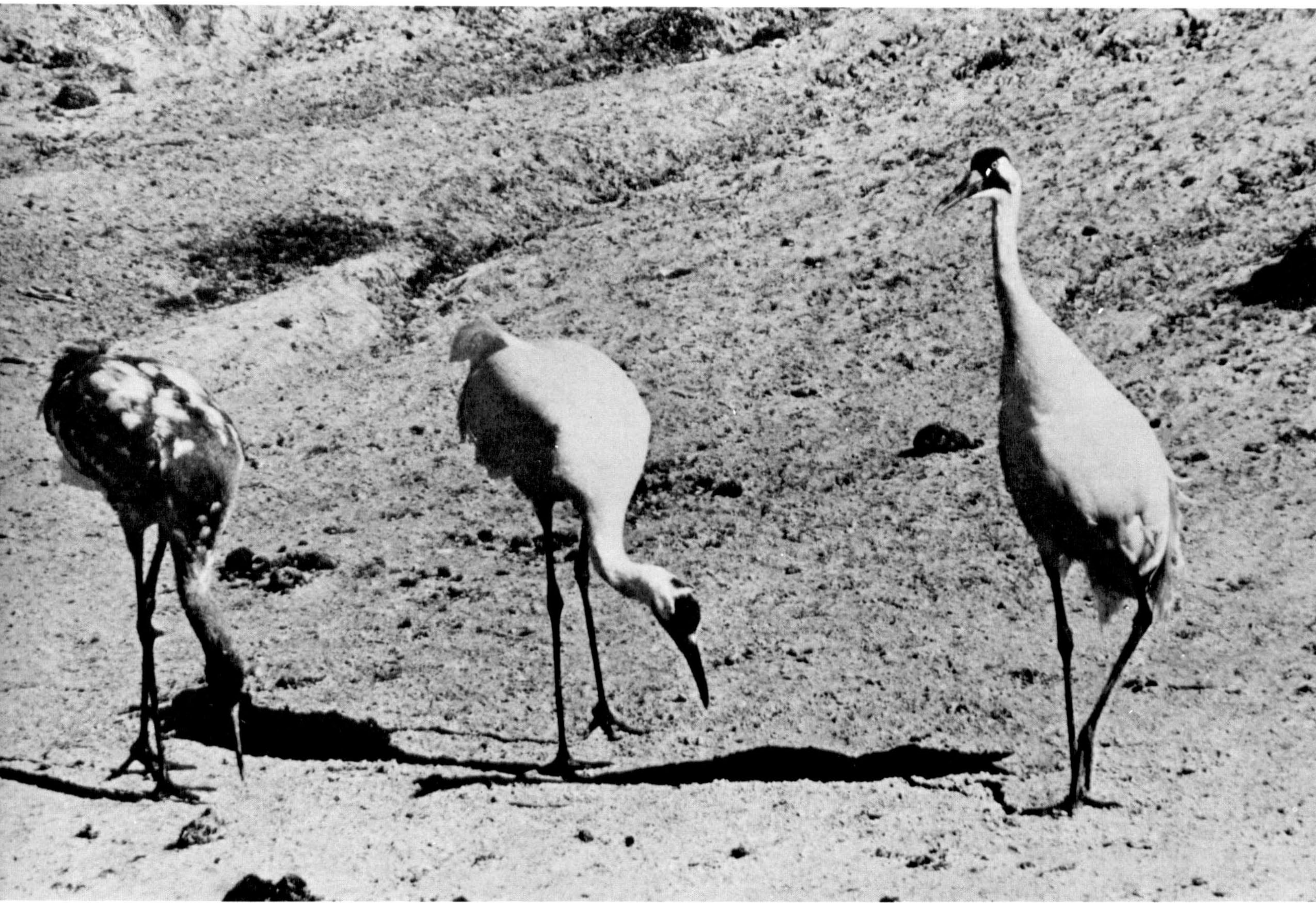
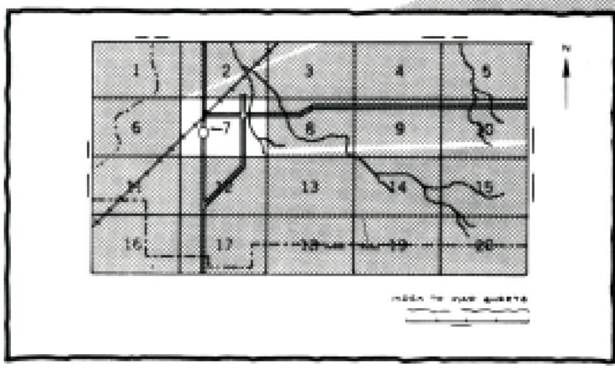
SOIL SURVEY OF SAN PATRICIO AND ARANSAS COUNTIES, TEXAS

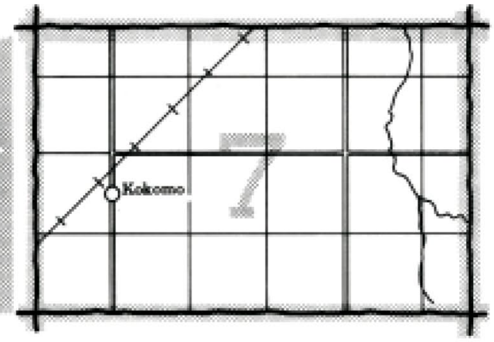


United States Department of Agriculture
Soil Conservation Service
in cooperation with
Texas Agricultural Experiment Station

HOW TO USE

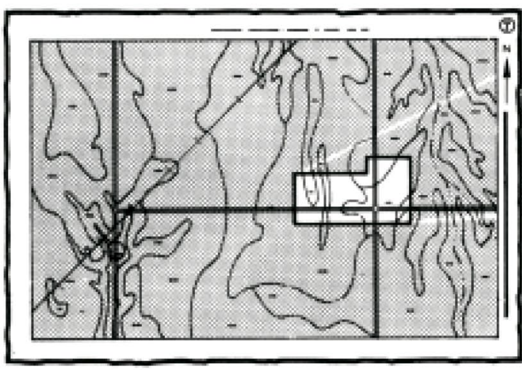
1. Locate your area of interest on the "Index to Map Sheets"

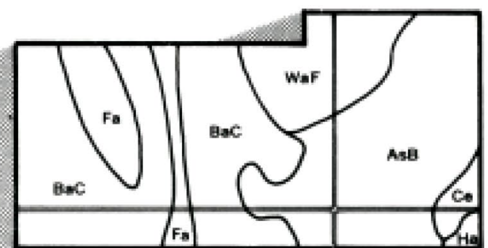




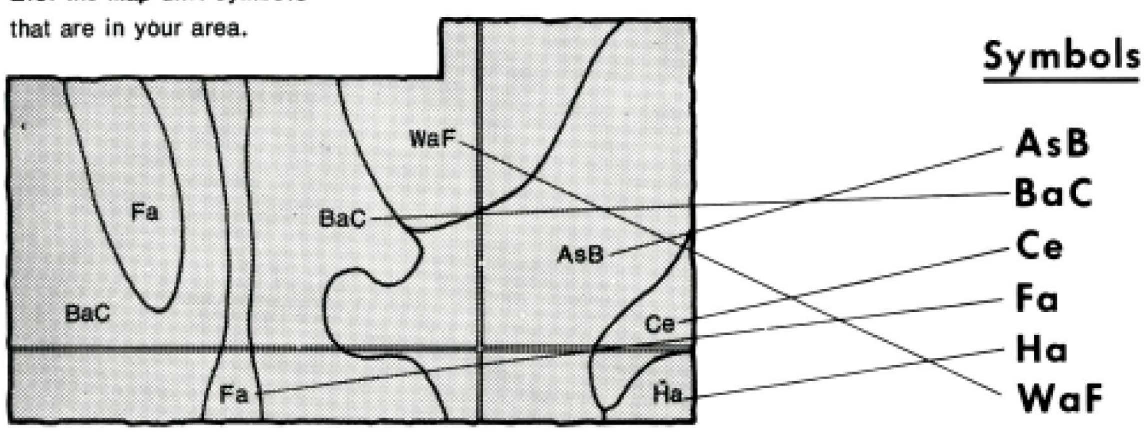
2. Note the number of the map sheet and turn to that sheet.

