41 to 55 inches; dark grayish brown (10YR 4/2) sandy clay, grayish brown (10YR 5/2) dry; few fine faint pale brown (10YR 6/3) mottles; weak fine subangular blocky structure; hard, very firm, sticky and plastic; few fine roots; moderately alkaline; clear smooth boundary.

Bk—55 to 74 inches; brown (10YR 5/3) sandy clay loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; slightly hard, firm, sticky and plastic; few fine roots; common fine and medium soft concretions of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

2C—74 to 80 inches; very pale brown (10YR 7/3) loamy sand, very pale brown (10YR 8/3) dry; single grained; loose; very friable; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. Some pedons have few to common concretions or soft masses of calcium carbonate below a depth of 36 inches.

The combined thickness of the A and E horizons ranges from 14 to 19 inches. The A horizon is dark gray, dark grayish brown, grayish brown, or light brownish gray. It has no mottles or has few or common mottles in shades of brown or yellow. Most pedons have an E horizon that has lighter colors than those of the A horizon.

The Btg horizons are very dark gray, dark gray, dark grayish brown, grayish brown, or light brownish gray. They have few to many mottles in shades of red, gray, brown, or yellow. They are clay or sandy clay. Reaction is slightly acid or neutral.

The Bk horizon is yellowish brown, brown, or light brown. Reaction is moderately alkaline.

The 2C horizon, if it occurs, is moderately alkaline loamy sand in shades of brown or yellow.

Texana Series

The Texana series consists of very deep, very slowly permeable, somewhat poorly drained soils in broad areas on upland meander-belt ridges. These soils formed in loamy alluvium. Slope is 0 to 1 percent.

Typical pedon of Texana fine sandy loam, in an area of Texana-Cieno complex, 0 to 1 percent slopes (fig. 22); from the intersection of Farm Road 616 and Farm Road 1593 in Lolita, 2.35 miles south on Farm Road 1593, about 1.7 miles east on a private ranch road, and 200 feet south in an area of rangeland:

A—0 to 10 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; many fine faint dark brown (10YR 4/3) mottles; weak fine subangular blocky structure; slightly hard, friable; many fine and common medium roots; common fine pores; slightly acid; clear smooth boundary.

E—10 to 14 inches; grayish brown (10YR 5/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; slightly hard, friable; many fine and common medium roots; common fine pores; few medium and coarse dark nodules in lower 2 centimeters; slightly acid; abrupt smooth boundary.

Bt1—14 to 17 inches; mottled grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) clay; many coarse strong brown (7.5YR 5/8) and common fine medium brown (7.5YR 4/6) mottles; mottles are mainly along root channels and in the interior of the peds; weak medium and coarse prismatic structure parting to weak coarse subangular blocky; very hard, very firm; few fine roots; many faint grayish brown (10YR 5/2) silt grains coating faces of most prisms and peds; common dark grayish brown (10YR 4/2) clay skins; few fine dark rounded nodules and soft masses; slightly acid; gradual wavy boundary.

Bt2—17 to 33 inches; mottled yellowish brown (10YR 5/8), brownish yellow (10YR 6/8), light brownish gray (2.5Y 6/2), and light gray (2.5Y 7/2) clay; few fine and medium prominent red (2.5YR 4/6) mottles; weak coarse prismatic structure parting to moderate coarse subangular blocky; very hard, very firm; few pressure faces; few prominent very dark grayish brown (10YR 3/2) clay skins on faces of peds; common prominent light brownish gray (2.5Y 6/2) silt coatings on faces of most prisms and peds; few fine and medium dark rounded nodules and soft masses; slightly sodic; moderately alkaline; gradual wavy boundary.

Bt3—33 to 44 inches; distinctly mottled brownish, grayish, and yellowish clay loam; moderate coarse prismatic structure parting to moderate coarse angular blocky; very hard, very firm; few fine roots; few fine red (2.5YR 4/6) mottles; many prominent grayish brown (2.5Y 5/2) silt grains coating faces of most prisms and peds; common distinct dark grayish brown (10YR 4/2) clay skins along root channels and on faces of peds; few pressure faces; few fine and medium dark rounded nodules and soft masses; moderately sodic; moderately alkaline; gradual wavy boundary.

Bt4—44 to 56 inches; mottled reddish, brownish, and yellowish sandy clay loam; moderate coarse prismatic structure parting to strong coarse angular blocky; very hard, very firm; few fine roots; common prominent light brownish gray (2.5Y 6/2) silt grains coating faces of most prisms and peds; few distinct grayish brown (2.5Y 5/2) clay skins on faces of some peds; few fine dark rounded nodules and soft masses; few fine mica flakes; moderately sodic; moderately alkaline; gradual wavy boundary.

Btk—56 to 69 inches; mottled brownish and yellowish sandy clay loam; strong coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm; few fine roots; few distinct brown (10YR 5/3) clay skins on faces of peds; many coarse dark masses coating faces of peds; few coarse rounded concretions of calcium carbonate; common fine masses of barite; common fine mica flakes; moderately sodic; moderately alkaline; gradual wavy boundary.

BCt—69 to 80 inches; yellowish brown (10YR 5/6) fine sandy loam, brownish yellow (10YR 6/6) dry; common coarse prominent strong brown (7.5YR 4/6) mottles; weak coarse subangular blocky structure; very hard, firm; few fine roots; few clay skins on faces of peds; common fine mica flakes; moderately sodic; neutral; abrupt wavy boundary.

2C—80 to 90 inches; strong brown (7.5YR 5/6) loamy fine sand, reddish yellow (7.5YR 6/6) dry; few medium and coarse prominent yellowish red (5YR 5/8) mottles; massive; slightly hard, very friable; few coarse rounded brownish and reddish masses of sandy clay loam; common fine mica flakes; slightly sodic; moderately alkaline.

The thickness of the solum ranges from 50 to more than 80 inches. The combined thickness of the A and E horizons ranges from 14 to 22 inches. The content of clay in the upper 20 inches of the argillic horizon ranges from 35 to 45 percent. The sodium adsorption ratio ranges from 1 to about 10 in the upper 16 inches of the Btg horizon, from 6 to 20 in the lower part of the Bt horizon, and from 1 to 10 in the BC and 2C horizons, to a depth of 90 inches. The depth to free carbonates ranges from 30 to 60 inches in most pedons. The number of dark nodules and masses ranges from none to few throughout the profile. Some pedons have white, noncarbonatic masses in the lower part of the Btg and Bk horizons. Most pedons have visible mica at a depth of 40 to more than 80 inches.

The A horizon is very dark brown, very dark grayish brown, or dark brown. The number of brownish or yellowish mottles ranges from none to many. Reaction is slightly acid or neutral.

The E horizon is dark grayish brown, grayish brown, gray, or light brownish gray. The number of brownish or yellowish mottles ranges from none to many. The boundary between the E and Bt horizons is abrupt or clear. Reaction is slightly acid or neutral.

The Bt horizon is mainly in shades of gray and brown. The interior of the peds has few to many reddish, yellowish, and brownish mottles. This horizon is clay, sandy clay, clay loam, or sandy clay loam. Reaction ranges from slightly acid to moderately alkaline.

The Btk horizon is mainly in shades of gray, brown, and yellow. Some pedons have few to many grayish, brownish, or reddish mottles. This horizon is sandy clay loam, clay loam, or clay. It has few or common concretions and soft masses of calcium carbonate and segregated masses of barite. Some pedons are calcareous.

The BC and 2C horizons are mainly in shades of gray, brown, red, and yellow. Some pedons have few or common brownish or reddish mottles. The BC horizon is fine sandy loam, sandy clay loam, or loam. The 2C horizon is fine sandy loam, very fine sandy loam, loamy fine sand, or silt loam. Most pedons have few or common fine mica flakes. Reaction ranges from slightly acid to moderately alkaline.

Zalco Series

The Zalco series consists of very deep, rapidly permeable, somewhat excessively drained sandy soils on flood plains. These soils formed in calcareous, sandy alluvium. Slope is 0 to 1 percent.

Typical pedon of Zalco fine sand, frequently flooded; from the intersection of U.S. Highway 59 and Farm Road 234 in El Toro, 4.1 miles southeast on Farm Road 234, about 1.8 miles southwest, 0.7 mile southeast, and 1.0 mile southwest on a paved county road, 1.1 miles southwest on a private shell road to the headquarters of a farm, and 0.5 mile south-southwest in an area of rangeland on a natural levee on the east bank of Arenosa Creek:

A1—0 to 5 inches; brown (10YR 5/3) fine sand, pale brown (10YR 6/3) dry; single grained; loose; few fine roots; moderately alkaline; clear smooth boundary.

C1—5 to 20 inches; pale brown (10YR 6/3) fine sand, very pale brown (10YR 7/3) dry; single grained; loose; few fine roots; calcareous; moderately alkaline; clear smooth boundary.

C2—20 to 32 inches; pale brown (10YR 6/3) fine sand, very pale brown (10YR 7/3) dry; single grained; loose; few fine roots; common thin strata of silt loam and loam; calcareous; moderately alkaline; clear wavy boundary.

C3—32 to 60 inches; very pale brown (10YR 7/3) sand, very pale brown (10YR 8/3) dry; single grained; loose; calcareous; moderately alkaline.

The sandy alluvial sediments are more than 80 inches thick. Texture is fine sand or sand throughout the profile. The C horizon has thin, loamy strata throughout. Reaction ranges from neutral to moderately alkaline throughout the profile. Most pedons are calcareous.

The A horizon is grayish brown, very pale brown, or pale brown.

The C horizons are grayish brown, pale brown, brown, or light yellowish brown.

Formation of the Soils

In this section the factors of soil formation are related to the formation of the soils in Jackson County. Also, processes of horizon differentiation and the surface geology of the county are described.

Factors of Soil Formation

Soil is formed by the action of soil-forming processes on material deposited or accumulated by geological forces. The characteristics of a soil depend on the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and has existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time the forces of soil development have acted on the soil material.

Climate and living organisms are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and living organisms are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into soil. Generally, a long time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other factors.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It affects the chemical and mineral composition of the soil. The parent material in Jackson County consists of loamy and clayey sediments deposited by ancient streams and rivers. Some of the loamy and clayey sediments have been reworked and modified by the wind. Some areas have windblown sands. The geology of the parent material is described in the section "Surface Geology."

Climate

Precipitation, temperature, and wind have had a major effect on the formation of soils in Jackson County.

Wetter or drier climates in the past had an effect on how parent material was deposited. The climate was drier when the sandy parent material of the Kuy and Rupley soils was deposited by wind. The climate was similar to the present one when the loamy and clayey parent material of the Dacosta and Laewest soils was deposited by rivers.

Jackson County has a humid subtropical climate. The climate is uniform throughout the county. The dominant climatic influence on soil formation has been precipitation, which has caused the translocation of carbonates and clays. The moderate amount of rainfall has resulted in moderately rapid soil formation.

Plant and Animal Life

Plants, micro-organisms, earthworms, and other living organisims have contributed to the formation of the soils. They provide organic matter, help to decompose plant residue, influence the chemistry of the soil, and contribute to soil development. Gains in content of organic matter and nitrogen in the soil, gains and losses in plant nutrients, and changes in structure and porosity are caused by plants and animals.

The dominant native vegetation in most of the county consisted of prairie plants. Soils that formed under this vegetation, such as Dacosta, Laewest, and Texana soils, have a dark-colored surface layer that contains an appreciable amount of organic matter. In some parts of the county, however, the native vegetation was dominantly woody plants. Soils that formed under these plants, such as Morales and Kuy soils, have a lighter colored surface layer that has less organic matter than the soils that formed under prairie vegetation.

Relief

Relief influences soil development through its effect on drainage and runoff. If other factors are equal, the degree of profile development depends mainly on the average amount of water in the soil. Soils in nearly level areas, such as Texana soils, absorb more water and generally have a more distinctly developed profile than soils in the more sloping areas, such as the Marcado soils, which erode almost as rapidly as they form.

Relief also affects the kind and amount of vegetation on a soil. Slopes that face north and east receive less direct sunlight and lose less moisture through evaporation than slopes facing south and west. As a result, vegetation is usually more dense on slopes that face north and east. Nearly level soils or those in slightly concave positions, such as Dacosta soils, receive more runoff than sloping soils and thus produce more vegetation. As a result, they generally have more organic matter and are darker in color.

Time

The length of time that the soil-forming factors have acted on the parent material determines, to a large degree, the characteristics of the soil. Usually a long time is required for formation of soils that have distinct horizons. In Jackson County, Chicolete and Swan soils are young soils that have little horizon development. Texana soils are older soils. They have better developed horizons and are deeper than younger soils.

Processes of Horizon Differentiation

Soils are derived from the decomposition of the mineral particles they contain and from the plant and animal remains added to them. Silicate clays, mineral particles, humus, living organisms, and water have a major influence in determining the character of the soil. Soil layers, or horizons, are formed by additions, removals, transfers, and transformations within the soil profile *(32)*. These processes include additions or losses of organic, mineral, and gaseous materials to the soil, transfers of material from one point to another within the soil, and physical and chemical transformation of mineral and organic materials within the soil. In most soils, more than one of these processes have been active in the development of horizons and many processes occur simultaneously.

Soil profiles are made up of a series of horizons that extend from the surface to the parent material. The parent material has been influenced little by the processes of soil formation. The horizons that make up a soil profile differ in one or more properties, such as color, texture, structure, consistence, porosity, and reaction.

Most profiles have four major horizons. These are the A, E, B, and C horizons. Some soils do not have E or B horizons.

The A horizon is the surface layer. It is the horizon that has the maximum accumulation of organic matter. Organic matter has accumulated, partially decomposed, and been incorporated into the soil. The accumulation of organic matter in soils is greatest in and above the surface layer. In very wet areas, such as marshes, a thin horizon of organic matter may form above the A horizon. Many of the more stable products of organic matter decomposition remain as finely divided materials that result in darker colors, increased water-holding and cation-exchange capacities, and granulation of the soil.

The content of organic matter in the soils in Jackson County ranges from low to medium. Texana, Dacosta, Laewest, Chicolete, and Ganado soils have accumulated sufficient organic matter to form a dark surface layer, or A horizon.

The E horizon is the subsurface layer. It is below the A horizon. It is characterized by the leaching of dissolved or suspended materials. Clay particles, organic matter, and oxides of free iron have been leached from the E horizon, leaving a concentration of light-colored sand and silt particles or other resistant materials. Fordtran, Milby, and Texana soils have well developed E horizons.

The B horizon is the subsoil. It is directly below the A or E horizons. It is the horizon that has the maximum accumulation of dissolved or suspended materials, such as clay and iron. It may also be an altered horizon that has a distinctly different structure than that of the A horizon but shows little evidence of clay translocation or accumulation.

A B horizon that has a significant amount of clay accumulation is called a Bt horizon. Clay accumulates in horizons largely because of translocation from upper to lower horizons. As water moves downward, it can carry small amounts of clay in suspension. This clay accumulates at depths penetrated by water. It accumulates in fine pores in the soil and as clay films on surfaces of peds. Over long periods of time, at least a few thousand years, such processes can result in distinct horizons. Edna, Milby, Morales, Telferner, and Texana soils are examples of soils that have strongly developed Bt horizons. Dacosta soils have a less developed Bt horizon.

A B horizon that has distinct structure or color development with little or no evidence of clay accumulation is called a Bw horizon. Plant roots and other organisms contribute to the rearrangement of soil materials into secondary aggregates. Organic residues and secretions of organisms serve as cementing agents that help stabilize structural aggregates. Soils that have appreciable amounts of clay develop structural aggregates because of drying and wetting and because of shrinking and swelling.