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



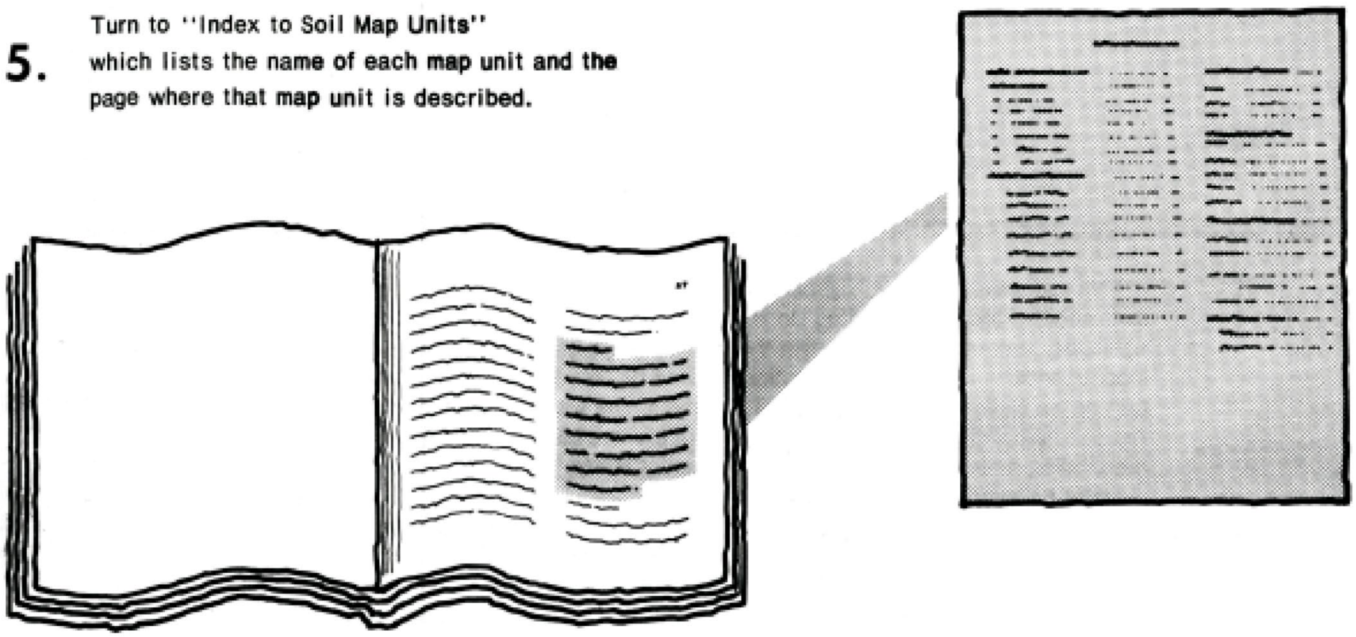


4. List the map unit symbols that are in your area.

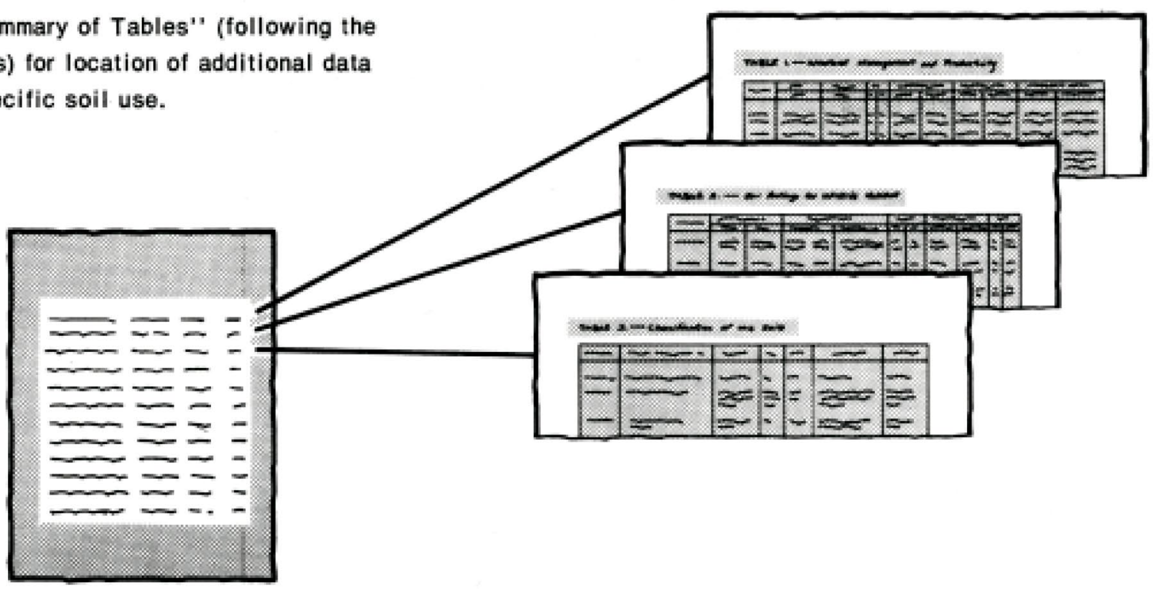


THIS SOIL SURVEY

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



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



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

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

Major fieldwork for this soil survey was completed in the period 1965-74. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1974. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the San Patricio and Copano Bay Soil and Water Conservation Districts.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Whooping cranes, an endangered species, search for food in an area of Tatton complex. (Photo courtesy of the U.S. Fish and Wildlife Service)

Contents

Issued July 1979

Index to Soil Map Units

Summary of Tables

Foreword

The Soil Survey of San Patricio and Aransas Counties contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

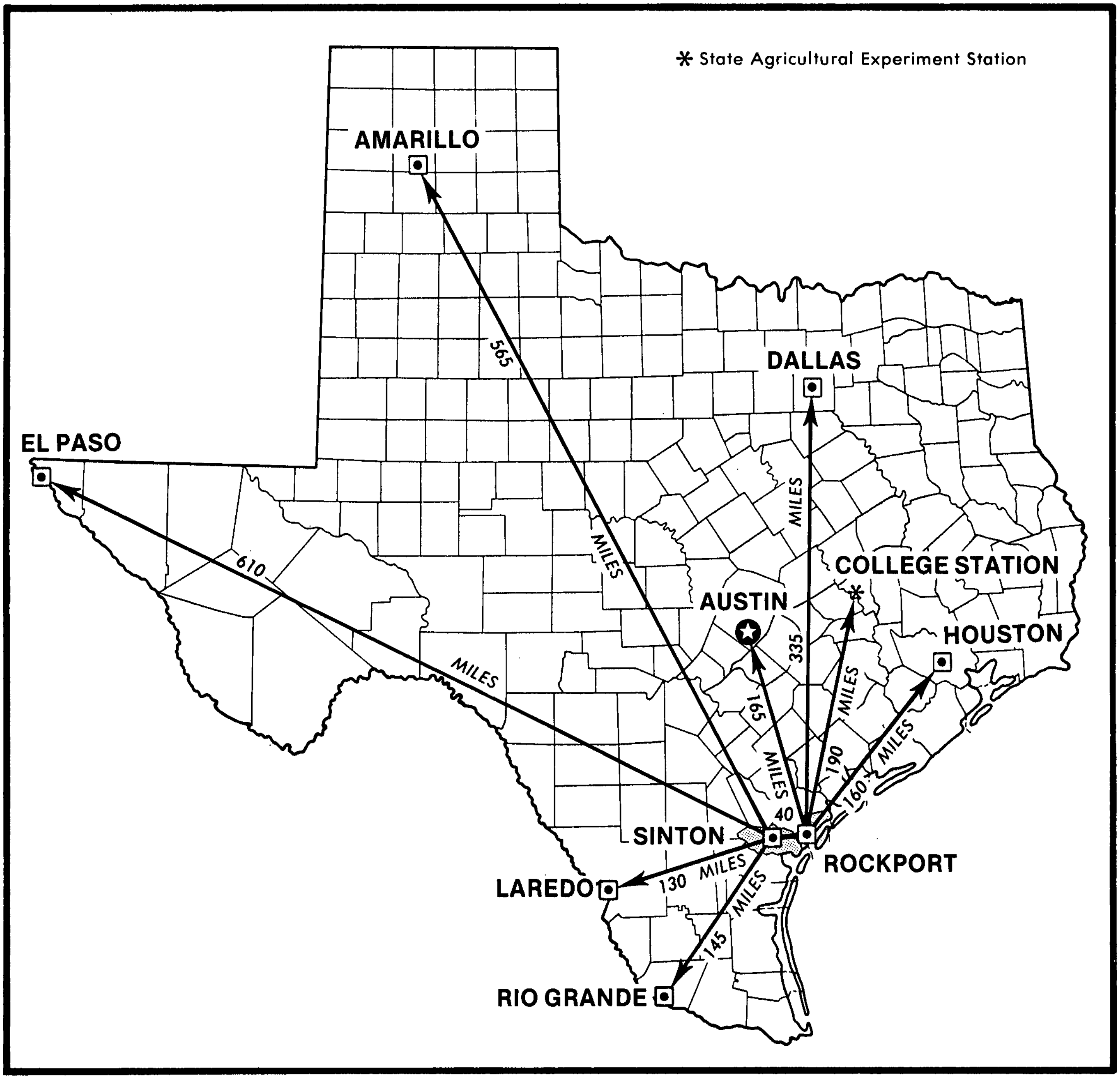
Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption 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 kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