Some soils in Jackson County have a high content of clay that has montmorillonite as the dominant clay mineral. These soils shrink and develop wide, deep cracks when dry and swell and become very plastic and cohesive when wet. Because of overburden pressure, soil movement, and stress caused by wetting and drying, a platy and wedge-like structure can form in the Bss horizon. Individual structural aggregates have distinct cleavage planes and polished faces known as slickensides. When the soil is dry, soil material from the surface often falls into the wide, deep cracks or is washed into the cracks by rain. When the soil is wet, lateral pressure caused by the swelling can result in surface heaving, which eventually leads to the formation of gilgai microrelief that consists of microknolls and microdepressions. This gilgai microrelief is locally referred to as "hogwallow land." Laewest and Francitas soils have Bss horizons that have slickensides. They have gilgai microrelief.

The C horizon is relatively unchanged by soil-forming processes, although in some places it is modified by weathering. It is generally below the B horizon, such as in Laewest and Morales soils. In some alluvial sediments near streams, rivers, and bays, the C horizon is directly below the A horizon. Placedo, Swan, and Zalco soils have C horizons directly below A horizons.

A horizon that is gray and shows evidence of reduction and segregation of iron compounds is designated by the addition of the symbol "g." Relatively long periods of wetness in poorly aerated horizons can reduce the amount of these iron compounds. In the more soluble, reduced form, appreciable amounts of iron can be translocated by water from one position to another within the soil. The presence of brown, yellow, or red mottles in predominantly gray horizons indicates segregation and local concentration of oxidized iron compounds as a result of oxidizing and reducing (wetting and drying) conditions in the soil. Aransas, Cieno, Placedo, and Swan soils are examples of soils that have mottles in these colors.

Another important process in soil formation is the loss of components from the soil. Water can leach many soluble components, such as calcium carbonate, to the lower horizons in the profile. A horizon that has a significant accumulation of calcium carbonate is designated by the addition of the symbol "k." Other accumulations of soluble components, such as exchangeable sodium, is designated by the addition of the symbol "n". Ganado, Inez, Marcado, Palacios, and Texana soils are examples of soils that have accumulations of calcium carbonate in the lower horizons. Livco and Palacios soils are examples of soils that have accumulations of other soluble components, such as exchangeable sodium.

Surface Geology

Prepared by Saul Aronow, Department of Geology, Lamar University, Beaumont, Texas.

Jackson County lies in the West Gulf Coastal Plain geomorphic unit *(14)*. The formations in the unit dip toward the gulf at an angle less than 3 degrees. They crop out in bands that parallel the gulf coast and are broken by normal faults that dip toward the gulf *(23)*.

The central part of the county is drained by the Lavaca and Navidad Rivers, the southwestern part is drained by Garcitas and Arenosa Creeks, and the southeastern part is drained by Carancahua Creek. All of these rivers and creeks flow into subbays of the Matagorda Bay complex. The streams belong to the intrabasinal group of smaller Gulf Coast streams that have drainage basins that are essentially confined to the coastal plain *(10)*. They have incised channels and are depositing small bayhead deltas into drowned lower channel portions. The major streams of the Texas Gulf Coast, however, are extrabasinal streams, such as the Rio Grande and Colorado Rivers, and have drainage basins that extend well beyond the coastal plain or are basin-fringe streams, such as the Guadalupe River, and have drainage basins that include areas peripheral to the coastal plain. The basin-fringe rivers are building deltas into drowned valleys. The larger, extrabasinal streams fill the drowned lower valleys and flow directly into the gulf.

The surface geology of Jackson County is shown on several regional maps *(1, 16, 17, 30, 31)*. The surface geologic units in the county are all Pleistocene or younger in age, less than 2.5 million years old. The oldest unit is the Lissie Formation, which crops out in the northwestern part of the county. The next youngest unit is the Beaumont Formation in the southeastern part of the county. The Lissie and Beaumont Formations are both Pleistocene in age and contemporaneous with several global advances and retreats of continental ice and the associated fall and rise in sea level.

The youngest units in the county are Holocene in age, about 10,000 years old. They include the flood plain deposits along the major and minor streams, the deltas being built in Lavaca and Carancuhua Bays, and the shoreline features around the edges of the bays. The terraces that flank the Lavaca River are possibly late Pleistocene in age.

Lissie and Beaumont Formations

The Lissie Formation is probably mid Pleistocene in age. It crops out in the northwestern part of the county in areas of the Morales-Cieno, Nada-Cieno, and the northern part of the Inez-Milby general soil map units. It consists of sediments of fluvial and deltaic origin that are the parent materials of the soils in these units. The exposed sediments have been modified in the past hundred thousand years or more by weathering, mass wasting, water erosion, and eolian activity.

The surface of the Lissie Formation is a plain that slopes 5 to 10 feet per mile toward the gulf. In contrast with the younger Beaumont Formation, the surface of the Lissie Formation has lost all traces of any relict depositional topography. This is mainly because of modification by wind action. The surface is characterized by a random distribution of isolated low mounds (pimple mounds) and undrained circular to oval depressional areas of Cieno soils.

In many areas of the Gulf Coastal plain, the formations of Pleistocene age are separated by slightly discernable scarps. In Jackson County, however, the formations can be discriminated topographically only by the increase in surface slope between the Beaumont Formation and the Lissie Formation.

The Beaumont Formation is of late Pleistocene age. It crops out in the southeastern four-fifths of the county. It underlies the Laewest-Dacosta, Livco, Palacios-Francitas, Telferner-Edna, Texana-Edna, and the southern part of the Inez-Milby general soil map units. The surface of the Beaumont Formation slopes about 2 to 5 feet per mile toward the Gulf.

The Beaumont Formation along the Texas Gulf Coast is the product of laterally coalescing alluvial plains. It was deposited during the Pleistocene age by streams that now drain into the Gulf of Mexico. In Nueces County, the Beaumont Formation was deposited by a paleo-Nueces River. In Jefferson County, the Beaumont Formation was deposited by a paleo-Trinity River. In Jackson County, almost all of the Beaumont Formation was deposited by paleo-Colorado, paleo-Lavaca, and paleo-Navidad Rivers.

The surface of these alluvial plains of late Pleistocene age have relict depositional topography. The varying degrees of deterioration of the fluvial patterns determines at least the broad soil patterns shown on the general soil map.

The major relict patterns on the Beaumont Formation that surface in Jackson County and in other areas of the Texas Gulf Coast consist of meander-belt ridges, generally with a local relief of 5 to 10 feet, and lower flood basins. The meander-belt ridges have loamy and sandy soils, pimple mounds, undrained depressions, and segments of meandering stream channels. The lower flood basins have clayey and loamy soils that have a high shrink-swell potential. The clayey flood basins in many places have a smooth to slightly "wormy" appearance on aerial photographs, which is an indication of gilgai microrelief *(12)*. In most places the patterns of meander-belt ridges are anastomosing or reticulate, as a result of numerous changes in the courses of depositing streams.

In Jackson County, soils in the Lawest-Dacosta and Palacios-Francitas general soil map units were formed from flood basin deposits. Soils in the Telferner-Edna, Texana-Edna, and Livco general soil map units were formed from materials on the meander-belt ridges.

The surface of the Beaumont Formation east of the Lavaca River and Lake Texana and south of Mustang Creek was probably deposited by a larger extrabasinal paleo-Colorado River. The entwining pattern of the Texana-Cieno, Telferner-Edna, and Livco general soil map units shows the shifting courses of this paleo-stream. The trend of the relict meander-belt patterns provides evidence that this part of the Beaumont Formation originated with the paleo-Colorado River *(10, 16, 17)*. This has been confirmed by a study on the distribution of biotite mica in soils that have parent material that originated with the Colorado River *(15)*. The remainder of the Beaumont Formation was deposited principally by paleo-Lavaca and paleo-Navidad Rivers.

The relict meandering stream and point-bar patterns on the paleo-stream terraces in Wharton, Brazoria, Harris, Galveston, Chambers, and Jefferson Counties are more distinguishable. In many areas in these counties, specific soils are associated with the fillings in relict channels and point-bar deposits. In Jackson County, the relationship between soils and geomorphic features is more difficult to recognize because the features are smaller and the margins are blurred.

The obscurity of meander-belt ridges in this area may be the result of age differences within the Beaumont Formation, the small size of meander patterns that were produced by the Lavaca and Navidad Rivers, and increased surface modification caused by eolian processes, probably resulting from a steady decrease in rainfall along the Texas coast to the southwest.

Even though the meander-belt ridges are not as well preserved in Jackson County as in counties to the north, a few can be seen on the detailed soil maps. A comparison of fairly recent aerial photographs used for the soil base maps with aerial photographs made in previous decades shows better preserved meander-belt ridges on the earlier photographs. This hastening of natural processes was probably a result of intensive cultivation, drainage, and land leveling.

A well preserved meandering channel segment is shown in the southeast corner of sheet 18 and on part of sheet 19 of the detailed soil maps. The channel merges into a tributary of West Carancahua Creek. It is a relict paleo-Colorado River channel.

The contrast between the partly preserved depositional patterns on the surface of the Beaumont

Formation versus the relatively uniform surface of the Lissie Formation is probably because of age. Because the Lissie Formation is older, eolian, mass wasting, sheet flow, erosional, and organic processes have had more time to obliterate surface details.

The relationship between the general soil map units and the Pleistocene geologic units has shown some correlation, however, a few irregularities exist. For example, a small part of the Nada-Cieno general soil map unit that is northeast of Ganado on the county line is within the outcrop area of the Beaumont Formation *(30)*. All other parts of this map unit, however, are within areas of the Lissie Formation. This may be because another formation exists that is not included with the Lissie or Beaumont Formations *(30, 31)*. Another example of an irregularity is the occurrence of the Inez-Milby general soil map unit in areas of both the Lissie and Beaumont Formations. This may be the result of eolian activity that occurred during the early Holocene period.

During the Pleistocene age, at least six continental ice advances caused sea levels to drop. Sea levels during this time were probably 300 to 450 feet below the present sea level. Streams draining into the Gulf of Mexico incised channels near the coast. With the rises in sea level accompanying the melting of the glaciers, these channels were flooded. Later, the drowned channels were again alluviated by advancing deltas. Finally, the streams prograded alluvial plains or aprons across the shallow continental shelves. According to most geologists, the Beaumont and Lissie Formations were deposited during the periods of rising sea levels and high sea levels *(5, 19)*. Because the western and northern margins of the Gulf Coast have been continuously subsiding toward the gulf, the surfaces of older units have steeper inclinations toward the gulf than the surfaces of younger units.

The Lissie Formation is probably more than 100,000 years old. It may have formed during a period of high sea levels that is older than the Sangamon period (the major interglacial period between the major Illinoian and Wisconsin glaciations). According to the Geologic Atlas Sheets, the Lissie Formation has been subdivided into two units, a younger Montgomery Formation (upper Lissie) and an older Bentley Formation (lower Lissie) *(29, 30, 31)*. The concept of the Pleistocene formations originating during high sea sevels suggests that there may have been two rises in sea levels rather than one. This may explain why one area of the Nada-Cieno general soil map unit is in an area of the Beaumont Formation. This area may be younger than the Lissie Formation and older than the Beaumont Formation.

The Beaumont Formation may have been deposited during the Sangamon interglacial period 75,000 to 120,000 years ago or during a rise in sea levels during the Wisconsinan period 30,000 to 40,000 years ago. Available radiocarbon dates yield ambiguous results. The Beaumont Formation may be a fusion of clay-rich alluvial deposits of diverse ages.

Stream Terraces and Eolian Deposits

Stream terraces in Jackson County occur only along the upper reaches of the Lavaca River and along a major tributary, Chicolete Creek, near the place where it enters the Lavaca River *(30, 31)*. The terraces are somewhat difficult to identify because their surfaces have been modified by stabilized dunes and deflationary depressions. The surface of the terraces is 15 to 25 feet above the level of the flood plains.

The stream terraces are in an area where the Lavaca River and Chicolete Creek are enclosed by the Lissie Formation, that is, inland from the contact point of the Lissie and Beaumont Formations. In the absence of detailed mapping in this area it is suggested that the terraces may be inland extensions of the Beaumont Formation. No such correlation is shown on the geologic map, however *(30)*. Small areas of the Dacosta soil occur on terraces of the Lavaca River. Otherwise, this soil occurs almost exclusively in areas of the Beaumont Formation.

The major soils on the stream terraces are the Milby, Kuy, and Rupley soils. They have thick, sandy A and E or A and C horizons. The presence of these soils on mounded, stabilized dunes indicates that the upper part of the Milby and Kuy soils and all of the Rupley soil are eolian in origin.

Generally, the soils that have the thickest sandy surface layer have mounded topography. The mounds are rounded to elongated or are shaped like bowling pins. They range from 0.2 to 0.75 mile in length and from 5 to more than 15 feet in height. The soils that make up these mounds also are on adjacent flood plains and upland areas of the Lavaca River and other streams. Most areas of these soils are in the Inez-Milby general soil map unit. The Inez soil is of minor extent on the flatter terraces but is of major extent in the uplands.

The occurrence of soils associated with the stream terraces, especially the Milby, Kuy, and Rupley soils, in other areas may indicate considerable eolian activity during the Holocene period. This could explain the occurrence of soils in the Inez-Milby general soil map unit in areas of both the Beaumont and Lissie Formations.

The Holocene flood plains of the soils with eolian components occurs along the Lavaca River as it flows through outcrop areas of the Lissie and Beaumont Formations. Within the outcrop area of the Lissie

Formation on map sheets 5 and 10, for example, the Kuy soil is on a Holocene point bar in the vicinity of oxbow lakes (abandoned meander loops). The Kuy and Rupley soils are in a similar area within the Beaumont Formation, almost directly north of Vanderbilt on map sheet 33. Near this is an area of the Fordtran soil at about the same elevation that has thick, sandy A and E horizons. It merges with other eolian soils. The Fordtran soil also is shown on map sheet 23 on a dunelike mound along the Holocene flood plain of the Lavaca River.

Most of the Inez-Milby general soil map unit occurs in upland areas rather than on stream terraces. Areas of this map unit are along the upper reaches of the Lavaca and Navidad Rivers and on part of the interfluve between these rivers. A large part of this unit also occurs in the drainage basin of Sandy Creek, a major tributary of the Navidad River.

The Inez soil has a loamy A horizon and typically does not occur in mounded, constructional areas. It generally is not believed to be eolian in origin, however, but it is associated with the Milby, Kuy, and Rupley soils and occurs on terraces and on flatter uplands around the margins of flood plains and stream channels, which suggests that it has some eolian components.

Sandy or loamy stream terraces, such as those along the Lavaca River and Chicolete Creek, are the obvious local source for the sand and silt in soils such as the Milby, Kuy, Rupley, and Inez soils. In those areas where terraces do not occur, the major source of sand and silt must have been the Holocene age flood plains of the major and minor streams. Eolian deposition may be occurring today and may have occurred during the droughty years of the 1930's. The main eolian deposition from flood plain sources, however, probably occurred during one or more arid periods in the past 10,000 years or since the flood plains were alluviated to their present levels and graded to current sea levels.

The upper parts of the sola in the Milby, Kuy, Rupley, Fordtran, and Inez soils may be eolian in origin. Other soils that are on mounds in upland areas and have a thick A and E horizon may also be eolian in origin. These include the Texana, Livco, Telferner, Morales, and Nada soils. Pedogenesis could have occurred during the accumulation of eolian components. Some kind of genetic discontinuity, however, may occur between the sandy and loamy A and E horizons and the more clayey subsoils.

Holocene Deposits

The soils of Holocene age that have surface layers less than 10,000 years old include almost all of the soils in the Chicolete-Navidad and Swan-Aransas general soil map units. These soils formed on flood plain and delta deposits. They cover about 36,000 acres, or about 7 percent of the county. About 78 percent of these soils have a clayey surface layer and about 25 percent have a loamy or sandy surface layer.

Along the upper reaches of the Navidad River in Jackson County, the loamy Navidad soil and the Chicolete soil that has a clayey surface layer and loamy and sandy clay substrata are dominant. Near the junction of the Navidad River and the Lavaca River, the Navidad soil does not occur and the Chicolete and Ganado soils that have a clayey surface layer are more common.

The Navidad soil also is on narrow flood plains that make up the Sandy Creek drainage basin. These flood plains are mostly within the Inez-Milby general soil map unit in the northeastern part of the county.

In the northwestern part of the county, the Navidad soil and the sandy Zalco soil are along the flood plain of Chicolete Creek. The Navidad soil also is along the flood plain of the Lavaca River from the northern edge of the county southeast to an area near the community of Morales where the Chicolete and Ganado soils become dominant. The Chicolete and Ganado soils merge with the saline, clayey Placedo, Swan, and Aransas soils in the Lavaca River flood plain below Lake Texana. Placedo and Swan soils are the major soils in the delta area of the Lavaca River.

The finer surface soils and sediments generally are downstream on flood plains. The loamy Navidad and the clayey Chicolete soils that have mostly loamy subsoils generally are on point bars and levees. Soils that have thicker clayey layers, such as Ganado soils, occur in abandoned stream channels and flood basins. Clayey soils occur in many places, especially downstream.

Many areas of the windblown Milby and Kuy soils that have a sandy surface layer and a few areas of the Rupley soils are parallel to the flood plains of the Lavaca and Navidad Rivers and Sandy Creek. The materials on the surface of the present flood plain are those left after the most modern floods. Because of the absence of sandy sediments on flood plains, the sources of sand for the Milby, Kuy, and Rupley soils are probably buried beneath the present surface of the flood plain or are completely scoured out. During one or more arid periods during the Holocene period, stream discharges and velocities were greater and more sand may have covered point bars and levees. Although lower rainfall is often associated with lower stream discharges, the lack of vegetation may enhance slope runoff and stream discharge.

The rise in sea level since its low stand about 18,000 years ago has been intermittent. The river channels that were incised and graded to a lower sea level were gradually flooded and enlarged by shoreline erosion. Near the entrance to Lavaca Bay in Calhoun County, the Pleistocene surface was incised to a little more than 100 feet below sea level. Near the Lavaca River delta, this surface was cut to a little more than 60 feet below sea level. About 2 miles downstream from the confluence of the Lavaca and Navidad Rivers, the Pleistocene surface was incised to slightly more than 40 feet below sea level *(33)*. The steep walls of the flood plain of the Lavaca River, extending north of this confluence, may have been cut by shoreline erosion during the last rise in sea level. If so, the processes of alluviation and delta formation by the river did not keep pace with the erosion around the estuarine margins and with the rise in sea level *(33)*. Carancahua Creek flows into a meandering, steep-walled estuary, Carancahua Bay, which probably was formed by similar processes of erosion. Sea level stabilized at its present level about 3,000 to 2,500 years ago.

At present, the shorelines of the Lavaca and Carancahua Bays are eroding at a rate of about 1 to 2 feet per year *(18)*.

Microrelief Features

Several microrelief features, including gilgai, pimple mounds, and undrained depressions, occur in Jackson County.

Gilgai is a topographical feature that consists of microknolls and microdepressions in a cyclic pattern, with a relief of less than 1 foot. The center of the microknolls is 4 to 16 feet from the center of the microdepressions. Although areal gilgai patterns vary by region, in many places in Jackson County the microdepressions are interconnected and the microknolls are isolated. Gilgai is mainly restricted to the Vertisols, such as Laewest, Francitas, and Ganado soils. Several processes have been suggested for the origin of gilgai microrelief *(12)*. The process most widely accepted as an origin is associated with the expansive nature of the smectite type of clays that make up the Vertisols. When these clays dry out, the surface cracks because of a loss in the volume of water. The cracks partially fill with soil material dislodged from the adjacent surface. Water moves rapidly into the soil through the cracks. The subsurface clay now has a greater volume, and it rehydrates and expands. The lateral and upward expansion of the clay produces the microknolls *(21)*. The clay shears in the subsoil and moves along shiny, striated, and slightly curved surfaces called slickensides.

Mounds are not original depositional features. Their formation on local Pleistocene surfaces represents a modification or deterioration of what was originally fluvial depositional topography. In Texas and Louisiana, mounds are known as pimple mounds. In the rest of the United States they are called mima mounds or prairie mounds. Many theories for the origin of these mounds have been proposed. Some theories are universal in scope, while some are strictly regional *(6, 7, 8, 11)*. In the Gulf Coast area, mounds may have formed through erosional, eolian, and organic processes.

Pimple mounds are scattered over the surface of the Lissie and Beaumont Formations and are generally less than 150 feet in diameter and less than 2.5 feet in height. They are round to elongated. They are mainly on the meander-belt ridges in areas of the Beaumont Formation. The soils occurring on the mounds include Fordtran, Texana, Livco, Telferner, and Morales soils. In map units where a soil occurs both on mounds and intermounds, the soil on the mounds has a thicker A and E horizon.

Undrained depressions are on the surface of both the Lissie and Beaumont Formations but are not on the Holocene surface. In Louisiana, similar depressions on the Pleistocene surface are called bagols, baygalls, or pockmarks *(9)*. In the forested areas of Texas, undrained depressions are called flatwoods ponds. In Jackson County, the Cieno soils occur in these depressions.

One theory proposes that the depressions originated at the same time as alluvial plain deposition and that they are the partly filled remnants of abandoned stream channels and point-bar swales that are subject to periodic overbank flood-basin deposition *(9)*. A few of the relict channels on the Beaumont Formation may illustrate this theory, especially in the Texana-Cieno general soil map unit. On the Lissie Formation, which lacks any relict depositional topography, the depressions are evenly distributed over the whole surface. The theory could be applied to Holocene alluvial plains and flood plains along large streams, but it does not explain the formation of these plains and their surface, which is similar to that of the Lissie Formation. A more probable theory is that the depression in the south Texas area resulted from a deflationary or blow-out process. The material from the small basins may have been incorporated into mounds and, in general, into the sola of the surrounding soils at the slightly higher elevations. Alternative explanations, such as surface collapse resulting from the solution of subsurface materials (such as calcium carbonate) or the physical downward translocation of fine-grained material (piping), do not seem applicable.

References

(1) Achalabhuti, C. Pleistocene depositional systems of central Texas coastal zone. Unpublished Ph.D. dissertation completed in 1973 at University of Texas, Austin, Texas.

(2) American Association of State Highway and Transportation Officials. 1986. Standard specifications for highway materials and methods of sampling and testing. Ed. 14, 2 vols.

(3) American Society for Testing and Materials. 1993. Standard classification of soils for engineering purposes. ASTM Stand. D 2487.

(4) Austin, Morris E. 1965. Land resource regions and major land resource areas of the United States. U.S. Dep. Agric. Handb. 296.

(5) Bernard H.A., and R.J. LeBlanc. 1965. Resume of the quaternary geology of the northwestern Gulf of Mexico Province. *In* The Quaternary of the United States. Princeton Univ. Press, pp. 137-185.

(6) Carty, D.J. Characteristics of pimple mounds associated with the Morey soil of southeast Texas. Unpublished master's thesis completed in 1980 at Texas A&M University, College Station, Texas.

(7) Cox, G.W. 1984. Mounds of mystery. *In* Natural History, vol. 93, no. 6, pp. 36-45.

(8) Cox, G.W., and C.G. Gakahu. 1986. A latitudinal test of the fossorial rodent hypothesis of mima mound formation. Zeitschrift fur Geomorphologie 30: 485-501.

(9) Fisk, H.N. 1940. Geology of Avoyelles and Rapides Parishes. La. Geol. Surv. Bull. 18.

(10) Galloway, W.E. 1982. Depositional architecture of cenozoic gulf coastal plain fluvial systems. Univ. Tex., Bur. Econ. Geol. Circ. 82-5.

(11) Goodarzi, N.K. Geomorphological and soil analysis of soil mounds in southwest Louisiana. Unpublished master's thesis completed in 1978 at Louisiana State University, Baton Rouge, Louisiana.

(12) Gustasvson, T.C. 1975. Microrelief (gilgai) structures on expansive clays of the Texas coastal plain—their recognition and significance in engineering construction. Univ. Tex., Bur. Econ. Geol. Circ. 75-7.

(13) Hogg, R.V., and E.A. Tanis. 1977. Probability and statistical inference.

(14) Hunt, C.B. 1974. Natural regions of the United States and Canada.

(15) Jacob, J.S., S. Aronow, L.P. Wilding, and W.L. Miller. 1986. Pleistocene Colorado delta (Texas) soils and geomorphology. Agron. Abstr., Am. Soc. of Agron.

(16) McGowen, J.H., L.F. Brown, T.J. Evans, W.L. Fisher, and C.G. Groat. 1976. Environmental geologic atlas of the Texas coastal zone—Bay City-Freeport area. Univ. Tex., Bur. of Econ. Geol.

(17) McGowen, J.H., L.F. Brown, T.J. Evans, W.L. Fisher, C.G. Groat, and C.V. Proctor. 1976. Environmental geologic atlas of the Texas coastal zone—Port Lavaca area. Univ. Tex., Bur. of Econ. Geol.

(18) Morton, R.A., and M.J. Pieper. 1976. Shoreline changes on Matagorda Island and San Jose Island (Pass Cavello to Aransas Pass)—an analysis of historical changes of the Texas gulf shoreline. Univ. Tex., Bur. of Econ. Geol. Circ. 76-4.

(19) Morton, R.A., and W.A. Price. 1987. Late Quaternary sea-level fluctuations and sedimentary phases of the Texas coastal plains and shelf. *In* Sea-level fluctuations and coastal evolution. Soc. of Econ. Paleontol. and Mineral., Spec. Publ. No. 41: 181-198.

(20) Newcomb, W.W., Jr. 1961. The Indians of Texas from prehistoric to modern time.

(21) Newman, A.L. 1983. Vertisols in Texas—some comments. *In* Soil Survey Horizons, vol. 24, no. 2, pp. 8-20.

(22) Richardson, R.N., E. Wallace, and A.N. Anderson. 1970. Texas, the lone star state.

(23) Solis, R.F. 1981. Upper Tertiary and Quaternary depositional systems, central coastal plain, Texas—regional geology of the coastal aquifer and potential liquid-waste repositories. Univ. Tex., Bur. of Econ. Geol. Rep. Invest. 108.

(24) Taylor, I.T. 1938. The cavalcade of Jackson County.

(25) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436.

(26) United States Department of Agriculture. 1984 (rev.). Procedures for collecting soil samples and methods of analysis for soil survey. Soil Surv. Invest. Rep. 1.

(27) United States Department of Agriculture. 1985. The 1982 national resources inventory statistical tables of Texas.

(28) United States Department of Agriculture. 1993. Soil survey manual. U.S. Dep. Agric. Handb. 18.

(29) University of Texas, Bureau of Economic Geology. 1968. Geologic atlas of Texas, Beaumont sheet.

(30) University of Texas, Bureau of Economic Geology. 1974. Geologic atlas of Texas, Seguin sheet.

(31) University of Texas, Bureau of Economic Geology. 1975. Geologic atlas of Texas, Beeville-Bay City sheet.

(32) Wilding, L.P., N.E. Smeck, and G.F. Hall. 1983. Pedogenesis and soil taxonomy, II: The soil orders.

(33) Wilkinson, B.H., and J.R. Byrne. 1977. Lavaca Bay—transgressive deltaic sedimentation in central Texas estuary. Am. Assoc. Pet. Geol. Bull. 61: 527-545.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

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. 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.

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:

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.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

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.

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.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

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.

Coarse textured soil. Sand or loamy sand.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

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.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

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.

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.

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 soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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 human or animal activities or of a catastrophe in nature, such as fire, that exposes the surface.

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 salt (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.

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.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant that is not a grass or a sedge.

Fragile (in tables). The soil is easily damaged by use or disturbance.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, this is the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

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 7.6 centimeters) in diameter. An individual piece is a pebble.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

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.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

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 uppercase letter represents the major horizons. Numbers or lowercase 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.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

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 accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or 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, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated rock (unweathered bedrock) beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

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.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

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 plants that are the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material. This contrasts with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

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:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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.

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.

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.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or 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).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR $^6/_4$ is a color with hue of 10YR, 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.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

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 affects the specified use.

Permeability. The quality of the soil that enables water to move through the profile. Permeability is measured as the number of inches per hour that water moves 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, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Subsurface tunnels or pipelike cavities are formed 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.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

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.

Rangeland. Land on which the potential climax 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 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 the 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 degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly 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.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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 the growth of plants. A saline soil does not contain excess exchangeable sodium. The classes of soil salinity, expressed as millimhos per centimeter (mmhos/cm) of electrical conductivity, are:

Nonsaline	less than 2
Very slight	2 to 4
Slight	4 to 8
Moderate	8 to 16
Strong	more than 16

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.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil 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.

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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to Ca^{++} + Mg^{++}. The degrees of sodicity are:

Nonsodic	less than 6:1
Slight	6-13:1
Moderate	13-30:1
Strong	more than 30:1

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, in millimeters, of separates recognized in the United States are as follows:

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, E, 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.

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).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

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 E horizon. Generally refers to a leached horizon lighter in color and lower in organic matter content than the overlying surface layer.

Surface layer. Techically, the A horizon in mineral soils.

Generally refers to the uppermost mineral layer of soil. Includes the "Ap horizon" or "plow layer."

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 on the contour or at a slight angle to the contour across sloping soils. 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). An otherwise suitable soil material that is 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 topdress roadbanks, lawns, and land affected by mining.

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 meltwater. In nonglaciated regions, alluvium deposited in stream valleys by heavily loaded streams.