George C. Marks

George C. Marks
State Conservationist
Soil Conservation Service



Location of San Patricio and Aransas Counties in Texas

SOIL SURVEY OF SAN PATRICIO AND ARANSAS COUNTIES TEXAS

By William J. Guckian and Ramon N. Garcia, Soil Conservation Service

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

SAN PATRICIO AND ARANSAS COUNTIES are in south Texas bordering the Gulf of Mexico (see facing page). The two counties combined have a land area of 956 square miles, or 611,776 acres. San Patricio County covers 438,592 acres and Aransas County 173,184 acres. The survey area is bordered by Refugio and Bee Counties on the north, Live Oak and Jim Wells Counties on the west, Nueces County on the south, and the Gulf of Mexico and Calhoun County on the east.

The counties are mainly in the southwestern part of the Coast Prairie Land Resource Area, and only the extreme western edge of San Patricio County is in the Rio Grande Plain Land Resource Area. The soils are dominantly dark colored, clayey and loamy and, for the most part, are not very susceptible to sheet or gulley erosion or soil blowing.

The topography of the survey area is a flat, almost featureless plain except the coastal part along the eastern edge, which has an undulating and dunelike appearance, and the extreme western edge, which is gently rolling terrain. The elevation ranges from sea level in the eastern part of the area to about 160 feet in the western part.

About 50 percent of the area is cropland and improved pasture, 35 percent is range, and the remaining 15 percent is industrial sites, recreational facilities, or urban areas.

General nature of the area

This section provides information of general interest about San Patricio and Aransas Counties (*13*). It discusses briefly the history, climate, industry and transportation, and natural resources of the area.

History

San Patricio County was created from a Mexican land grant in 1836 and named for an earlier settlement by that name. It was organized in 1837 and reorganized in 1847. At this time San Patricio was the county seat; and San Patricio and Sharpsburg were the only towns in the county until about 1880. In 1893 the county seat was moved to Sinton.

Aransas County was created and organized from Refugio County in 1871. It was named for Rio Nuestra Senora de Aranzau, the name being derived originally from a Spanish palace. Rockport was founded in 1867 and became the county seat, first of Refugio County and later of Aransas County.

The area had a steady growth rate until recent years when incoming industry caused the growth of both population and commerce to accelerate. The population of the area was estimated to be 59,000 in 1973 (*10*). Sinton, in San Patricio County, had an estimated population of 5,750; and Rockport, in Aransas County, had 4,000. Other towns and communities in the two-county area are Mathis, St. Paul, Ingleside, Portland, Gregory, Taft, Odem, San Patricio, and West Sinton in San Patricio County and are Fulton, Copano Village, Lamar, Holiday Beach, and Key Allegro in Aransas County. Aransas Pass is on the San Patricio-Aransas County line and lies partly in both counties. The major streams of the area are the Nueces and Aransas Rivers and the Chiltipin, Papalote, Copano, Cavasso, and Salt Creeks. All flow in an easterly or southeasterly direction.

Climate

Robert Orton, former State climatologist, Austin, Texas, and Donald Bryant, weather recorder, National Weather Service, Sinton, Texas, assisted in preparing this section.

The climate of the survey area ranges from humid subtropical along the coast to dry subhumid in the western part with warm summers and mild winters. The prevailing southeasterly winds from the Gulf of Mexico help regulate the temperature, and severe extremes are rare. The peak rainfall periods usually occur in September and October in the fall and April, May, and June in the spring and early in summer.

Polar air masses that push south across the area in winter produce days of cool, cloudy, sometimes rainy weather, but these cool spells rarely last longer than 48 to 72 hours.

Tropical storms are a threat to the Texas coast in summer and fall; however, storms of hurricane intensity do not occur often, and the probability of a storm of such severity striking a particular location, within any particular year, is exceedingly small. Since hurricanes move slowly, adequate warnings are issued by the National Weather Service well in advance of landfall.

Table 1 gives data on temperature and precipitation for San Patricio and Aransas Counties, as recorded at Sinton for the period 1921 to 1973 and the Aransas National Wildlife Refuge for the period 1942 to 1971. 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 57 degrees F in both counties of the survey area, and the average daily minimum temperature is 46 degrees in San Patricio County and 47 degrees in Aransas County. The lowest temperature on record, 11 degrees, occurred at Sinton and the Aransas National Wildlife Refuge in 1962. In summer the average temperature is 86 degrees in San Patricio County and 83 degress in Aransas County, and the average daily maximum is 96 degress in San Patricio County and 91 in Aransas County. The highest temperatures recorded are 108 degrees at Sinton in San Patricio County and 103 degrees at the Aransas National Wildlife Refuge in Aransas County.

Growing degree days, shown in table 1, 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. The normal monthly accumulation is used to schedule single or successive plantings of a crop within the seasonal limits of the last freeze in spring and the first freeze in fall.

As shown in table 1, the total precipitation is 29.3 inches in San Patricio County and 36.8 inches in Aransas County. Of this total, 18.6 inches in San Patricio County and 23.3 inches in Aransas County, or 63 percent, usually falls during the period March through September, which includes the growing season for most crops. Two years in 10, the March-September rainfall is less than 13 inches in San Patricio County and 17 inches in Aransas County. The heaviest 1-day rainfall during the period of record was 22 inches at Sinton, in San Patricio County in September 1967 and 12.3 inches at the Aransas Wildlife Refuge in Aransas County in August 1945. Thunderstorms are numerous and mostly occur in the spring and fall seasons of the year.

Snowfall is rare. In 90 percent of the winters there is no measurable snowfall, and in 7 percent the snowfall is less than 1.0 inch.

The average relative humidity in midafternoon in spring is less than 75 percent; during the rest of the year it is about 60 percent. Humidity is higher at night in all seasons, and the average at dawn is about 85 percent. The percentage of possible sunshine is 95 in summer and 50 in winter. The prevailing direction of the wind is from the southeast. Average windspeed is highest, 35 miles per hour, in April.

Industry and transportation

Industry in the survey area is varied. Farming and ranching are the major enterprises. However, with deep water port facilities and the intracoastal canal available, several large manufacturing and oil companies and a carbon processing plant have located in the Aransas Pass-Ingleside-Gregory-Portland area. Seafood processing and ship building are important industries in the Aransas Pass-Rockport-Fulton area.

Four major highways cross the survey area. Interstate Highway 37 crosses the western part of the area from northwest to southeast; U.S. Highway 181 crosses the central part from northwest to southeast through Sinton; U.S. Highway 77 crosses from northeast to southwest through Sinton; and Texas Highway 35 crosses the eastern part of the area from Gregory through Rockport. Numerous farm roads and county roads connect the towns and communities of the survey area. All the farm roads and some of the county roads are paved with asphalt.

There are two railroads in the area. One crosses the western part of the area from northwest to southeast. The other crosses the central part of the area from northeast to southwest. Branch lines service Rockport, Gregory, and other parts of the area.