Weathering. All physical and chemical changes produced by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1961-90 at Danevang, Texas)

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average daily	Temperature: 2 years in 10 will have-- Maximum temperature higher than--	Temperature: 2 years in 10 will have-- Minimum temperature lower than--	Temperature: Average number of growing degree days*	Precipitation: Average	Precipitation: 2 years in 10 will have-- Less than--	Precipitation: 2 years in 10 will have-- More than--	Precipitation: Average number of days with 0.10 inch or more
	°F	°F	°F	°F	°F	Units	In	In	In	
January-----	62.9	43.3	53.1	80	20	181	2.76	1.36	3.97	5
February----	66.3	45.4	55.9	83	25	208	2.55	1.16	3.75	4
March-------	74.0	52.7	63.3	87	29	420	2.02	0.77	3.07	3
April-------	80.6	60.5	70.5	91	37	616	2.46	0.64	3.91	3
May---------	85.0	66.6	75.8	93	50	798	4.86	1.60	7.53	4
June--------	89.8	71.2	80.5	97	60	915	4.72	1.41	7.42	5
July--------	92.8	72.7	82.8	99	67	981	3.60	1.40	5.91	5
August------	93.5	72.8	83.1	101	65	1,005	3.62	1.76	5.22	5
September---	89.4	69.7	79.6	98	52	883	5.89	2.54	8.73	6
October-----	83.3	60.7	72.0	94	41	678	3.93	1.25	6.13	4
November----	74.1	52.8	63.5	88	30	408	3.11	1.18	4.73	4
December----	66.2	45.7	55.9	82	22	239	2.70	1.22	3.96	4
Yearly:										
Average---	79.8	59.5	69.7	---	---	---	---	---	---	---
Extreme---	---	---	---	101	17	---	---	---	---	---
Total-----	---	---	---	---	---	7,333	42.21	33.77	49.98	52

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1961-90 at Danevang, Texas)

Probability	Temperature 24 °F or lower	Temperature 28 °F or lower	Temperature 32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Feb. 10	Mar. 6	Mar. 21
2 years in 10 later than--	Feb. 3	Feb. 25	Mar. 12
5 years in 10 later than--	Jan. 22	Feb. 6	Feb. 24
First freezing temperature in fall:			
1 year in 10 earlier than--	Dec. 17	Nov. 20	Nov. 13
2 years in 10 earlier than--	Dec. 26	Dec. 2	Nov. 22
5 years in 10 earlier than--	Jan. 12	Dec. 26	Dec. 9

TABLE 3.--GROWING SEASON

(Recorded in the period 1961-90 at Danevang, Texas)

Probability	Daily minimum temperature during growing season: Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	309	286	256
8 years in 10	318	294	266
5 years in 10	335	308	284
2 years in 10	352	323	303
1 year in 10	361	331	312

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ar	Aransas clay, saline, frequently flooded	4,920	0.9
Ch	Chicolete clay, frequently flooded	7,320	1.3
DaA	Dacosta sandy clay loam, 0 to 1 percent slopes	130,190	23.7
DaB	Dacosta sandy clay loam, 1 to 3 percent slopes	3,490	0.6
EdA	Edna fine sandy loam, 0 to 1 percent slopes	17,730	3.2
FaB	Fordtran loamy fine sand, 0 to 2 percent slopes	4,580	0.9
FcA	Francitas clay, 0 to 1 percent slopes	1,020	0.2
Ga	Ganado clay, frequently flooded	7,810	1.4
InB	Inez fine sandy loam, 0 to 2 percent slopes	35,150	6.4
KuC	Kuy sand, 1 to 5 percent slopes	4,970	0.9
LaA	Laewest clay, 0 to 1 percent slopes	120,300	21.9
LaB	Laewest clay, 1 to 3 percent slopes	1,770	0.3
LaD3	Laewest clay, 5 to 8 percent slopes	7,570	1.4
LvA	Livco fine sandy loam, 0 to 1 percent slopes	5,040	0.9
MaC	Marcado sandy clay loam, 3 to 8 percent slopes	13,350	2.4
MbB	Milby sand, 0 to 2 percent slopes	9,520	1.7
MrA	Morales-Cieno complex, 0 to 1 percent slopes	34,900	6.4
NcA	Nada-Cieno complex, 0 to 1 percent slopes	28,920	5.3
Nv	Navidad fine sandy loam, frequently flooded	7,460	1.4
PaA	Palacios loam, 0 to 1 percent slopes	5,740	1.1
Pd	Placedo clay, tide flooded	3,520	0.7
RuC	Rupley sand, 1 to 5 percent slopes	460	0.1
Sw	Swan clay, tide flooded	5,030	0.9
TfA	Telferner fine sandy loam, 0 to 1 percent slopes	13,830	2.5
TxA	Texana-Cieno complex, 0 to 1 percent slopes	54,884	10.0
Za	Zalco fine sand, frequently flooded	490	0.1
	Water areas more than 40 acres in size	18,766	3.4
	Total	548,730	100.0

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability		Cotton lint	Grain sorghum	Corn	Rice	Improved bermuda-grass
	N	I	N	N	N	I	N
			Lbs	Bu	Bu	Bu	AUM*
Ar----------------- Aransas	VIw	---	---	---	---	---	---
Ch----------------- Chicolete	Vw	---	---	---	---	---	8.0
DaA---------------- Dacosta	IIw	---	500	85	---	100	10.0
DaB---------------- Dacosta	IIIe	---	475	80	---	---	8.0
EdA---------------- Edna	IIIw	IIIw	400	65	40	120	8.0
FaB---------------- Fordtran	IIw	---	250	45	---	---	---
FcA---------------- Francitas	IVw	---	---	35	---	100	---
Ga----------------- Ganado	Vw	---	---	---	---	---	8.0
InB---------------- Inez	IIw	---	---	60	50	85	7.0
KuC---------------- Kuy	IIIs	---	---	---	---	---	6.0
LaA---------------- Laewest	IIw	IIw	500	90	95	130	10.0
LaB---------------- Laewest	IIe	---	450	85	90	---	9.0
LaD3--------------- Laewest	IVe	---	---	---	---	---	5.0
LvA---------------- Livco	IIIs	---	---	---	---	100	---
MaC---------------- Marcado	IVe	---	---	---	---	---	6.0
MbB---------------- Milby	IIIs	---	---	---	---	---	6.0
MrA:							
Morales-----------	IIw	---	---	---	---	85	7.0
Cieno--------------	IVw	IIIw	---	---	---	100	6.0
NcA:							
Nada--------------	IIw	IIw	---	---	---	120	6.0

See footnotes at end of table.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability		Cotton lint	Grain sorghum	Corn	Rice	Improved bermuda-grass
	N	I	N	N	N	I	N
			Lbs	Bu	Bu	Bu	AUM*
NcA:							
Cieno	IVw	IIIw	---	---	---	100	6.0
Nv Navidad	Vw	---	---	---	---	---	6.0
PaA Palacios	IVw	---	---	---	---	100	---
Pd Placedo	VIIw	---	---	---	---	---	---
RuC Rupley	VIs	---	---	---	---	---	---
Sw Swan	VIIw	---	---	---	---	---	---
TfA Telferner	IIw	---	---	45	---	80	8.0
TxA:							
Texana	IIw	IIw	---	95	100	95	8.0
Cieno	IVw	IIIw	---	---	---	100	6.0
Za Zalco	Vw	---	---	---	---	---	6.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
Ar Aransas	Salty Bottomland	7,000	5,000	2,000
Ch Chicolete	Clayey Bottomland	8,000	6,500	5,000
DaA, DaB Dacosta	Blackland	7,000	5,500	4,000
EdA Edna	Claypan Prairie	8,000	6,000	5,000
FaB Fordtran	Sandy Prairie	6,000	4,500	3,000
FcA Francitas	Salty Prairie	9,000	7,000	5,000
Ga Ganado	Clayey Bottomland	---	---	---
InB Inez	Sandy Loam	6,500	5,000	4,000
KuC Kuy	Deep Sand	4,500	3,250	2,000
LaA, LaB, LaD3 Laewest	Blackland	9,000	7,500	6,000
LvA Livco	Salty Prairie	8,000	6,000	4,500
MaC Marcado	Blackland	6,000	4,500	3,000
MbB Milby	Sandy	5,000	3,500	2,500
MrA*:				
Morales	Sandy Loam	6,500	5,000	4,000
Cieno	Lowland	8,000	6,000	5,000
NcA*:				
Nada	Claypan Prairie	5,000	4,000	2,000
Cieno	Lowland	8,000	6,000	5,000
Nv Navidad	Loamy Bottomland	8,000	6,500	5,000
PaA Palacios	Salty Prairie	8,000	6,000	4,500
Pd Placedo	Salt Marsh	12,000	10,000	8,000

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
RuC----------------------- Rupley	Deep Sand----------------------------	4,500	3,250	2,000
Sw------------------------ Swan	Salt Marsh---------------------------	12,000	10,000	8,000
TfA----------------------- Telferner	Loamy Prairie------------------------	6,500	5,000	3,500
TxA*:				
Texana-------------------	Loamy Prairie------------------------	8,000	6,500	5,000
Cieno--------------------	Lowland------------------------------	8,000	6,000	5,000
Za------------------------ Zalco	Sandy Bottomland---------------------	7,000	5,000	3,000