Natural resources

The soil of the survey area is its most important natural resource. The soils are generally excellent for field crop and grass production. Grain sorghum and cotton are the most important field crops; however, some corn, flax, hay crops, and truck crops are also grown. Beef cattle are the most important product of the grasslands.

Other natural resources important to the economy of the area are the fish, shrimp, and oysters produced by the Gulf of Mexico and the various bays. The pleasant climate, fishing, and beaches attract tourists to the coastal areas. The survey area includes the Aransas National Wildlife Refuge, Welder Wildlife Refuge, Goose Island State Park, Lake Corpus Christi State Park, the

State Marine Laboratory and Museum, Welder Park, and several bird sanctuaries.

Oil and gas are produced throughout the area. The first gas field was opened for production in San Patricio County in 1920, and by 1930 it was an important gas- and oil-producing county. Oil was discovered in Aransas County in 1936, and exploration is continuing. Sand, gravel, and caliche for roads and construction purposes are obtained in the Mathis area. Shell is dredged in the coastal areas for the same purpose.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

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

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land use planning

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

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, drainage, or other characteristics that affect their management.

The soils in the survey area vary widely in their potential for major land uses. Table 4 shows the extent of the map units shown on the general soil map and gives general ratings of the potential of each, in relation to the other map units, for major land uses. Soil properties that pose limitations to the use are indicated. The ratings of soil potential are based on the assumption that practices in common use in the survey area are being used to overcome soil limitations. These ratings reflect the relative cost of such practices, the ease of overcoming the soil limitations, and the probability of soil problems persisting after such practices are used.

Each map unit is rated for *cultivated farm crops, specialty crops, range, urban uses,* and *recreation areas.* Cultivated farm crops are those grown extensively by farmers in the survey area, such as grain sorghum and cotton. Specialty crops include vegetables, fruits, and nursery crops grown on limited acreage and generally requiring intensive management. Range refers to areas growing native range plants. Urban uses include residential, commercial, and industrial developments. Recreation areas include campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic and areas used for nature study and as wilderness.

Map unit descriptions

1. Victoria-Raymondville-Orelia

Nearly level to gently sloping, very slowly permeable to slowly permeable, nonsaline through strongly saline, clayey and loamy soils on uplands

This map unit consists of nearly level to gently sloping soils that have slopes of 0 to 3 percent. It makes up about 47 percent of the survey area. Victoria soils make up about 53 percent of the unit; Raymondville soils, 21 percent; Orelia soils, 18 percent; and other soils the remaining 8 percent (fig. 1).

Victoria soils have a surface layer of dark gray, moderately alkaline clay that is about 38 inches thick and contains a few concretions of calcium carbonate. Below this, to a depth of 58 inches, is moderately alkaline, moderately saline, light gray clay that has vertical dark gray streaks and, in the lower part, a few pockets and seams of gypsum crystals. The underlying material, to a depth of 72 inches, is light gray, moderately alkaline, strongly saline clay that has a few gray streaks, a few concretions of calcium carbonate, and a few pockets and seams of gypsum and other salts.

Raymondville soils have a surface layer of moderately alkaline clay loam about 14 inches thick that contains a few cracks and fine concretions of calcium carbonate. It is dark gray in the upper 8 inches and very dark gray below. Below this, to a depth of 38 inches, is moderately alkaline clay. Between depths of 14 and 25 inches, is gray clay that contains concretions of calcium carbonate; and between 25 and 38 inches, is light gray clay that contains concretions and soft bodies of calcium carbonate. The underlying material, to a depth of 60 inches, is light gray, moderately alkaline clay loam that is about 5 percent concretions and soft bodies of calcium carbonate.

Orelia soils have a surface layer of gray, slightly acid fine sandy loam about 5 inches thick. Below this, to a depth of 32 inches, is sandy clay loam that increases in salinity with depth. Between depths of 5 and 10 inches, it is dark gray and neutral; between 10 and 25 inches, it is dark gray, mildly alkaline, moderately saline, and contains a few black concretions; and between 25 and 32 inches, it is light gray, moderately alkaline, moderately saline, and is about 5 percent weakly cemented concretions of calcium carbonate. The underlying material, to a depth of 60 inches, is light gray, moderately alkaline, strongly saline sandy clay loam that has brownish mottles and is about 5 percent weakly cemented concretions and soft bodies of calcium carbonate.

Of minor extent in this unit are Edroy, Monteola, Narta, Papalote, Victine, and Willacy soils and some areas of oil-waste land.

Most of this map unit is cultivated or is planted to improved pasture. A few small areas are in range or are used for wildlife habitat. Most of the acreage has been cleared. Some drainage has been installed, and some land has been leveled and smoothed. Wetness is the main limitation to the use of the soils for farming and for most other purposes.

This unit has high potential for cultivated farm crops. Because the soils are wet and have high shrink-swell potential, the potential for urban use is low. The potential for openland wildlife habitat is high.

2. Galveston-Mustang-Dianola

Nearly level to undulating, rapidly permeable, nonsaline through extremely saline, sandy soils in low coastal areas

This map unit consists of nearly level to undulating soils that have slopes of 0 to 8 percent. It makes up about 21 percent of the survey area. Galveston soils make up about 26 percent of the unit; Mustang soils, about 26 percent; Dianola soils, about 8 percent; and other soils, the remaining 40 percent.

Galveston soils have a surface layer of light gray, neutral fine sand about 4 inches thick. From 4 to 42 inches is white, mildly alkaline fine sand. The underlying material, to a depth of 72 inches, is white, mildly alkaline fine sand.

Mustang soils have a surface layer of light brownish gray, moderately alkaline fine sand about 5 inches thick. The underlying material is white fine sand. To a depth of 14 inches, it is moderately alkaline and has brownish mottles and streaks; to a depth of 60 inches, it is neutral and has brownish mottles.

In Dianola soils, the surface layer is gray, moderately alkaline, extremely saline loamy sand about 6 inches thick. The underlying material, to a depth of 60 inches, is moderately alkaline, extremely saline loamy sand. To a depth of 15 inches, it is light brownish gray with brownish mottles; between 15 and 35 inches, it is light gray with brownish mottles and streaks; and to 60 inches, it is light gray with yellowish mottles and streaks.

Of minor extent in this map unit are Barrada, Dietrich, Falfurrias, Ijam, Psamments, and Tatton soils and some areas of Beaches and Oil-waste land.

Most of this unit is used as range or wildlife habitat. A few small areas are used for improved pasture or recreation. Soil blowing, a high water table, salinity, wetness, and flooding are limitations to the use of these soils for most purposes other than range or wildlife habitat.

This unit has low potential for range. To maintain productivity, a good system of deferred grazing and proper stocking rates is required. Because of soil wetness, a high water table, and flooding, potential is low for cultivated crops and urban and recreational use. The potential for openland, rangeland, and wetland wildlife habitat is high.

3. Narta-Aransas-Victine

Nearly level, very slowly permeable, slightly saline through extremely saline, clayey and loamy soils on flood plains and in low coastal areas

This unit consists of nearly level soils that have slopes of 0 to 1 percent. It makes up about 9 percent of the survey area. Narta soils make up 40 percent of the unit; Aransas soils, 30 percent; Victine soils, 15 percent; and other soils, the remaining 15 percent.

Narta soils have a surface layer of gray, moderately alkaline, moderately saline fine sandy loam about 8 inches thick. Below this to a depth of 14 inches, is very dark gray, moderately alkaline, extremely saline clay that contains a few black concretions; to 26 inches, is gray, moderately alkaline, extremely saline clay loam that contains thin seams of salt crystals and a few black concretions; and to 36 inches is gray, strongly alkaline, extremely saline clay loam that contains coatings of salt crystals on peds, about 4 percent soft bodies and concretions of calcium carbonate, and a few black concretions. The underlying material, to a depth of 46 inches, is light brownish gray, strongly alkaline, extremely saline clay loam that contains concretions and soft bodies of calcium carbonate and black concretions. To a depth of 60 inches, it is light gray, strongly alkaline, extremely saline clay loam containing soft bodies and concretions of calcium carbonate and a few black concretions.

Aransas soils have a surface layer of dark gray, moderately alkaline, moderately saline clay about 40 inches thick. In the upper 22 inches, it contains a few fine threads and soft bodies of calcium carbonate; the lower part contains a few concretions of calcium carbonate and black concretions. The underlying material, to a depth of 66 inches, is gray, moderately alkaline, strongly saline clay that contains a few concretions of calcium carbonate, black concretions, and salt crystals.

Victine soils have a surface layer of dark gray, moderately alkaline clay about 40 inches thick that contains a few concretions of calcium carbonate. The surface layer is slightly saline in the upper 12 inches and moderately saline in the lower part. Between 40 and 60 inches, is gray, moderately alkaline, strongly saline clay that contains concretions and soft bodies of calcium carbonate and a few gypsum crystals. The underlying material, to a depth of 72 inches, is white, strongly alkaline, strongly saline clay that contains concretions and soft bodies of calcium carbonate and crystals of gypsum and other salts.

Of minor extent in this map unit are Barrada, Dianola, Dietrich, Edroy, Orelia, Papalote, and Victoria soils and some areas of Oil-waste land.

All of this unit is used for range or wildlife habitat. Wetness, flooding, salinity, shrink-swell, and corrosivity are limitations to the use of these soils for any other purposes.

This unit has high potential for range. To maintain productivity, a good system of deferred grazing and proper stocking rates is required. Wetness, flooding, salinity, shrink-swell, and corrosivity give this unit low potential for cultivated crops, urban use, and recreational uses. The potential for wetland and shallow water wildlife habitats is medium.

4. Orelia-Papalote

Nearly level to gently sloping, very slowly permeable to slowly permeable, nonsaline through strongly saline, loamy soils on uplands

This map unit consists of nearly level to gently sloping soils that have slopes of 0 to 5 percent. It makes up about 8 percent of the survey area. The unit is 45 percent Orelia soils, 40 percent Papalote soils, and 15 percent other soils (fig. 2).

Orelia soils have a surface layer of gray, slightly acid fine sandy loam about 5 inches thick. Below that to a depth of 10 inches, is dark gray, neutral sandy clay loam; then to 25 inches, is dark gray, mildly alkaline, moderately saline sandy clay loam that contains a few black concretions; and to 32 inches, is light gray, moderately alkaline, moderately saline sandy clay loam that is about 5 percent weakly cemented concretions of calcium carbonate. The underlying material, to a depth of 60 inches, is light gray, moderately alkaline, strongly saline sandy clay loam that contains brownish mottles and about 5 percent weakly cemented concretions and soft bodies of calcium carbonate.

Papalote soils have a surface layer of neutral fine sandy loam about 14 inches thick. This layer is light brownish gray in the upper 8 inches and is grayish brown in the lower part. Below that to a depth of 17 inches, is dark gray, neutral sandy clay that contains brownish mottles; to 30 inches, is grayish brown, mildly alkaline sandy clay that contains grayish and reddish mottles and a few black concretions; to 36 inches, is grayish brown, mildly alkaline sandy clay that contains yellowish, brownish, and grayish mottles and a few black concretions; and to 48 inches, is light brownish gray, moderately alkaline sandy clay loam that contains reddish and grayish mottles, a few black concretions, and a few concretions and soft bodies of calcium carbonate. The underlying material, to a depth of 60 inches, is pale brown, moderately alkaline sandy clay loam containing grayish and brownish mottles and concretions and soft bodies of calcium carbonate.

Of minor extent in this map unit are the Delfina, Edroy, Leming, Raymondville, and Victoria soils and some areas of Oil-waste land.

Most of this unit is used as range or wildlife habitat. A few areas are cultivated or planted to improved pasture. Some areas have been drained, and some tracts have been leveled and smoothed. Wetness is the main limitation to the use of these soils for farming and for most other purposes.

This unit has high potential for range. To maintain productivity, a good system of deferred grazing and proper stocking rates is required. Because of wetness, shrink-swell, and low strength, this unit has only medium potential for urban and recreational use. The potential for rangeland wildlife habitat is high.

5. Aransas-Sinton-Odem

Nearly level to gently sloping, very slowly permeable to moderately rapidly permeable, nonsaline through strongly saline, clayey and loamy soils on bottom lands

This unit consists of nearly level to gently sloping soils that have slopes of 0 to 3 percent. It makes up about 7 percent of the survey area. Aransas soils make up about 35 percent of the unit; Sinton soils, 14 percent; Odem soils, about 12 percent; and other soils, the remaining 39 percent (fig. 3).

Aransas soils have a surface layer of dark gray, moderately alkaline, moderately saline clay about 40 inches thick. This layer has a few fine threads and soft bodies of calcium carbonate in the upper 22 inches and has a few calcium carbonate and black concretions in the lower part. The underlying material, to a depth of 66 inches, is gray, moderately alkaline, strongly saline clay that contains a few concretions of calcium carbonate, black concretions, and salt crystals.

The Sinton soils have a surface layer of moderately alkaline loam about 28 inches thick. In the upper 15 inches it is very dark gray and contains a few films of calcium carbonate; between 15 and 28 inches, it is dark gray and contains a few thin strata and lenses of sandy clay loam in the lower part and a few films and threads of calcium carbonate. To a depth of 44 inches, the underlying material is light gray, moderately alkaline loam that contains a few bedding planes and a few thin strata and lenses of fine sandy loam and loamy fine sand. To a depth of 72 inches, it is white, moderately alkaline loamy fine sand that contains a few bedding planes and thin strata of fine sandy loam.

Odem soils have a surface layer of dark gray fine sandy loam about 40 inches thick. Reaction is neutral in the upper 16 inches and mildly alkaline in the lower part. The underlying material, to a depth of 60 inches, is grayish brown, moderately alkaline fine sandy loam that contains a few bedding planes and thin strata of loamy fine sand.

Of minor extent in this map unit are the Barrada, Comitas, Dianola, Falfurrias, Nueces, and Sarita soils, a few large sand and gravel pits, and some areas of Oil-waste land.

Most of this unit is used as range or wildlife habitat. A few small areas are improved pasture, are cultivated, or are used for recreation. Flooding and wetness are the main limitations to the use of these soils for most purposes other than range, pasture, and wildlife habitat.

This map unit has high potential for range. To maintain productivity, a good system of deferred grazing and proper stocking rate is required. Because of flooding and wetness, the potential is only medium for farming and is low for recreation and urban uses. The potential for shallow water, openland, and rangeland wildlife habitat is high.

6. Papalote-Delfina-Leming

Nearly level to gently sloping, slowly permeable to moderately slowly permeable, nonsaline, sandy and loamy soils on uplands

This unit consists of nearly level to gently sloping soils that have slopes of 0 to 5 percent. It makes up about 6 percent of the survey area. Papalote soils make up about 42 percent of the unit; Delfina soils, 24 percent; Leming soils, 10 percent; and other soils, the remaining 24 percent.

Papalote soils have a surface layer of neutral fine sandy loam about 14 inches thick. It is light brownish gray in the 8 upper inches and is grayish brown in the lower part. Below that, to a depth of 17 inches, is dark gray, neutral sandy clay that has brownish mottles; to 30 inches, is grayish brown, mildly alkaline sandy clay that has grayish and reddish mottles and a few black concretions; to 36 inches, is grayish brown, mildly alkaline sandy clay that has yellowish, brownish, and grayish mottles and a few black concretions; and to 48 inches, is light brownish gray, moderately alkaline sandy clay loam that contains reddish and grayish mottles, a few black concretions, and a few concretions and soft bodies of calcium carbonate. The underlying material, to a depth of 60 inches, is pale brown, moderately alkaline sandy clay loam that contains grayish and brownish mottles and concretions and soft bodies of calcium carbonate.

Delfina soils have a surface layer of grayish brown, slightly acid loamy fine sand about 14 inches thick. Below that, to a depth of 17 inches, is grayish brown, slightly acid sandy clay loam that has brownish mottles and black concretions; to 30 inches is grayish brown, neutral sandy clay loam that has brownish and reddish mottles and black concretions; to 40 inches is light brownish gray, neutral sandy clay loam with yellowish mottles; and, to a depth of 60 inches, is light gray, moderately alkaline sandy clay loam that contains concretions and soft bodies of calcium carbonate.