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ar: Aransas	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, excess salt.	Severe: too clayey, wetness, flooding.	Severe: wetness, too clayey.	Severe: excess salt, wetness, droughty.
Ch: Chicolete	Severe: flooding, too clayey.	Severe: too clayey.	Severe: too clayey, flooding.	Severe: too clayey.	Severe: flooding, too clayey.
DaA, DaB: Dacosta	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
EdA: Edna	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
FaB: Fordtran	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Moderate: too sandy.	Moderate: droughty.
FcA: Francitas	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
Ga: Ganado	Severe: flooding, percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey, flooding, percs slowly.	Severe: too clayey.	Severe: flooding, too clayey.
InB: Inez	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
KuC: Kuy	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
LaA, LaB: Laewest	Severe: percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.
LaD3: Laewest	Severe: percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: slope, too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.
LvA: Livco	Severe: percs slowly, excess sodium.	Severe: excess sodium, percs slowly.	Severe: percs slowly, excess sodium.	Slight	Severe: excess sodium.
MaC: Marcado	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
MbB: Milby	Moderate: wetness, too sandy.	Moderate: wetness, too sandy.	Moderate: too sandy, wetness.	Moderate: too sandy.	Severe: droughty.
MrA*: Morales	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
MrA*:					
Cieno	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
NcA*:					
Nada	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
Cieno	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
Nv Navidad	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
PaA Palacios	Severe: flooding, wetness, percs slowly.	Severe: wetness, excess sodium, excess salt.	Severe: wetness, percs slowly, excess sodium.	Severe: wetness.	Severe: excess sodium, wetness.
Pd Placedo	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, excess salt.	Severe: too clayey, ponding, flooding.	Severe: ponding, too clayey.	Severe: excess salt, ponding, droughty.
RuC Rupley	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
Sw Swan	Severe: flooding, ponding, percs slowly.	Severe: ponding, excess humus, percs slowly.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.	Severe: ponding, flooding, excess humus.
TfA Telferner	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
TxA*:					
Texana	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
Cieno	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
Za Zalco	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy, flooding.	Severe: too sandy.	Severe: flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Ar------------------ Aransas	Very poor	Poor	Poor	Fair	Poor	Good	Poor	Fair	Poor.
Ch------------------ Chicolete	Poor	Fair	Fair	---	Poor	Poor	Fair	Poor	---
DaA, DaB----------- Dacosta	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
EdA----------------- Edna	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
FaB----------------- Fordtran	Poor	Fair	Good	Good	Fair	Fair	Fair	Fair	Good.
FcA----------------- Francitas	Poor	Fair	Fair	Fair	Poor	Good	Poor	Fair	Fair.
Ga------------------ Ganado	Poor	Fair	Fair	Good	Poor	Poor	Fair	Very poor	---
InB----------------- Inez	Fair	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
KuC----------------- Kuy	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
LaA----------------- Laewest	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair.
LaB----------------- Laewest	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
LaD3---------------- Laewest	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Poor	Fair.
LvA----------------- Livco	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor.
MaC----------------- Marcado	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
MbB----------------- Milby	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
MrA*:									
Morales-----------	Fair	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Cieno-------------	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
NcA*:									
Nada--------------	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Cieno-------------	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
Nv------------------ Navidad	Poor	Fair	Fair	Good	Very poor	Very poor	Fair	Very poor	Fair.
PaA----------------- Palacios	Poor	Fair	Poor	Poor	Good	Good	Poor	Good	Poor.
Pd------------------ Placedo	Very poor	Very poor	Very poor	Very poor	Poor	Good	Very poor	Fair	Very poor.
RuC----------------- Rupley	Very poor	Very poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
Sw------------------ Swan	Very poor	Very poor	Very poor	Very poor	Poor	Good	---	Fair	Very poor.
TfA----------------- Telferner	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair.
TxA*:									
Texana-------------	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Cieno--------------	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
Za------------------ Zalco	Poor	Fair	Fair	Good	Very poor	Very poor	Fair	Very poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ar---------------- Aransas	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.	Severe: excess salt, wetness, droughty.
Ch---------------- Chicolete	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding, too clayey.
DaA, DaB---------- Dacosta	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
EdA--------------- Edna	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
FaB--------------- Fordtran	Severe: cutbanks cave.	Slight---------	Moderate: shrink-swell.	Slight---------	Slight---------	Moderate: droughty.
FcA--------------- Francitas	Severe: cutbanks cave, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness, too clayey.
Ga---------------- Ganado	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: flooding, too clayey.
InB--------------- Inez	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
KuC--------------- Kuy	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Slight---------	Moderate: droughty, too sandy.
LaA, LaB, LaD3---- Laewest	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
LvA--------------- Livco	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: excess sodium.
MaC--------------- Marcado	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
MbB--------------- Milby	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.	Severe: droughty.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MrA*:						
Morales	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Cieno	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
NcA*:						
Nada	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Cieno	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
Nv Navidad	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
PaA Palacios	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: excess sodium, wetness.
Pd Placedo	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: excess salt, ponding, droughty.
RuC Rupley	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Severe: droughty.
Sw Swan	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, flooding, excess humus.
TfA Telferner	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
TxA*:						
Texana	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
Cieno	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: ponding.
Za Zalco	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ar: Aransas	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Ch: Chicolete	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
DaA: Dacosta	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
DaB: Dacosta	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
EdA: Edna	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
FaB: Fordtran	Severe: percs slowly.	Severe: seepage.	Severe: too clayey.	Severe: seepage.	Poor: too clayey, hard to pack.
FcA: Francitas	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey, excess salt.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Ga: Ganado	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
InB: Inez	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
KuC: Kuy	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
LaA: Laewest	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
LaB, LaD3: Laewest	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
LvA: Livco	Severe: percs slowly.	Slight	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack, excess sodium.
MaC: Marcado	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
MbB: Milby	Severe: wetness, poor filter.	Severe: seepage, wetness.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey, wetness.
MrA*:					
Morales	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Cieno	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
NcA*:					
Nada	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Cieno	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Nv: Navidad	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding, seepage.	Poor: too sandy.
PaA: Palacios	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Pd: Placedo	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
RuC: Rupley	Severe: poor filter.	Severe: seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Sw: Swan	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, ponding.	Poor: ponding, excess salt.
TfA: Telferner	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
TxA*:					
Texana	Severe: percs slowly.	Moderate: seepage.	Severe: seepage.	Slight	Fair: too clayey.
Cieno	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
Za: Zalco	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ar: Aransas	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Ch: Chicolete	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
DaA, DaB: Dacosta	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
EdA: Edna	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
FaB: Fordtran	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, thin layer.
FcA: Francitas	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Ga: Ganado	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
InB: Inez	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
KuC: Kuy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
LaA, LaB, LaD3: Laewest	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
LvA: Livco	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess sodium.
MaC: Marcado	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
MbB: Milby	Fair: shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
MrA*:				
Morales	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Cieno	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
NcA*:				
Nada	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Cieno	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Nv Navidad	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
PaA Palacios	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, excess sodium.
Pd Placedo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
RuC Rupley	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Sw Swan	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
TfA Telferner	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
TxA*:				
Texana	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Cieno	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Za Zalco	Good	Probable	Improbable: too sandy.	Poor: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ar-----------------Aransas	Slight----------	Severe: excess salt, wetness.	Ponding, percs slowly, flooding.	Droughty, slow intake.	Percs slowly---	Wetness, excess salt, droughty.
Ch-----------------Chicolete	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding--------	Favorable-------	Favorable.
DaA, DaB-----------Dacosta	Slight----------	Moderate: hard to pack.	Deep to water	Percs slowly---	Percs slowly---	Percs slowly.
EdA----------------Edna	Slight----------	Severe: hard to pack.	Deep to water	Soil blowing, percs slowly.	Erodes easily, soil blowing, percs slowly.	Erodes easily, percs slowly.
FaB----------------Fordtran	Severe: seepage.	Moderate: hard to pack.	Deep to water	Droughty, fast intake.	Soil blowing, percs slowly.	Droughty, percs slowly.
FcA----------------Francitas	Slight----------	Severe: hard to pack, wetness, excess salt.	Percs slowly, excess salt.	Wetness, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
Ga-----------------Ganado	Slight----------	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, flooding.	Percs slowly---	Percs slowly.
InB----------------Inez	Slight----------	Severe: hard to pack.	Deep to water	Soil blowing, percs slowly.	Erodes easily, soil blowing, percs slowly.	Erodes easily, percs slowly.
KuC----------------Kuy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, slope.	Too sandy, soil blowing.	Droughty.
LaA, LaB-----------Laewest	Slight----------	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly---	Percs slowly.
LaD3---------------Laewest	Moderate: slope.	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Percs slowly---	Percs slowly.
LvA----------------Livco	Slight----------	Severe: excess sodium.	Deep to water	Droughty, soil blowing, percs slowly.	Erodes easily, soil blowing, percs slowly.	Excess sodium, erodes easily, droughty.
MaC----------------Marcado	Slight----------	Moderate: hard to pack.	Deep to water	Slope, percs slowly.	Percs slowly---	Roothing depth, percs slowly.
MbB----------------Milby	Severe: seepage.	Moderate: piping, wetness.	Favorable-------	Droughty, fast intake.	Wetness, soil blowing.	Droughty.
MrA*:						
Morales------------	Slight----------	Slight----------	Deep to water	Soil blowing---	Erodes easily, soil blowing, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
MrA*:						
Cieno	Slight	Severe: ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
NcA*:						
Nada	Slight	Slight	Deep to water	Soil blowing, percs slowly, excess salt.	Soil blowing, percs slowly.	Percs slowly.
Cieno	Slight	Severe: ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Nv Navidad	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, flooding.	Too sandy	Droughty.
PaA Palacios	Slight	Severe: hard to pack, wetness, excess sodium.	Percs slowly, excess salt, excess sodium.	Wetness, percs slowly, excess sodium.	Wetness, percs slowly.	Wetness, excess salt, excess sodium.
Pd Placedo	Slight	Severe: hard to pack, ponding, excess salt.	Ponding, percs slowly, flooding.	Ponding, droughty, slow intake.	Ponding, percs slowly.	Wetness, excess salt.
RuC Rupley	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, slope.	Too sandy, soil blowing.	Droughty.
Sw Swan	Severe: seepage.	Severe: piping, ponding, excess salt.	Ponding, percs slowly, flooding.	Ponding, droughty, percs slowly.	Ponding	Wetness, excess salt, droughty.
TfA Telferner	Slight	Moderate: hard to pack.	Deep to water	Soil blowing, percs slowly.	Erodes easily, soil blowing, percs slowly.	Erodes easily, percs slowly.
TxA*:						
Texana	Slight	Moderate: thin layer.	Deep to water	Soil blowing, percs slowly, erodes easily.	Erodes easily, soil blowing, percs slowly.	Erodes easily, percs slowly.
Cieno	Slight	Severe: ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Za Zalco	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In								Pct	
Ar--- Aransas	0-60	Clay---	CH	A-7-6	100	95-100	95-100	75-95	51-75	30-50
Ch--- Chicolete	0-13	Clay---	CL, CH	A-7-6	90-100	90-100	90-100	75-100	40-66	25-50
	13-80	Sandy clay loam, clay loam, fine sandy loam.	CL	A-6	90-100	90-100	70-95	51-85	26-40	12-25
DaA--- Dacosta	0-9	Sandy clay loam	CL, SC	A-6, A-7	95-100	90-100	90-100	43-70	30-45	16-25
	9-62	Clay, clay loam, sandy clay.	CH, CL	A-7-6	95-100	90-100	90-100	50-80	42-65	26-40
	62-80	Sandy clay loam, sandy clay, clay loam.	CL, CH, SC	A-7-6	95-100	90-100	85-100	45-75	40-60	25-40
DaB--- Dacosta	0-8	Sandy clay loam	CL, SC	A-6, A-7	95-100	90-100	90-100	43-70	30-45	16-25
	8-42	Clay, clay loam, sandy clay.	CH, CL	A-7-6	95-100	90-100	90-100	50-80	42-65	26-40
	42-80	Sandy clay loam, sandy clay, clay loam.	CL, CH, SC	A-7-6	95-100	90-100	85-100	45-75	40-60	25-40
EdA--- Edna	0-10	Fine sandy loam	SM, SC-SM, ML, SC	A-4, A-6	100	95-100	80-100	36-66	20-32	3-15
	10-25	Clay, clay loam	CH	A-7	100	98-100	90-100	60-80	50-72	28-46
	25-51	Clay, clay loam	CL, CH	A-7	100	98-100	80-100	70-80	41-60	20-36
	51-80	Clay, clay loam, sandy clay loam.	CL, CH	A-7, A-6	98-100	98-100	80-100	55-80	30-60	13-35
FaB--- Fordtran	0-18	Loamy fine sand	SM, SC-SM	A-2-4	95-100	95-100	75-100	13-30	<25	NP-6
	18-25	Loamy fine sand	SM, SC-SM	A-2-4	95-100	95-100	75-100	13-30	<25	NP-6
	25-39	Sandy clay, clay, clay loam.	CH, CL	A-7	95-100	95-100	70-100	51-90	41-55	20-30
	39-80	Sandy clay loam, clay loam, fine sandy loam.	CL, SC, CH	A-6, A-7	95-100	90-100	70-100	36-95	30-60	12-35
FcA--- Francitas	0-14	Clay---	CH	A-7-6	100	100	95-100	80-95	51-65	30-40
	14-75	Clay, silty clay	CH	A-7-6	98-100	95-100	95-100	80-95	60-90	40-65
	75-80	Clay, silty clay, silty clay loam.	CH	A-7-6	98-100	95-100	95-100	80-95	60-90	40-65
Ga--- Ganado	0-6	Clay---	CH	A-7-6	100	95-100	80-100	75-100	51-76	31-50
	6-68	Clay---	CH	A-7-6	100	95-100	80-100	75-100	51-76	31-50
	68-80	Clay loam, silty clay loam, sandy clay loam.	CH, CL	A-6, A-7-6	90-100	90-100	75-95	75-95	38-60	21-41
InB--- Inez	0-12	Fine sandy loam	SM, SC-SM	A-2-4, A-4	98-100	98-100	90-100	20-49	<25	NP-7
	12-47	Clay, sandy clay	CL, CH	A-7-6, A-6	98-100	98-100	90-100	50-75	36-66	21-45
	47-80	Sandy clay, clay loam, sandy clay loam.	CL, CH, SC	A-6, A-7-6	98-100	98-100	90-100	49-75	36-55	25-40
KuC--- Kuy	0-52	Sand---	SM, SC-SM SP-SM	A-2-4, A-3	100	95-100	70-100	6-35	<25	NP-7
	52-86	Sandy clay loam, clay loam.	SC, CL	A-4, A-6, A-2-4 A-2-6	100	90-100	75-100	25-75	21-40	7-21

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
LaA-------------	0-10	Clay-------------	CH	A-7	98-100	98-100	90-100	75-90	59-76	41-59
Laewest	10-37	Clay-------------	CH	A-7	98-100	98-100	90-100	75-90	59-76	41-59
	37-80	Clay, clay loam	CH	A-7	94-100	94-100	90-100	75-90	59-76	41-59
LaB-------------	0-5	Clay-------------	CH	A-7	98-100	98-100	90-100	75-90	59-76	41-59
Laewest	5-41	Clay-------------	CH	A-7	98-100	98-100	90-100	75-90	59-76	41-59
	41-80	Clay, clay loam	CH	A-7	94-100	94-100	90-100	75-90	59-76	41-59
LaD3------------	0-10	Clay-------------	CH	A-7	98-100	98-100	90-100	75-90	59-76	41-59
Laewest	10-42	Clay-------------	CH	A-7	98-100	98-100	90-100	75-90	59-76	41-59
	42-80	Clay, clay loam	CH	A-7	94-100	94-100	90-100	75-90	59-76	41-59
LvA-------------	0-8	Fine sandy loam	ML, CL,	A-4	100	100	95-100	65-90	20-30	NP-10
Livco	8-30	Clay loam, clay	CH	A-7-6	100	100	95-100	75-98	51-70	30-45
	30-60	Clay loam, clay	CH	A-7-6	95-100	90-100	90-100	80-98	45-64	25-40
	60-80	Clay loam, sandy clay loam, clay.	CH, CL	A-7-6	95-100	90-100	90-100	80-98	60-80	39-57
MaC-------------	0-8	Sandy clay loam	CL	A-6, A-7-6	100	100	90-100	65-85	35-45	18-25
Marcado	8-23	Clay-------------	CL, CH	A-7-6	100	95-100	90-100	70-90	45-65	30-45
	23-80	Clay-------------	CL, CH	A-7-6	95-100	90-100	85-100	70-90	45-65	28-40
MbB-------------	0-6	Sand-------------	SM, SC-SM	A-2-4	100	95-100	75-100	15-35	<25	NP-7
Milby	6-30	Sand, loamy sand	SM, SC-SM	A-2-4	100	95-100	75-100	15-35	<25	NP-7
	30-70	Sandy clay loam, sandy clay, clay loam.	SC, CL	A-6, A-7, A-2-7 A-2-6	100	95-100	75-100	22-52	26-45	10-25
	70-90	Sandy clay, clay	CL, CH	A-6, A-7	100	95-100	75-100	65-94	35-55	15-30
MrA*:										
Morales---------	0-8	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-4, A-2-4	98-100	95-100	75-100	30-60	<25	NP-7
	8-18	Very fine sandy loam, loam, sandy clay loam.	CL-ML, CL, SC-SM, SC	A-4, A-6, A-7-6	98-100	95-100	75-100	45-75	17-45	5-25
	18-90	Sandy clay loam, clay loam, sandy clay.	CL, SC	A-6, A-7-6	98-100	95-100	75-100	38-70	30-45	18-30
Cieno-----------	0-12	Sandy clay loam	CL	A-6	98-100	95-100	85-100	51-70	28-40	15-25
	12-66	Sandy clay loam, clay loam, sandy clay.	CL	A-6, A-7-6	98-100	95-100	90-100	59-85	32-48	20-30
	66-80	Sandy clay loam, clay loam.	CL, SC	A-6, A-7-6	98-100	95-100	85-100	40-70	28-45	15-28
NcA*:										
Nada------------	0-7	Sandy loam-------	SM, SC-SM, SC, CL	A-4	95-100	95-100	80-100	36-55	<25	NP-9
	7-28	Sandy clay loam, clay loam, sandy clay.	CL	A-6, A-7-6	98-100	95-100	90-100	51-75	30-44	19-32
	28-80	Sandy clay loam, clay loam.	CL, SC	A-6	95-100	95-100	85-100	40-70	28-40	15-25
Cieno-----------	0-6	Sandy clay loam	CL	A-6	98-100	95-100	85-100	51-70	28-40	15-25
	6-55	Sandy clay loam, clay loam, sandy clay.	CL	A-6, A-7-6	98-100	95-100	90-100	59-85	32-48	20-30
	55-80	Sandy clay loam, clay loam.	CL, SC	A-6, A-7-6	98-100	95-100	85-100	40-70	28-45	15-28

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In								Pct	
Nv--------------- Navidad	0-33	Fine sandy loam	SC, SC-SM	A-4, A-6, A-2-4, A-2-6	100	100	95-100	15-45	21-30	4-11
	33-59	Fine sand, loamy fine sand, fine sandy loam.	SM, SC-SM	A-2-4	95-100	95-100	70-100	15-35	<25	NP-5
	59-80	Fine sandy loam, sandy clay loam.	SC, CL, SC-SM, CL-ML	A-4, A-6, A-2-4 A-2-6	100	90-100	75-100	21-51	21-40	4-20
PaA-------------- Palacios	0-7	Loam-------------	CL, CL-ML	A-4, A-6	98-100	98-100	90-100	60-80	20-30	4-12
	7-27	Silty clay, clay, silty clay loam.	CH	A-7-6	95-100	90-100	90-100	75-95	51-70	30-45
	27-40	Silty clay, clay, silty clay loam.	CH	A-7-6	95-100	90-100	90-100	75-95	51-70	30-45
	40-80	Clay, silty clay, silty clay loam.	CL, CH	A-7-6	95-100	85-100	85-100	80-100	41-70	25-45
Pd--------------- Placedo	0-21	Clay-------------	CL, CH	A-7-6 A-7-5	100	98-100	95-100	85-100	45-115	25-81
	21-55	Clay, silty clay, silty clay loam.	CH, CL	A-7-6	100	98-100	95-100	85-100	45-70	25-45
	55-80	Stratified clay to fine sandy loam.	CL, CH	A-6, A-7-6	100	98-100	95-100	75-100	35-60	20-40
RuC-------------- Rupley	0-6	Sand-------------	SP-SM, SM, SP	A-2-4, A-3	100	100	70-100	3-25	<25	NP-3
	6-80	Fine sand, loamy fine sand, sand.	SP-SM, SM, SP	A-2-4, A-3	100	100	70-100	3-25	<25	NP-3
Sw--------------- Swan	0-15	Clay, silty clay	CH, CL	A-7-6	100	100	95-100	85-100	45-85	25-55
	15-48	Stratified fine sandy loam to clay loam.	CL-ML, SC-SM, CL, SC	A-4, A-6	98-100	95-100	85-100	45-75	23-40	6-20
	48-80	Loamy sand, loamy fine sand.	SC-SM, SM	A-2-4	95-100	95-100	70-85	15-35	<25	NP-5
TfA-------------- Telferner	0-18	Fine sandy loam	CL, SC, CL-ML, SC-SM	A-4	90-100	90-100	80-100	40-60	20-30	5-10
	18-55	Sandy clay, clay	CH	A-7-6	90-100	90-100	90-100	55-85	51-65	30-40
	55-74	Sandy clay loam, clay loam, sandy clay.	CL	A-6, A-7	90-100	90-100	85-100	50-75	30-50	15-32
	74-80	Loamy sand-------	SC-SM, SM	A-2-4	95-100	95-100	70-85	15-35	<25	NP-5
TxA*: Texana-----------	0-14	Fine sandy loam	SM, SC-SM	A-4	98-100	98-100	90-100	36-49	<25	NP-7
	14-33	Clay, sandy clay	CL, CH	A-7-6	98-100	98-100	90-100	55-75	41-66	25-45
	33-69	Sandy clay loam, clay loam.	CL	A-7-6	95-100	90-100	85-100	51-70	40-49	25-33
	69-90	Fine sandy loam, loamy fine sand.	SM, SC-SM	A-2-4	95-100	95-100	75-100	15-35	<25	NP-7
Cieno-----------	0-8	Sandy clay loam	CL	A-6	98-100	95-100	85-100	51-70	28-40	15-25
	8-46	Sandy clay loam, clay loam, sandy clay.	CL	A-6, A-7-6	98-100	95-100	90-100	59-85	32-48	20-30
	46-80	Sandy clay loam, clay loam.	CL, SC	A-6, A-7-6	98-100	95-100	85-100	40-70	28-45	15-28