Leming soils have a surface layer of slightly acid loamy fine sand about 28 inches thick. It is pale brown in the upper 24 inches and is very pale brown with brownish mottles in the lower part. Below that, to a depth of 32 inches, is pale brown, slightly acid sandy clay that has grayish, brownish, and reddish mottles; to 40 inches, is pale brown, mildly alkaline sandy clay that has reddish, grayish, and yellowish mottles and black concretions; and to 54 inches, is light yellowish brown, mildly alkaline sandy clay loam that has yellowish, reddish, and grayish mottles. The underlying material, to a depth of 62 inches, is light yellowish brown, moderately alkaline sandy clay loam that contains yellowish, brownish, and reddish mottles and about 5 percent concretions and soft bodies of calcium carbonate. To a depth of 72 inches, it is light yellowish brown and light gray, moderately alkaline sandy clay loam that contains yellowish and reddish mottles and concretions of calcium carbonate.

Of minor extent in this map unit are Comitas, Edroy, Falfurrias, Nueces, Pharr, Sarita, and Willacy soils.

Most of this unit is used as improved pasture, range, or wildlife habitat. A few areas are cultivated. Soil blowing, slow to moderately slow permeability, and shrink-swell are the main limitations to the use of these soils for farming and for most other purposes.

This unit has high potential for improved pasture and range. To maintain productivity, a good program of fertilization and weed control is required on improved pasture as well as a good system of deferred grazing and proper stocking rates on both improved pasture and range. Because of permeability, soil blowing, shrink-swell, and low strength, this unit has only medium potential for farming and urban use. The potential for rangeland and openland wildlife habitat is high.

7. Pettus-Pharr

Nearly level to gently sloping, moderately permeable, nonsaline through slightly saline, loamy soils on uplands

This map unit consists of nearly level to gently sloping soils that have slopes of 0 to 5 percent. It makes up about 2 percent of the survey area. Pettus soils make up about 33 percent of the unit; Pharr soils, about 29 percent; and other soils, the remaining 38 percent (fig. 4).

Pettus soils have a surface layer of grayish brown, moderately alkaline loam about 6 inches thick. Below that, to a depth of 18 inches, is light brownish gray, moderately alkaline sandy clay loam that contains a few concretions of calcium carbonate. The material to a depth of 24 inches is white, weakly cemented, platy and fractured caliche that contains solution channels.

Pharr soils have a surface layer of dark grayish brown, moderately alkaline fine sandy loam about 18 inches thick. Below that, to a depth of 32 inches, is brown, moderately alkaline sandy clay loam with films and threads of calcium carbonate. To 42 inches, is pale brown, moderately alkaline sandy clay loam that is about 7 percent soft bodies of calcium carbonate. The underlying material, to a depth of 72 inches, is very pale brown, moderately alkaline sandy clay loam that is about 10 percent soft bodies of calcium carbonate.

Of minor extent in this map unit are Papalote, Raymondville, Victoria, and Willacy soils and numerous large caliche pits.

Most of this unit is used as range, improved pasture, or wildlife habitat. A few areas are cultivated, used for recreation, or are caliche pits. The medium available water capacity and shallowness to weakly cemented and fractured caliche are the main limitations to the use of these soils for farming and for most other purposes.

The potential for range is medium because of a shallow rooting zone in some of the soils. Because of the available water capacity and depth to weakly cemented and fractured caliche, the potential is low for farming. Potential is high for urban uses and recreation. The potential for openland and rangeland wildlife habitat is medium.

Land use potentials

Each year more land is developed for urban use in Sinton, Portland, Ingleside, Rockport, and other cities in the survey areas. About 32,000 acres, or 5 percent of the survey area, was urban or built-up land in 1967, according to the Conservation Needs Inventory (*9*). Much of this acreage was well suited to crops.

Most map units in the survey area have low potential for urban development; however, the Orelia-Papalote and Papalote-Delfina-Leming units have medium potential, and the Pettus-Pharr unit has high potential for this use. Urban development is very costly on the wet and sometimes flooded soils of the Galveston-Mustang-Dianola, Narta-Aransas-Victine, and Aransas-Sinton-Odem units and on the clayey, high shrink-swell soils of the Victoria-Raymondville-Orelia unit.

Some soils and landscapes can be developed for urban use at lower cost than the soils named in the last paragraph. These include portions of the Pettus-Pharr unit and the less sloping soils of the Papalote-Delfina-Leming unit. The first of these units has low potential for farming; the latter has medium potential.

The Victoria-Raymondville-Orelia map unit has high potential for farming, but low potential for nonfarm development. It is suitable for vegetables and other specialty crops where properly drained. The wetness, clayey surface, and shrink-swell properties of these soils are hazards for nonfarm development. With proper drainage, proper design of building foundations, and shaping of the soil surface, these hazards can be overcome.

The rolling Pettus-Pharr map unit has high potential for parks and other recreational use. Undrained portions of the Galveston-Mustang-Dianola, Narta-Aransas-Victine, and the Aransas-Sinton-Odem units are good marsh nature study areas. All of these map units also provide habitat for many important wildlife species.

The Orelia-Papalote map unit, less sloping areas of the Papalote-Delfina-Leming unit, and some parts of the Aransas-Sinton-Odem unit have medium potential for specialty crops. Most of these soils are well drained and warm up earlier in spring than the heavier, wetter soils. The well drained soils are suited to nurseries.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have a profile that is almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. The Victoria series, for example, was named for the town of Victoria in Victoria County.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Papalote fine sandy loam, 1 to 3 percent slopes, is one of several phases within the Papalote series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes and soil associations.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Sarita-Nueces complex is an example.

A *soil association* is made up of soils that are geographically associated and are shown as one unit on the map because it is not practical to separate them. A soil association has considerable regularity in geographic pattern and in the kinds of soil that are a part of it. The extent of the soils can differ appreciably from one delineation to another; nevertheless, interpretations can be made for use and management of the soils. Galveston-Mustang association is an example.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Oil-waste land is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

Not all of the map units in this survey area have been mapped with the same degree of detail. Broadly defined units—indicated by symbols in which the first and second letters are capitals—are apt to be large and to vary more in composition than units mapped in greater detail. Composition has been controlled well enough, however, to be interpreted for the expected use of the soils.

The acreage and proportionate extent of each map unit are given in table 5, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Soil descriptions

Ac—Aransas clay. This is a deep, nearly level, poorly drained soil on bottom lands. These are mostly long and narrow areas that are parallel or adjacent to flood plains.

Aransas clay is occasionally flooded during periods of very high rainfall such as those that accompany tropical storms or hurricanes. Flooding occurs once or twice in 10 years. The soil is saturated in spring and fall but dry in summer. Areas of this soil range from 20 to 1,550 acres. Slopes range from 0 to 1 percent.

The surface layer is very dark gray, moderately alkaline clay about 6 inches thick. Dark gray, moderately alkaline clay is between depths of 6 and 46 inches. The underlying material, to a depth of 66 inches, is gray, moderately alkaline clay.

Aransas clay has high available water capacity and very slow permeability. Surface runoff is very slow.

Included with this soil in mapping are small areas of soils that are similar to Aransas clay but have slopes of up to 2 percent and small areas where the surface layer is clay loam. Also included are small areas of Sinton and Odem soils; Aransas clay, frequently flooded; and, near the coast, Aransas clay, saline. Inclusions make up less than 15 percent of any one mapped area.

This Aransas soil is mainly used for range (fig. 5), and potential is high for climax range vegetation. A system of controlled grazing and proper stocking rates help keep a good vegetative cover on the surface and maintain productivity. This soil has only medium potential for wildlife habitat.

This soil has high potential for pasture production. Wetness is a limitation, but can be easily overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control, all of which help to keep a good surface cover and maintain productivity. Fertilization and weed control can be done during the dry season. Improved varieties of bermudagrass and bluestem are suited to this soil.

This soil has only medium potential for crops. The limitations of wetness and occasional damaging floods can be overcome, with some difficulty, by properly designed and installed diversion terraces and field drainage systems. A system of proper fertilization; planting crops that produce a large amount of residue and cover crops, including legumes; and residue management will reduce soil temperature and improve and maintain soil tilth and productivity. Suitable crops are grain sorghum, cotton, and corn.

Potential is low for urban uses and recreation. Flooding and wetness are the main hazards.