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
Za--------------- Zalco	0-60	Fine sand--------	SM, SC-SM, SP-SM	A-2-4	95-100	95-100	70-85	10-25	<25	NP-7

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ar--------------- Aransas	0-60	35-60	1.35-1.60	<0.06	0.01-0.12	7.9-9.0	>4	High------	0.32	5	4	1-4
Ch--------------- Chicolete	0-13	40-60	1.20-1.45	0.06-0.2	0.15-0.20	6.6-8.4	---	High------	0.32	5	4	1-3
	13-80	18-40	1.50-1.70	0.6-2.0	0.08-0.19	6.6-8.4	---	Moderate	0.28			
DaA-------------- Dacosta	0-9	20-30	1.35-1.65	0.2-0.6	0.15-0.20	6.1-7.3	---	Moderate	0.32	5	6	<1
	9-62	35-55	1.40-1.60	<0.06	0.13-0.16	6.1-8.4	---	High------	0.32			
	62-80	25-45	1.40-1.65	<0.06	0.13-0.15	6.6-8.4	---	High------	0.32			
DaB-------------- Dacosta	0-8	20-30	1.35-1.65	0.2-0.6	0.15-0.20	6.1-7.3	---	Moderate	0.32	5	6	<1
	8-42	35-55	1.40-1.60	<0.06	0.13-0.16	6.1-8.4	---	High------	0.32			
	42-80	25-45	1.40-1.65	<0.06	0.13-0.15	6.6-8.4	---	High------	0.32			
EdA-------------- Edna	0-10	4-15	1.40-1.60	0.6-2.0	0.10-0.15	5.1-7.3	---	Low-------	0.37	5	3	.5-3
	10-25	35-55	1.35-1.55	<0.06	0.12-0.17	5.6-7.3	---	High------	0.32			
	25-51	35-55	1.35-1.55	<0.06	0.12-0.17	6.6-8.4	---	High------	0.32			
	51-80	30-55	1.40-1.65	<0.06	0.12-0.17	6.6-8.4	---	High------	0.32			
FaB-------------- Fordtran	0-18	5-12	1.45-1.65	2.0-6.0	0.06-0.10	5.1-6.5	---	Low-------	0.24	5	2	<1
	18-25	5-12	1.40-1.65	2.0-6.0	0.06-0.10	5.1-6.5	---	Low-------	0.24			
	25-39	35-50	1.35-1.60	<0.06	0.12-0.16	5.1-7.8	---	Moderate	0.32			
	39-80	15-42	1.45-1.65	0.2-0.6	0.10-0.15	6.1-8.4	---	Moderate	0.32			
FcA-------------- Francitas	0-14	35-50	1.30-1.50	<0.06	0.10-0.18	6.1-8.4	<4	High------	0.32	5	4	<2
	14-75	40-60	1.30-1.50	<0.06	0.06-0.12	6.6-8.4	>4	Very high	0.32			
	75-80	40-60	1.30-1.50	<0.06	0.06-0.12	7.9-8.4	>8	Very high	0.32			
Ga--------------- Ganado	0-6	40-60	1.20-1.45	<0.06	0.13-0.17	6.6-8.4	---	High------	0.32	5	4	2-5
	6-68	40-60	1.20-1.45	<0.06	0.13-0.17	6.6-8.4	---	Very high	0.32			
	68-80	30-50	1.30-1.50	0.06-0.2	0.13-0.16	7.9-8.4	---	Moderate	0.32			
InB-------------- Inez	0-12	6-18	1.40-1.65	0.6-2.0	0.09-0.13	5.6-7.3	---	Low-------	0.37	5	3	1-2
	12-47	35-55	1.25-1.45	<0.06	0.14-0.19	4.5-7.3	---	High------	0.32			
	47-80	25-40	1.30-1.50	0.06-0.2	0.14-0.19	6.6-8.4	---	Moderate	0.32			
KuC-------------- Kuy	0-52	5-12	1.50-1.70	6.0-20	0.07-0.11	5.6-7.3	---	Very low	0.17	5	2	<1
	52-86	20-35	1.45-1.70	0.6-2.0	0.12-0.17	4.5-6.5	---	Low-------	0.24			
LaA-------------- Laewest	0-10	45-60	1.15-1.35	<0.06	0.12-0.18	6.1-7.3	---	Very high	0.32	5	4	2-5
	10-37	45-60	1.25-1.40	<0.06	0.12-0.18	6.1-7.3	---	Very high	0.32			
	37-80	35-60	1.30-1.45	<0.06	0.12-0.18	7.9-8.4	---	Very high	0.32			
LaB-------------- Laewest	0-5	45-60	1.15-1.35	<0.06	0.12-0.18	6.1-7.3	---	Very high	0.32	5	4	2-5
	5-41	45-60	1.25-1.40	<0.06	0.12-0.18	6.1-7.3	---	Very high	0.32			
	41-80	35-60	1.30-1.45	<0.06	0.12-0.18	7.9-8.4	---	Very high	0.32			
LaD3------------- Laewest	0-10	45-60	1.15-1.35	<0.06	0.12-0.18	6.1-7.3	---	Very high	0.32	5	4	2-5
	10-42	45-60	1.25-1.40	<0.06	0.12-0.18	6.1-7.3	---	Very high	0.32			
	42-80	35-60	1.30-1.45	<0.06	0.12-0.18	7.9-8.4	---	Very high	0.32			
LvA-------------- Livco	0-8	5-20	1.45-1.65	0.6-2.0	0.12-0.16	6.1-7.8	<2	Low-------	0.37	3	3	1-2
	8-30	35-45	1.25-1.45	<0.06	0.10-0.17	6.6-8.4	2-8	High------	0.32			
	30-60	30-45	1.45-1.70	<0.06	0.06-0.12	7.4-8.4	4-16	High------	0.32			
	60-80	25-40	1.50-1.70	<0.06	0.04-0.10	7.4-8.4	4-16	High------	0.32			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
MaC---------------- Marcado	0-8	20-30	1.40-1.65	0.2-0.6	0.15-0.20	6.1-7.3	---	Moderate	0.32	5	4	<2
	8-23	40-60	1.35-1.55	<0.06	0.07-0.14	6.6-8.4	---	High------	0.32			
	23-80	40-60	1.35-1.55	<0.06	0.07-0.14	7.9-8.4	---	High------	0.32			
MbB---------------- Milby	0-6	2-10	1.50-1.70	6.0-20	0.03-0.10	5.1-7.3	---	Low--------	0.17	5	2	<2
	6-30	2-10	1.50-1.70	6.0-20	0.03-0.10	5.6-7.3	---	Low--------	0.17			
	30-70	20-35	1.40-1.69	0.6-2.0	0.10-0.15	4.5-6.5	---	Moderate	0.32			
	70-90	30-45	1.40-1.65	0.6-2.0	0.12-0.17	5.1-7.8	---	Moderate	0.32			
MrA*:												
Morales----------	0-8	5-15	1.45-1.55	0.6-2.0	0.11-0.15	5.1-7.3	---	Low--------	0.37	5	3	<1
	8-18	10-22	1.45-1.60	0.6-2.0	0.11-0.16	4.5-7.3	---	Low--------	0.28			
	18-90	22-40	1.40-1.60	<0.06	0.11-0.16	5.1-8.4	---	Moderate	0.32			
Cieno------------	0-12	20-30	1.40-1.60	0.2-0.6	0.12-0.18	5.6-7.3	---	Moderate	0.32	5	5	1-3
	12-66	24-35	1.40-1.65	<0.06	0.12-0.18	5.6-8.4	---	Moderate	0.32			
	66-80	20-30	1.40-1.65	0.06-0.2	0.12-0.18	6.6-8.4	---	Moderate	0.32			
NcA*:												
Nada-------------	0-7	2-15	1.40-1.60	0.6-2.0	0.10-0.15	5.6-7.3	---	Low--------	0.32	5	3	<1
	7-28	20-30	1.45-1.70	<0.06	0.12-0.18	5.6-7.3	---	Moderate	0.32			
	28-80	15-30	1.40-1.65	0.06-0.2	0.12-0.17	6.6-8.4	---	Moderate	0.32			
Cieno------------	0-6	20-30	1.40-1.60	0.2-0.6	0.12-0.18	5.6-7.3	---	Moderate	0.32	5	5	1-3
	6-55	24-35	1.40-1.65	<0.06	0.12-0.18	5.6-8.4	---	Moderate	0.32			
	55-80	20-30	1.40-1.65	0.06-0.2	0.12-0.18	6.6-8.4	---	Moderate	0.32			
Nv----------------- Navidad	0-33	10-25	1.35-1.50	0.6-2.0	0.11-0.16	6.6-8.4	---	Low--------	0.32	5	5	1-3
	33-59	4-10	1.45-1.75	2.0-20	0.05-0.11	6.6-8.4	---	Low--------	0.24			
	59-80	15-30	1.40-1.60	0.6-2.0	0.12-0.17	6.6-8.4	---	Low--------	0.32			
PaA---------------- Palacios	0-7	10-30	1.45-1.65	0.6-2.0	0.14-0.18	6.1-7.8	<4	Low--------	0.49	5	4	1-2
	7-27	35-50	1.30-1.60	<0.06	0.12-0.16	6.6-8.4	2-8	High------	0.32			
	27-40	35-50	1.25-1.55	<0.06	0.06-0.12	6.6-8.4	4-16	High------	0.32			
	40-80	30-50	1.30-1.55	0.06-0.2	0.06-0.12	7.4-8.4	4-16	High------	0.32			
Pd----------------- Placedo	0-21	27-50	1.10-1.30	<0.06	0.06-0.17	7.4-8.4	>8	High------	0.32	5	8	1-10
	21-55	35-55	1.10-1.40	<0.06	0.03-0.10	7.4-8.4	>16	High------	0.32			
	55-80	20-50	1.10-1.40	<0.06	0.03-0.10	7.4-8.4	>16	Moderate	0.37			
RuC---------------- Rupley	0-6	1-9	1.45-1.60	6.0-20	0.04-0.08	5.6-7.3	---	Very low	0.15	5	1	<1
	6-80	1-9	1.45-1.60	6.0-20	0.02-0.08	5.6-7.3	---	Very low	0.15			
Sw----------------- Swan	0-15	40-60	1.20-1.45	<0.06	0.03-0.13	7.9-9.0	>8	High------	0.32	---	---	1-4
	15-48	18-34	1.30-1.60	0.2-2.0	0.04-0.14	7.9-9.0	>8	Low--------	0.32			
	48-80	2-10	1.25-1.55	2.0-20	0.03-0.10	7.9-9.0	>8	Low--------	0.24			
TfA---------------- Telferner	0-18	8-18	1.45-1.60	0.6-2.0	0.10-0.15	5.6-7.3	---	Low--------	0.43	5	3	<1
	18-55	35-50	1.35-1.65	<0.06	0.12-0.17	6.1-8.4	---	High------	0.32			
	55-74	20-40	1.35-1.65	0.06-0.2	0.12-0.15	7.4-8.4	---	Moderate	0.32			
	74-80	3-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-8.4	---	Low--------	0.32	---	---	
TxA*:												
Texana-----------	0-14	2-17	1.40-1.60	0.6-2.0	0.11-0.17	5.1-7.3	---	Low--------	0.43	5	3	1-3
	14-33	35-45	1.35-1.60	<0.06	0.14-0.19	6.1-8.4	---	High------	0.32			
	33-69	25-40	1.25-1.50	0.06-0.2	0.14-0.18	6.1-8.4	<2	Moderate	0.32			
	69-90	3-18	1.30-1.60	2.0-6.0	0.11-0.15	6.1-8.4	<2	Low--------	0.32			
Cieno------------	0-8	20-30	1.40-1.60	0.2-0.6	0.12-0.18	5.6-7.3	---	Moderate	0.32	5	5	1-3
	8-46	24-35	1.40-1.65	<0.06	0.12-0.18	5.6-8.4	---	Moderate	0.32			
	46-80	20-30	1.40-1.65	0.06-0.2	0.12-0.18	6.6-8.4	---	Moderate	0.32			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Za--------------- Zalco	0-60	0-8	1.35-1.55	6.0-20	0.05-0.11	6.6-8.4	---	Low--------	0.17	5	1	<.5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft				
Ar: Aransas	D	Frequent	Brief to very long.	Jan-Dec	0.5-3.0	Apparent	Jan-Dec	High	Low.
Ch: Chicolete	C	Frequent	Brief	Jan-Dec	>6.0	---	---	Moderate	Low.
DaA, DaB: Dacosta	D	None	---	---	>6.0	---	---	High	Low.
EdA: Edna	D	None	---	---	>6.0	---	---	High	Low.
FaB: Fordtran	C	None	---	---	>6.0	---	---	High	Moderate.
FcA: Francitas	D	Rare	---	---	0-3.0	Perched	Jan-Apr	High	Low.
Ga: Ganado	D	Frequent	Brief	Jan-Dec	>6.0	---	---	High	Low.
InB: Inez	D	None	---	---	>6.0	---	---	High	Low.
KuC: Kuy	A	None	---	---	4.0-6.0	Perched	Dec-Jul	High	Moderate.
LaA, LaB, LaD3: Laewest	D	None	---	---	>6.0	---	---	High	Low.
LvA: Livco	D	None	---	---	>6.0	---	---	High	High.
MaC: Marcado	D	None	---	---	>6.0	---	---	High	Low.
MbB: Milby	B	None	---	---	2.0-3.0	Perched	Dec-Jul	Low	Moderate.
MrA*:									
Morales	C	None	---	---	>6.0	---	---	High	High.
Cieno	D	None	---	---	+2-3.0	Perched	Sep-Jun	High	Low.
NcA*:									
Nada	D	None	---	---	>6.0	---	---	High	Low.
Cieno	D	None	---	---	+2-3.0	Perched	Sep-Jun	High	Low.
Nv: Navidad	B	Frequent	Brief	Jan-Dec	>6.0	---	---	High	Low.
PaA: Palacios	D	Rare	---	---	0-2.5	Perched	Dec-Apr	High	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Uncoated steel	Concrete
					Ft				
Pd---------------- Placedo	D	Frequent----	Long------	Jan-Dec	+.5-1.0	Apparent	Jan-Dec	High-----	High.
RuC--------------- Rupley	A	None--------	---	---	5.0-6.0	Apparent	Dec-Jul	Low------	Low.
Sw---------------- Swan	D	Frequent----	Long------	Jan-Dec	+.5-1.0	Apparent	Jan-Dec	High-----	High.
TfA--------------- Telferner	D	None--------	---	---	>6.0	---	---	High-----	Low.
TxA*:									
Texana-----------	D	None--------	---	---	>6.0	---	---	High-----	Low.
Cieno------------	D	None--------	---	---	+2-3.0	Perched	Sep-Jun	High-----	Low.
Za---------------- Zalco	A	Frequent----	Brief-----	Jan-Dec	>6.0	---	---	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL ANALYSES OF SELECTED SOILS

(Dashes indicate that data were not available or material was not detected)

Soil name and sample number	Depth	Horizon	Particle-size distribution: Sand: Very coarse (2-1 mm)	Coarse (1-0.5 mm)	Medium (0.5-0.25 mm)	Fine (0.25-0.1 mm)	Very fine (0.1-0.05 mm)	Total (2-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)	Bulk density (1/3 bar)	COLE	Water content: 1/3 bar	15 bar
	In		Pct (wt)								g/cc	Cm/cm	Pct (wt)	
Cieno[1,2]														
(S84TX-239-002)														
2236	0-8	A	0.0	0.0	1.3	23.6	11.6	36.5	43.5	20.0	1.52	0.026	22.0	---
2237	8-15	Btg1	0.0	0.0	1.0	21.2	7.5	29.7	45.9	24.4	1.48	0.043	23.9	---
2238	15-25	Btg2	0.0	0.0	1.0	18.3	12.2	31.5	42.4	26.1	1.60	0.036	23.4	---
2239	25-35	Btg3	0.0	0.0	1.3	24.6	11.0	36.9	36.5	26.6	1.55	0.051	24.6	---
2240	35-46	Btg3	0.0	0.0	1.3	26.6	11.1	39.0	33.7	27.3	---	---	---	---
2241	46-58	Btkg1	0.0	0.0	1.2	25.9	13.3	40.4	29.9	29.7	1.55	0.043	22.1	---
2242	58-82	Btkg2	0.0	0.0	1.3	31.2	11.0	43.5	28.4	28.1	1.70	0.049	20.8	---
2243	82-101	BC	0.3	0.4	4.4	40.7	10.2	56.0	22.2	21.8	---	---	---	---
2244	101-109	CB	0.1	0.0	8.1	59.0	7.0	74.2	11.4	14.4	---	---	---	---
Kuy[3,4]														
(S82TX-239-002)														
824455	0-7	A	---	4.4	48.0	36.5	4.4	93.3	6.3	0.4	1.70	---	---	1.5
824456	7-27	E1	---	3.8	48.7	36.9	4.3	93.7	6.1	0.2	1.70	---	---	0.8
824457	27-52	E2	0.1	3.9	42.9	40.6	5.3	92.8	6.9	0.3	1.70	---	---	0.9
824458	52-59	Bt	---	2.4	29.2	29.2	6.3	67.1	21.2	11.7	1.90	0.009	9.3	6.2
824459	59-68	Btg	---	0.7	9.9	22.3	7.5	40.4	26.0	33.6	1.56	0.060	22.9	14.8
824460	68-80	Btg	---	0.3	4.0	20.6	10.2	35.1	28.6	36.3	1.61	0.051	20.8	15.9
824461	80-86	BC	---	0.5	8.7	45.1	17.0	71.3	9.7	19.0	1.67	0.027	15.9	8.4
824462	86-92	2C	---	0.3	8.0	65.3	5.7	79.3	6.5	14.2	1.70	---	---	5.9
824463	92-103	2C	0.1	1.3	19.3	63.9	8.0	92.6	2.8	4.6	1.70	---	---	2.8
Milby[3,4]														
(S82TX-239-001)														
824444	0-6	A	---	3.9	37.6	39.6	7.8	88.9	8.9	2.2	1.70	---	---	1.7
824445	6-16	E1	0.2	3.4	38.2	40.2	7.7	89.7	8.5	1.8	1.67	---	2.5	0.8
824446	16-30	E2	0.1	4.7	39.0	38.6	6.8	89.2	8.6	2.2	1.71	---	2.1	0.6
824447	30-32	Bt/E	---	4.9	37.9	36.4	6.5	85.7	11.3	3.0	1.85	0.016	10.8	0.8
824448	32-35	Bt/E	0.2	3.6	25.7	25.0	4.1	58.6	7.4	34.0	1.69	0.029	15.9	13.2
824449	35-44	Btg	0.1	2.2	25.0	25.0	3.5	55.8	5.3	38.9	1.54	0.055	22.8	15.2
824450	44-53	Bt	---	2.5	34.8	34.2	3.5	75.0	2.2	22.8	1.59	0.054	21.6	9.5
824451	53-70	BC	---	2.3	36.2	37.0	3.4	78.9	4.0	17.1	1.81	0.023	12.7	8.0
824452	70-90	2C	---	1.3	12.0	14.6	4.3	32.2	23.9	43.9	1.41	0.129	29.4	19.5
824453	90-109	2C1	---	5.2	31.1	16.8	2.8	55.9	19.7	24.4	1.50	---	---	11.7
824454	109-129	2C2	0.1	2.9	13.5	14.7	8.7	39.9	35.4	24.7	1.50	---	---	11.9

See footnotes at end of table.

TABLE 16.--PHYSICAL ANALYSES OF SELECTED SOILS--Continued

Soil name and sample number	Depth	Horizon	Particle-size distribution: Sand: Very coarse (2-1 mm)	Sand: Coarse (1-0.5 mm)	Sand: Medium (0.5-0.25 mm)	Sand: Fine (0.25-0.1 mm)	Sand: Very fine (0.1-0.05 mm)	Sand: Total (2-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)	Bulk density (1/3 bar)	COLE	Water content: 1/3 bar	Water content: 15 bar
	In		Pct (wt)								g/cc	Cm/cm	Pct (wt)	
Morales[3,4]														
(S82TX-239-003)														
824464	0-4	A	0.2	2.8	21.9	38.3	12.6	75.8	21.0	3.2	1.76	---	5.3	1.7
824465	4-8	E	0.3	2.9	20.9	36.8	12.8	73.7	21.7	4.6	1.84	0.002	5.3	1.5
824466	8-15	Bt/E1	0.3	2.8	19.7	35.1	12.2	70.1	21.7	8.2	1.74	0.013	10.1	2.3
824467	15-18	Bt/E2	0.2	3.0	18.6	32.1	11.5	65.4	20.6	14.0	1.69	0.021	13.6	4.9
824468	18-29	Bt1	0.2	2.1	13.4	22.8	8.3	46.8	19.1	34.1	1.58	0.052	19.8	12.8
824469	29-43	Bt2	0.1	2.0	16.3	29.0	10.1	57.5	18.9	23.6	1.78	0.041	15.9	9.3
824470	43-53	Bt2	---	2.3	18.4	33.1	9.1	62.9	14.8	22.3	1.91	0.037	13.6	8.8
824471	53-62	Bt3	0.2	2.4	18.1	30.2	9.3	60.2	17.3	22.5	1.91	0.047	13.8	9.0
824472	62-76	BC	---	2.0	17.4	29.3	9.3	58.0	18.7	23.3	1.89	0.045	14.2	9.3
824473	76-90	Cg	---	1.8	16.5	28.9	9.2	56.4	19.1	24.5	1.80	0.061	16.6	10.1
Texana[1,4]														
(S84TX-239-001)														
2245	0-10	A	0.0	0.0	2.2	53.0	14.0	69.2	26.6	4.2	1.43	0.061	21.9	---
2246	10-14	Eg	0.0	0.0	2.1	56.6	10.2	68.9	28.2	2.9	1.41	0.041	18.8	---
2247	14-17	Bt1	0.1	0.0	1.0	29.1	5.6	35.7	16.3	48.0	1.42	0.082	30.9	---
2248	17-26	Bt2	0.0	0.0	1.2	31.1	5.3	37.6	14.9	47.5	1.41	0.097	33.6	---
2249	26-33	Bt2	0.0	0.0	0.9	33.5	7.4	41.8	15.5	42.7	---	---	---	---
2250	33-44	Bt3	0.0	0.0	0.8	35.6	7.0	43.4	23.4	33.3	1.52	0.052	24.9	---
2251	44-56	Bt4	0.0	0.0	0.8	36.4	14.5	51.7	21.2	27.1	1.58	0.033	24.4	---
2252	56-69	Btk	0.0	0.0	0.6	42.9	12.3	55.8	18.9	25.3	1.60	0.020	24.1	---
2253	69-80	BCt	0.0	0.0	1.1	44.3	18.9	64.3	17.4	18.3	1.51	0.019	19.1	---
2254	80-96	2C1	0.0	0.0	2.0	83.7	5.2	90.9	3.5	5.6	---	---	---	---
2255	96-105	2C2	0.0	0.0	4.0	88.3	1.9	94.2	4.1	1.7	---	---	---	---

[1] Analysis by the Soil Characterization Laboratory, Texas Agricultural Experiment Station, College Station, Texas.
[2] The pedon sampled is adjacent to the pedon sampled for the Texana soil in an area of the Texana-Cieno complex.
[3] Analysis by the National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska.
[4] Location of the pedon sampled is the same as that of the typical pedon described in the section "Soil Series and Their Morphology."

TABLE 17.--CHEMICAL ANAYLSIS OF SELECTED SOILS

(Dashes indicate that data were not determined. TR means trace; CEC, cation-exchange capacity; ESP, exchangeable sodium percentage; and SAR, sodium adsorption ratio)

Soil name and sample number	Depth	Horizon	Extractable bases					Extractable acidity	CEC (sum of cations)	Base saturation (sum)	Organic carbon	pH		Electrical conductivity	ESP	SAR
			Ca	Mg	Na	K	Sum					H_2O (1:1)	$CaCl_2$ 0.1M (1:2)			
	In		Milliequivalents/100 grams of soil							Pct	Pct			mmhos/cm	Pct	
Cieno[1,2]																
(S84TX-239-002)																
2236	0-8	A	6.4	2.9	0.5	0.2	10.0	---	13.0	77	0.98	6.5	---	---	4	---
2237	8-15	Btg1	7.7	4.4	1.2	0.2	13.6	---	16.2	84	0.48	6.2	---	---	8	---
2238	15-25	Btg2	8.2	4.6	2.0	0.2	15.0	---	15.0	100	0.31	6.5	---	0.6	11	13
2239	25-35	Btg3	8.3	5.0	2.3	0.2	15.8	---	16.5	96	0.21	7.4	---	0.5	13	9
2240	35-46	Btg3	8.9	6.4	2.8	0.3	18.4	---	17.0	100	0.12	7.7	---	0.5	14	10
2241	46-58	Btkg1	9.1	6.8	3.1	0.3	19.3	---	18.5	100	0.11	7.7	---	0.6	15	13
2242	58-82	Btkg2	10.1	6.3	3.1	0.3	19.7	---	17.8	100	0.08	8.0	---	0.9	14	16
2243	82-101	BC	9.8	5.2	2.2	0.3	17.6	---	16.4	100	0.05	8.0	---	1.0	11	10
2244	101-109	CB	5.5	3.6	1.2	0.2	10.5	---	10.1	100	0.02	6.5	---	1.1	9	11
Kuy[3,4]																
(S82TX-239-002)																
824455	0-7	A	1.0	0.2	TR	0.1	1.3	1.3	1.1	100	0.35	5.7	5.3	---	---	---
824456	7-27	E1	0.5	---	TR	TR	0.5	0.7	0.3	100	0.05	6.2	5.5	---	---	---
824457	27-52	E2	0.7	---	TR	TR	0.7	---	0.3	100	0.04	6.5	5.7	---	---	---
824458	52-59	Bt	3.1	2.7	TR	0.2	6.0	0.9	6.7	90	0.09	5.7	4.9	---	---	---
824459	59-68	Btg	7.7	8.8	0.1	0.5	17.1	5.2	19.8	86	0.09	5.4	4.6	---	---	---
824460	68-80	Btg	8.5	10.4	0.2	0.5	19.6	7.1	23.9	82	0.07	5.1	4.3	---	---	---
824461	80-86	BC	3.6	4.5	0.1	0.3	8.5	4.6	11.6	73	0.07	5.0	4.2	---	---	---
824462	86-92	2C	1.5	2.3	0.1	0.2	4.1	3.5	7.5	55	0.05	4.9	4.0	---	---	---
824463	92-103	2C	0.8	0.9	TR	0.1	1.8	1.4	2.8	64	0.05	4.9	4.1	---	---	---
Milby[3,4]																
(S82TX-239-001)																
824444	0-6	A	1.8	0.3	0.4	0.4	2.9	3.7	1.5	100	0.48	5.3	4.8	---	---	---
824445	6-16	E1	0.9	TR	TR	TR	0.9	0.7	0.9	100	0.25	6.3	5.6	---	---	---
824446	16-30	E2	0.7	---	---	TR	0.7	---	0.5	100	0.11	6.5	5.7	---	---	---
824447	30-32	Bt/E	0.4	---	0.1	TR	0.5	0.5	0.6	83	0.10	6.0	5.4	---	---	---
824448	32-35	Bt/E	6.0	2.2	0.7	0.4	9.3	8.2	14.8	63	0.25	5.0	4.3	0.10	---	---
824449	35-44	Btg	8.4	3.0	1.2	0.4	13.0	8.7	19.0	68	0.29	5.0	4.2	0.13	---	---
824450	44-53	Bt	6.8	2.1	0.9	0.3	10.1	4.6	13.0	78	0.17	5.0	4.1	0.10	---	---
824451	53-70	BC	6.7	1.8	1.3	0.2	10.0	1.9	11.3	88	0.14	4.3	5.1	0.20	---	---
824452	70-90	2C	20.6	5.7	4.4	0.6	31.3	2.8	30.8	100	0.14	5.5	5.2	1.99	11	9
824453	90-109	2C1	14.7	3.7	3.0	0.4	21.8	---	19.8	100	0.14	7.0	6.9	2.95	11	9
824454	109-129	2C2	---	3.6	2.8	0.4	---	---	18.7	---	0.06	7.8	7.7	3.27	10	9

See footnotes at end of table.

TABLE 17.--CHEMICAL ANAYLSIS OF SELECTED SOILS--Continued

Soil name and sample number	Depth	Horizon	Extractable bases: Ca	Extractable bases: Mg	Extractable bases: Na	Extractable bases: K	Extractable bases: Sum	Extractable acidity	CEC (sum of cations)	Base saturation (sum)	Organic carbon	pH H_2O (1:1)	pH $CaCl_2$ 0.1M (1:2)	Electrical conductivity	ESP	SAR
	In		Milliequivalents/100 grams of soil							Pct	Pct			mmhos/cm	Pct	
Morales[3,4] (S82TX-239-003)																
824464	0-4	A	1.1	0.2	TR	0.1	1.4	0.8	1.5	93	0.44	5.3	4.8	---	---	---
824465	4-8	E	0.9	0.2	TR	TR	1.1	---	1.2	92	0.22	5.0	4.6	---	---	---
824466	8-15	Bt/E1	1.1	0.3	0.1	TR	1.5	1.4	2.3	65	0.10	4.9	4.3	0.02	---	---
824467	15-18	Bt/E2	1.5	0.8	0.3	0.1	2.7	3.9	5.1	53	0.11	5.3	3.9	0.02	---	---
824468	18-29	Bt1	5.1	3.0	1.4	0.1	9.6	6.6	15.7	61	0.22	5.4	4.1	0.06	---	---
824469	29-43	Bt2	5.5	2.6	1.5	0.2	9.8	3.1	11.2	87	0.11	5.5	4.6	0.11	---	---
824470	43-53	Bt2	5.2	2.5	1.5	0.1	9.3	3.3	11.0	85	0.07	5.6	4.8	0.17	---	---
824471	53-62	Bt3	6.2	2.9	2.1	0.2	11.4	1.1	12.3	93	0.07	5.8	5.1	1.04	14	9
824472	62-76	BC	7.5	3.5	2.6	0.2	13.8	0.4	14.2	97	0.06	6.5	6.1	1.64	15	13
824473	76-90	Cg	8.8	3.9	3.0	0.2	15.9	---	15.9	100	0.07	6.9	6.6	1.77	15	13
Texana[1,4] (S84TX-239-001)																
2245	0-10	A	3.3	0.9	0.1	0.1	4.4	---	4.2	100	0.55	7.2	---	---	2	---
2246	10-14	E	0.7	0.4	0.1	0.0	1.2	---	1.9	63	0.17	6.4	---	---	5	---
2247	14-17	Bt1	10.8	6.0	2.5	0.4	19.7	---	22.9	86	0.72	6.5	---	---	11	---
2248	17-26	Bt2	6.6	6.7	4.3	0.3	17.9	---	26.0	69	0.41	6.7	---	0.5	14	9
2249	16-33	Bt2	6.4	6.3	5.8	0.3	18.8	---	20.5	91	0.25	6.4	---	0.9	23	11
2250	33-44	Bt3	11.3	6.2	6.1	0.3	23.9	---	17.4	100	0.16	7.2	---	1.3	28	15
2251	44-56	Bt4	10.4	5.2	5.9	0.3	21.8	---	14.8	100	0.10	7.6	---	1.9	31	17
2252	56-69	Btk	4.8	4.1	5.2	0.3	14.4	---	14.0	100	0.10	7.5	---	2.0	28	17
2253	69-80	BCt	7.9	3.7	3.1	0.2	14.9	---	11.0	100	0.07	7.3	---	1.8	21	16
2254	80-96	2C1	3.8	1.4	0.9	0.1	6.2	---	4.7	100	0.04	7.3	---	0.7	14	8
2255	96-105	2C2	2.2	0.6	0.3	0.0	3.1	---	2.3	100	0.03	7.3	---	---	13	---

[1] Analysis by the Soil Characterization Laboratory, Texas Agricultural Experiment Station, College Station, Texas.
[2] The pedon sampled is adjacent to the pedon sampled for the Texana soil in an area of the Texana-Cieno complex.
[3] Analysis by the National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska.
[4] Location of the pedon sampled is the same as that of the typical pedon in the section "Soil Series and Their Morphology."