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

Af—Aransas clay, frequently flooded. This is a deep, nearly level, poorly drained soil in slightly concave basins, sloughs, and abandoned stream channels and on flood plains. Areas are mostly long and narrow and lie parallel and adjacent to rivers and creeks. This soil is frequently flooded by major stream overflows during heavy rains and by runoff during brief local rains. Flooding occurs about 3 times in 5 years. Areas of this soil range from 15 to 360 acres. Slopes range from 0 to 1 percent.

The surface layer is very dark gray, moderately alkaline clay about 35 inches thick. Dark gray, moderately alkaline clay is between depths of 35 and 50 inches. The underlying material, to a depth of 60 inches, is gray, moderately alkaline clay.

Aransas clay, frequently flooded, has high available water capacity and very slow permeability. Surface runoff is ponded to very slow.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 2 percent and small areas where the surface layer is clay loam. Also included are small areas of Sinton soils, Odem soils, Aransas clay, and, near the coastal areas, Aransas clay, saline. Inclusions make up less than 20 percent of any one mapped area.

This soil is mainly used for range and has high potential for climax range vegetation. A system of controlled grazing and proper stocking rates will help keep a good surface cover and maintain productivity. Potential is only medium for wetland and rangeland wildlife habitat.

Potential for urban uses and recreation is low because of flooding and wetness.

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

As—Aransas clay, saline. This is a deep, nearly level, poorly drained soil on deltas, ancient lagoons, and flood plains adjoining inland bays and coastal areas. Areas of this soil are mostly long, narrow bands.

Aransas clay, saline, is subject to flooding by salt water during periods of high tides accompanying storms and by the fresh water of heavy rains accompanying tropical storms or hurricanes. This soil is flooded by fresh water about 3 times in 5 years and by salt water 2 or 3 times in 10 years. It is saturated to the surface during part of most years. Areas of this soil range from 20 to 1,640 acres. Slopes range from 0 to 1 percent.

The surface layer is dark gray, moderately alkaline, moderately saline clay about 22 inches thick. It contains a few fine threads and soft bodies of calcium carbonate. Between depths of 22 and 40 inches is dark gray, moderately alkaline, moderately saline clay that contains a few calcium carbonate and black concretions. The underlying material, to a depth of 66 inches, is gray, moderately alkaline, strongly saline clay that contains a few concretions of calcium carbonate, black concretions, and salt crystals.

Aransas clay, saline, has low available water capacity and very slow permeability. Surface runoff is ponded to very slow.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 2 percent, and small areas where the surface layer is clay loam. Also included are small areas of Narta, Victine, Victoria, Mustang, Galveston, Barrada, Tatton, and Dianola soils and, inland at the extreme upper reaches of saltwater inundation, small areas of Aransas clay, frequently flooded. Inclusions make up less than 20 percent of any one mapped area.

All of this soil is used for range. It has high potential for climax range vegetation. A system of controlled grazing and proper stocking rates help keep a good surface cover and maintain productivity. Plants such as salcornia, bushy-sea-ox-eye, and various sedges and reeds increase and decrease from season to season as moisture conditions vary. Potential is only medium for shallow water wildlife habitat.

Potential for urban uses and recreation is low because of flooding and wetness.

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

BT—Barrada-Tatton association. These are deep, nearly level, poorly drained soils on undulating low coastal tidelands. Areas are mostly long and narrow and border bays and lagoons. They are inland from and adjacent to the coastal beaches where elevation ranges from sea level to about 3 feet above sea level. Portions of this association are inundated by normal high tides, and all of it is inundated by abnormally high tides and high tides accompanying storms. Areas range from 50 to 810 acres. Slopes range from 0 to 1 percent.

Barrada clay makes up about 49 percent of this association, Tatton fine sand makes up about 45 percent, and other soils make up the remaining 6 percent. These soils could be mapped separately, but since their use and management are similar, it is not practical to do so.

Barrada clay is in slightly concave positions that range from sea level to an elevation of about 1.5 feet. The area from sea level to about 1 foot in elevation is inundated by daily high tides and is continually saturated to the surface. Periodically areas above 1 foot in elevation are inundated by abnormally high tides and high tides accompanying storms. This soil is never dry below a depth of 8 inches and is saturated to the surface for periods of 4 to 6 months annually. A permanent water table fluctuates between about 6 and 36 inches in depth.

Barrada clay has a surface layer of light brownish gray, strongly alkaline, extremely saline clay about 4 inches thick. Between depths of 4 and 20 inches it is light brownish gray, strongly alkaline, extremely saline clay containing yellowish and grayish mottles. Between 20 and 36 inches it is light gray, strongly alkaline, extremely saline silty clay containing yellowish and grayish mottles. The underlying material, to a depth of 60 inches, is light gray, strongly alkaline, extremely saline silty clay containing brownish and grayish mottles.

Barrada clay has very low available water capacity and very slow permeability. Surface runoff is ponded to very slow.

Tatton fine sand is on slightly undulating positions that range in elevation from about 0.5 foot to 3 feet. This soil is subject to periodic inundation by abnormally high tides and high tides accompanying storms and, in a few areas, by daily high tides. Following heavy rains or inundation the soil is saturated to the surface for periods of 2 to 3 months. Tatton fine sand is never dry below a depth of about 10 inches, and the permanent water table fluctuates somewhat with the tides but is usually at a depth of 6 to 36 inches.

The Tatton soil has a surface layer of light gray, moderately alkaline, extremely saline fine sand about 5 inches thick. Between the depths of 5 and 20 inches it is white, moderately alkaline, extremely saline fine sand containing brownish and grayish mottles. The underlying material, to a depth of 60 inches, is white, moderately alkaline, extremely saline fine sand.

Tatton fine sand has very low available water capacity, and rapid permeability above the water table. Surface runoff is very slow.

Other soils make up the remaining 6 percent of this association. They are small areas of Beaches, and of Dianola, Dietrich, Mustang, Galveston, and Aransas, saline, soils.

All of this association is used for wildlife habitat (fig. 6), and it has medium potential for wetland wildlife habitat. It is barren or very sparsely vegetated. The vegetation consists of salt- and water-tolerant species such as pickleweed, shoregrass, and bushy-sea-ox-eye. Potential is low for all other uses. Salinity, frequent flooding by salt water, wetness, and a high water table are limitations that are most difficult to overcome.

This association is in capability subclass VIIIs and is not assigned to a range site.

By—Beaches. This map unit consists of deep, nearly level and gently sloping, poorly drained sandy soils on coastal beaches. Areas are mostly long, narrow, uniform bands that reach from the Gulf of Mexico and various bays to higher duned inland areas on barrier islands and the mainland.

Beaches have an elevation of 0 to about 3 feet above sea level, and they are washed and rewashed by wave action and high tides and reworked by wind.

The largest area of Beaches in the survey area occurs on the east, or Gulf of Mexico, side of the barrier islands. This area varies from 150 feet to 0.5 mile wide and is a continuous band about 26 miles long. The Beaches that are on the bay shores are not as wide. They vary from 10 to 100 feet wide and are not a continuous band as is the gulf beach. A permanent high water table ranges from the surface to a depth of about 6 inches. These areas are partially inundated by normal daily high tides and abnormally high tides and are completely covered by high tides from storms. Areas of Beaches range from 10 to about 3,100 acres. Slopes range from 0 to 2 percent.

Typically, Beaches are, to a depth of 60 inches, stratified sands. Individual strata range from white to light gray, light brownish gray, very pale brown, or pale brown and have brownish mottles and splotches.

Beaches have very low available water capacity and rapid permeability above the water table. Surface runoff is slow to very slow.

Included in mapping are small areas of Psamments on coastal dunes, and small areas of Galveston, Mustang, Dianola, Barrada, and Tatton soils. Inclusions make up less than 10 percent of any one mapped area.

All of the accessible areas are used for recreation, although they have low potential for recreational development. Beaches are smooth and barren of vegetation. They are worked and reworked by wave action, high tides, and wind. Flooding by salt water, wetness, salinity, a high water table, and soil blowing are limitations that are most difficult to overcome for any development other than temporary facilities.

This map unit is in capability subclass VIIIs. Not assigned to a range site.