TABLE 18.--CLAY MINERALOGY OF SELECTED SOILS

(Dashes indicate that the material was not detected)

Soil name and sample numbers	Depth	Horizon	Clay minerals[1] (X-ray diffraction)			
			Montmorillonite	Mica	Kaolinite	Quartz
	In					
Cieno:[2,3]						
2236	0-8	A	5	2	2	2
2238	15-25	Btg2	5	2	2	2
2241	46-58	Btkg1	5	2	2	2
2244	101-109	CB	5	2	2	2
Milby:[4,5]						
82P4445	6-16	E1	---	1	1	2
82P4449	35-44	Btg	3	2	3	1
82P4452	70-90	2C	5	2	3	2
Morales:[4,5]						
82P4465	4-8	E	1	---	1	2
82P4467	15-18	Bt/E2	3	1	3	2
82P4468	18-29	Bt1	3	1	3	2
82P4473	76-90	Cg	5	1	3	2
Texana:[2,5]						
2245	0-10	A	2	1	---	3
2247	14-17	Bt1	4	2	---	2
2251	44-56	Bt4	4	2	---	2
2253	69-80	BCt	5	2	---	2

[1] Relative amounts: 5 dominant; 4 abundant; 3 moderate; 2 small; 1 trace.

[2] Analysis by the Soil Characterization Laboratory, Texas Agricultural Experiment Station, College Station, Texas.

[3] The pedon sampled is adjacent to the pedon sampled for the Texana soil in an area of the Texana-Cieno complex.

[4] Analysis by the National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska.

[5] Location of the pedon sampled is the same as that of the typical pedon described in the section "Soil Series and Their Morphology."

TABLE 19.--PROBABLILITY OF A WATER TABLE IN SELECTED SOILS

(Percentages indicate the probability of a water table in at least 6 of 10 years at the depth shown)

Soil name	Depth to water table	January	February	March	April	May	June	July	August	September	October	November	December
	In	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct
Dacosta	13	0	5	5	1	1	22	5	0	0	22	1	5
	30	1	5	1	1	5	5	5	0	1	5	5	69
	119	1	22	69	69	22	69	22	5	7	69	69	69
Kuy	51	0	0	1	1	1	5	0	0	0	0	0	0
	104	1	69	69	69	22	95	22	1	0	5	1	22
Telferner	18	0	69	1	1	0	1	5	0	0	1	0	5
	30	5	1	5	5	1	5	5	0	0	22	22	22
	98	1	0	0	0	0	0	0	0	0	0	0	0

TABLE 20.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. Location of the pedons sampled is the same as that of the typical pedons in the section "Soil Series and Their Morphology")

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit*	Plasticity index*	Specific gravity	Shrinkage		
			Percentage passing sieve--						Percentage smaller than--								
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
												Pct		g/cc	Pct	Pct	
Aransas clay: (S84TX-239-001)																	
Ag2 ---- 8 to 28	A-7-6(38)	CH	100	100	100	100	100	93	84	50	40	59	37	2.68	16.0	17.7	1.85
Ag3 ---- 28 to 40	A-7-6(37)	CH	100	100	100	100	100	94	73	42	40	57	36	2.64	14.0	18.2	1.89
Chicolete clay: (S84TX-239-004)																	
A ------ 0 to 13	A-7-6(28)	CL	100	100	100	100	100	80	---	---	---	56	33	2.61	12.0	18.1	2.03
A2 ----- 13 to 36	A-6(9)	CL	100	100	100	100	100	64	---	---	---	35	17	2.60	19.0	7.7	1.73
Bw ----- 36 to 72	A-6(4)	CL	100	100	100	100	100	52	---	---	---	29	13	2.60	18.0	6.1	1.78
Cieno sandy clay loam: (S84TX-239-005)																	
A ------ 6 to 10	A-6(4)	CL	100	100	100	100	98	51	40	23	20	29	15	2.58	15.0	7.8	1.90
Btg1 --- 10 to 39	A-7-6(14)	CL	100	100	100	100	97	59	51	38	31	46	29	2.66	12.0	16.3	2.09
Btg2 --- 39 to 55	A-7-6(13)	CL	100	100	100	99	95	59	53	32	27	42	27	2.66	11.0	15.2	2.09
Dacosta sandy clay loam: (S81TX-239-002)																	
Ap ----- 0 to 9	A-6(3)	SC	100	100	100	100	98	43	41	22	18	30	16	2.62	15.0	7.8	1.82
Bt2 ---- 21 to 44	A-7-6(17)	CH	100	100	100	100	99	57	53	45	42	54	37	2.61	13.0	18.3	1.99
Bt3 ---- 44 to 62	A-7-6(11)	SC	100	100	100	100	99	49	48	36	33	46	32	2.64	15.0	14.6	1.94
Fordtran loamy fine sand: (S84TX-239-005)																	
A ------ 0 to 18	A-2-4(0)	SM	100	100	100	100	100	22	12	3	2	19	2	2.62	19.0	0.0	1.68
Bt1 ---- 25 to 31	A-7(12)	CL	100	100	100	100	100	61	60	50	50	46	24	2.63	15.0	14.1	1.86
Bt2 ---- 31 to 39	A-7(8)	CL	100	100	100	100	100	50	47	38	36	42	23	2.64	16.0	12.2	1.84
Inez fine sandy loam: (S81TX-239-003)																	
A ------ 0 to 12	A-4(0)	SM	100	100	100	100	97	41	---	---	---	17	2	2.63	16.0	1.2	1.82
Bt1 ---- 12 to 18	A-6(8)	CL	100	100	100	100	98	55	---	---	---	36	21	2.66	16.0	10.1	1.87
Bk ----- 47 to 80	A-7-6(17)	CL	100	100	99	97	94	68	---	---	---	43	29	2.64	17.0	12.6	1.89

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit*	Plas- ticity index*	Specific gravity	Shrinkage		
			Percentage passing sieve--						Percentage smaller than--						Limit	Linear	Ratio
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm						
												Pct		g/cc	Pct	Pct	
Kuy sand:																	
(S82TX-239-002)																	
E2 ----- 27 to 52	A-2-4(0)	SM-SW	100	100	100	100	96	8	---	---	---	20	2	2.68	17.0	0.0	1.80
Btg ---- 59 to 79	A-7-6(13)	CH	100	100	100	100	99	69	---	---	---	51	32	2.67	15.0	16.0	1.93
BC ----- 79 to 86	A-2-4(0)	SM-SC	100	100	100	100	98	25	---	---	---	26	7	2.64	20.0	3.8	1.72
Milby sand:																	
(S82TX-239-001)																	
E2 ----- 16 to 30	A-2-4(0)	SM	100	100	100	100	92	15	6	2	1	18	3	2.61	14.0	0.0	1.82
Btg ---- 35 to 44	A-7-6(6)	SC	100	100	100	100	96	47	43	38	36	44	21	2.65	16.0	13.2	1.90
BC ----- 53 to 70	A-2-4(0)	SC	100	100	100	100	95	23	19	13	11	26	10	2.61	20.0	3.5	1.74
Morales fine sandy loam:																	
(S82TX-239-003)																	
A/E ---- 0 to 8	A-2-4(0)	SM	100	100	100	100	95	32	25	8	6	13	2	2.64	13.0	0.0	1.92
B/E1 --- 8 to 15	A-4(0)	SM	100	100	100	100	95	39	33	15	12	17	5	2.60	17.0	1.0	1.94
B/E2 --- 15 to 18	A-6(10)	CL	100	100	100	100	96	58	52	38	34	40	22	2.67	14.0	12.8	1.95
Bt1 ---- 18 to 29	A-6(4)	SC	100	100	100	100	96	44	34	25	20	32	19	2.65	14.0	9.8	1.92
Nada sandy loam:																	
(S82TX-239-006)																	
Ap ----- 0 to 7	A-4(1)	CL	100	100	100	100	98	51	43	22	16	22	9	2.58	15.0	4.3	1.89
Btg1 --- 7 to 28	A-6(9)	CL	100	100	100	100	98	63	57	36	28	31	19	2.62	13.0	8.8	1.96
Btg2 --- 28 to 43	A-6(5)	SC	100	100	100	100	98	48	42	25	24	30	18	2.64	15.0	8.3	1.91
Navidad fine sandy loam:																	
(S82TX-239-004)																	
A1 ----- 0 to 10	A-4(0)	SM-SC	100	100	100	100	99	38	28	14	13	26	7	2.66	20.0	3.0	1.71
A2 ----- 10 to 33	A-2-4(0)	SM	100	100	100	100	100	30	20	10	10	22	4	2.65	20.0	1.8	1.73
C1 ----- 33 to 43	A-2-4(0)	SM	100	100	100	100	99	17	10	2	2	20	3	2.66	19.0	0.0	1.73
Palacios loam:																	
(S84TX-239-007)																	
Ap ----- 0 to 7	A-4(6)	CL	100	100	100	100	100	79	46	20	18	28	9	2.57	21.0	3.8	1.7
Btng1 -- 7 to 14	A-7-6(39)	CH	100	100	100	100	100	88	80	54	50	57	39	2.64	16.0	17.3	1.9
BCtng -- 40 to 70	A-7-6(34)	CH	100	100	100	100	100	90	84	54	48	54	36	2.67	15.0	17.3	1.9
Rupley sand:																	
(S81TX-239-001)																	
A1 ----- 0 to 6	A-2-4(0)	SW	100	100	100	100	74	4	4	1	1	22	3	2.62	18.0	0.0	1.68
C1 ----- 6 to 48	A-2-4(0)	SW	100	100	100	100	74	3	2	1	1	22	3	2.64	19.0	0.0	1.68
C2 ----- 48 to 80	A-2-4(0)	SW	100	100	100	100	75	3	2	1	1	22	3	2.60	18.0	0.0	1.69

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution: Percentage passing sieve--						Grain-size distribution: Percentage smaller than--			Liquid limit*	Plasticity index*	Specific gravity	Shrinkage		
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
												Pct		g/cc	Pct	Pct	
Swan silt loam:																	
(S84TX-239-003)																	
Ag ----- 3 to 15	A-7-5(61)	CH	100	100	100	100	100	98	88	71	60	84	52	1.77	15.0	22.1	1.8
Cg1 ---- 15 to 30	A-6(14)	CL	100	100	100	100	100	69	55	25	15	39	23	1.76	19.0	9.7	1.8
Cg2 ---- 30 to 48	A-4(1)	SC	100	100	100	100	99	46	17	6	2	26	9	1.72	19.0	3.5	1.7
Cg3 ---- 48 to 63	A-2-4(0)	SM	---	---	100	100	99	30	9	3	3	21	3	1.68	22.0	0.0	1.7
Telferner fine sandy loam:																	
(S85TX-239-006)																	
A ------ 0 to 14	A-4(0)	CL-ML	100	100	100	100	100	46	37	14	12	21	4	2.64	19.0	1.8	1.77
Bt1 ---- 18 to 33	A-7-6(25)	CH	100	100	100	100	100	73	68	48	45	54	35	2.58	13.0	18.3	2.02
Bt2 ---- 33 to 41	A-7-6(22)	CH	100	100	100	100	100	73	67	46	40	50	32	2.64	11.0	17.8	2.04

* Liquid limit and plasticity index were determined by the AASHTO-89 and AASHTO-90 methods except that soil was added to water.

TABLE 21.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Aransas	Fine, montmorillonitic (calcareous), hyperthermic Vertic Haplaquolls
Chicolete	Fine-loamy, siliceous, hyperthermic Cumulic Hapludolls
Cieno	Fine-loamy, siliceous, hyperthermic Typic Epiaqualfs
Dacosta	Fine, montmorillonitic, hyperthermic Vertic Argiudolls
Edna	Fine, montmorillonitic, thermic Vertic Hapludalfs
Fordtran	Clayey, montmorillonitic, hyperthermic Aquic Arenic Hapludalfs
Francitas	Fine, montmorillonitic, hyperthermic Typic Pelluderts
Ganado	Fine, montmorillonitic, hyperthermic Typic Hapluderts
Inez	Fine, montmorillonitic, hyperthermic Albaquic Hapludalfs
Kuy	Loamy, siliceous, hyperthermic Grossarenic Paleudalfs
Laewest	Fine, montmorillonitic, hyperthermic Typic Hapluderts
Livco	Fine, montmorillonitic, hyperthermic Typic Natrudalfs
Marcado	Fine, montmorillonitic, hyperthermic Vertic Hapludalfs
Milby	Loamy, siliceous, hyperthermic Aquic Paleudalfs
Morales	Fine-loamy, siliceous, hyperthermic Aquic Glossudalfs
Nada	Fine-loamy, siliceous, hyperthermic Albaquic Hapludalfs
Navidad	Coarse-loamy, siliceous, hyperthermic Cumulic Haplustolls
Palacios	Fine, montmorillonitic, hyperthermic Mollic Natraqualfs
Placedo	Fine, montmorillonitic, nonacid, hyperthermic Typic Fluvaquents
Rupley	Hyperthermic, coated Typic Quartzipsamments
Swan	Fine-loamy, mixed (calcareous), hyperthermic Typic Haplaquolls
Telferner	Fine, montmorillonitic, hyperthermic Albaquic Hapludalfs
Texana	Fine, montmorillonitic, hyperthermic Typic Argialbolls
Zalco	Sandy, siliceous, hyperthermic Typic Udifluvents

☆ U.S. GOVERNMENT PRINTING OFFICE : 1997—417-265/40507/NRCS

Accessibility Statement

The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The USDA Target Center can convert USDA information and documents into alternative formats, including Braille, large print, video description, diskette, and audiotape. For more information, visit the TARGET Center's Web site (http://www.targetcenter.dm.usda.gov/) or call (202) 720-2600 (Voice/TTY).

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).