Cs—Comitas loamy fine sand. This is a deep, nearly level to gently sloping, well drained soil on terraces and uplands. Areas are mostly long and irregularly shaped and are adjacent to and above the bottom land and flood plain of rivers and creeks. Areas of this soil range from 15 to 100 acres. Slopes range from 0 to 5 percent.

The surface layer is neutral loamy fine sand about 28 inches thick. It is grayish brown in the upper 8 inches and brown in the lower part. Below that, to a depth of 36 inches, is brown, mildly alkaline sandy clay loam; and to a depth of 55 inches, is light brown, moderately alkaline sandy clay loam. Light brown, moderately alkaline fine sandy loam extends to a depth of 80 inches.

Comitas loamy fine sand has medium available water capacity and moderately rapid permeability. Surface runoff is very slow.

Included with this soil in mapping are small areas of Nueces, Sarita, Falfurrias, Leming, Delfina, and Willacy soils. Inclusions make up less than 10 percent of any one mapped area.

Comitas soil is mainly used for range, and potential is medium for climax range vegetation. Soil blowing is the main limitation, but it can be easily overcome by using controlled grazing and proper stocking rates to keep a good cover on the surface and maintain productivity. This soil has only medium potential for openland and rangeland wildlife habitat.

This soil has low potential for pasture production. The limitations of soil blowing and low fertility can be overcome by using controlled grazing, proper stocking rates, fertilization, and weed control to help keep a good surface cover and maintain productivity. Improved varieties of bermudagrass, lovegrass, and buffelgrass are suited to this soil.

This soil has medium potential for crops. Soil blowing, low fertility, and low organic-matter content are limitations, but can be overcome by proper fertilization; high-residue crops and cover crops, including legumes; and residue management. Using cover crops and leaving crop residue on the surface help to conserve moisture, reduce soil temperature and soil blowing, increase organic-matter content, and improve fertility. Suitable crops are grain sorghum and watermelons.

Potential is medium for urban uses and recreation. The sandy surface, soil blowing, and low strength are the main limitations.

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

Dn—Delfina loamy fine sand. This is a deep, nearly level to gently sloping, well drained soil on uplands and stream terraces. Areas of this soil range from 20 to 750 acres. Slopes range from 0 to 3 percent.

The surface layer is grayish brown, slightly acid loamy fine sand about 14 inches thick. Below that, sandy clay loam extends to a depth of 60 inches. To a depth of 17 inches, it is grayish brown and slightly acid and has brownish mottles and black concretions; to 30 inches it is grayish brown and neutral and has brownish and reddish mottles and black concretions; to 40 inches, light brownish gray and neutral and has yellowish mottles; and to 60 inches, light gray, moderately alkaline, and has concretions and soft bodies of calcium carbonate.

Delfina loamy fine sand has medium available water capacity and moderately slow permeability. Surface runoff is medium. Included with this soil in mapping are small areas of Nueces, Sarita, Falfurrias, Leming, Papalote, Comitas, and Willacy soils. Also included are small areas where 25 to 50 percent of the surface layer has been removed by wind action. Inclusions make up less than 15 percent of any one mapped area.

This soil is mainly used for range, and potential is medium for climax range vegetation. Soil blowing is the main limitation, but can be easily overcome by using a system of controlled grazing and proper stocking rates to keep a good vegetative cover on the surface and maintain productivity. This soil has high potential for openland and rangeland wildlife habitat.

This soil has high potential for pasture production. The limitations of soil blowing, low fertility, and low organic matter can be easily overcome by proper fertilization, proper stocking rates, controlled grazing, and weed control, all of which help to keep a good surface cover and maintain productivity. Improved varieties of bermudagrass, lovegrass, and buffelgrass are suited to this soil.

This soil has low potential for crops. The limitations of soil blowing, low fertility, and low organic matter can be easily overcome by proper fertilization; high-residue crops and cover crops, including legumes; and residue management. Using cover crops and leaving crop residue on the surface help to conserve moisture, reduce soil temperature and soil blowing, increase organic-matter content, and improve fertility. Suitable crops are grain sorghum, cotton, and watermelons.

Potential is medium for urban uses and recreation. Shrink-swell, low strength, and a sandy surface are the main limitations.

This soil is in capability subclass IIIe and Loamy Sand range site.

Ds—Dianola soils. These deep, nearly level, poorly drained soils are on coastal lowlands. They are affected for short periods by abnormally high tides and high tides caused by storms. The water table varies somewhat in relation to the tides, but is usually at a depth of less than 40 inches. The soils are never dry below a depth of about 12 inches, and following heavy rains or inundation by high tides they are saturated to the surface for periods of several days to several weeks. Elevation is 2 to about 6 feet above sea level. Areas range from 10 to 400 acres. Slopes range from 0 to 1 percent.

Dianola soils make up about 85 percent of this map unit, and other soils make up the remaining 15 percent. These soils are not uniform and do not occur in a regular pattern.

The surface layer is gray, moderately alkaline, extremely saline loamy sand about 6 inches thick. The underlying material is moderately alkaline, extremely saline loamy sand. To a depth of 15 inches, it is light brownish gray with brownish mottles; to 35 inches, it is light gray and contains brownish mottles and streaks; and to 60 inches, it is light gray with yellowish mottles and streaks.

Dianola soils have very low available water capacity and rapid permeability above the water table. Surface runoff is very slow.

Included with these soils in mapping are small areas of Beaches and Barrada, Tatton, Dietrich, Mustang, Galveston, and Aransas, saline, soils. Inclusions make up less than 15 percent of any one mapped area.

All of these soils are used for range and have low potential for climax range vegetation. Some areas are sparsely vegetated, and salt barrens occur. Salt barrens are the main limitation. Controlled grazing and proper stocking rates help keep a good surface cover, maintain productivity, and keep the size of the salt barrens to a minimum. Potential is high for wetland wildlife habitat.

This soil has low potential for urban uses and recreation because of wetness.

This soil is in capability subclass VIIs and Salt Flat range site.

Dt—Dietrich fine sand. This is a deep, nearly level, somewhat poorly drained soil on low coastal terraces. Areas are mostly broad bands that separate the fine textured soils of the interior uplands from the coarse textured soils of the coastline. Dietrich fine sand occurs in a band 0.25 to 0.75 mile wide that roughly parallels the coastline. Areas of this soil range from 20 to 350 acres. Slopes range from 0 to 1 percent.

The surface layer is neutral fine sand about 12 inches thick that is light brownish gray in the upper 9 inches and light gray in the lower part. Below that, to a depth of 18 inches, is light brownish gray, mildly alkaline sandy clay loam with yellowish, reddish, and grayish mottles; to 30 inches, light brownish gray, moderately alkaline, slightly saline sandy clay loam with reddish, yellowish, and grayish mottles; and to 45 inches, light gray, moderately alkaline, slightly saline sandy clay loam with yellow and brown mottles. The underlying material, to a depth of 72 inches, is light gray, moderately alkaline, moderately saline sandy clay loam that has yellowish and brownish mottles and black concretions.

Dietrich fine sand has medium available water capacity and slow permeability. Surface runoff is slow to very slow.

Included with this soil in mapping are small areas of soils that are similar to Dietrich fine sand but have slopes of up to 2 percent. Also included are small areas of Dianola, Mustang, Narta, Galveston, Falfurrias, Nueces, and Papalote soils. Inclusions make up less than 15 percent of any one mapped area.

This Dietrich soil is mainly used for range, and potential is medium for climax range vegetation. Soil blowing is the main limitation, but can be easily overcome by using a system of controlled grazing and proper stocking rates to keep a good cover on the surface and maintain productivity. This soil has only medium potential for wildlife habitat.

This soil has low potential for pasture. Soil blowing, low fertility, low organic matter, and wetness are limitations, but can be easily overcome by proper fertilization, proper stocking rates, controlled grazing, and weed control, all of which help to keep a good surface cover and maintain productivity. This soil can be fertilized and weeds controlled during the dry season. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

A few areas are used for crops. Potential for this use is low because of wetness and soil blowing.

This soil has medium potential for urban use. Wetness, corrosivity to uncoated steel, and shrink-swell properties are limitations. They can be overcome by using proper materials and design in the installation of drainage systems, utility lines, and building foundations.

This soil is in capability subclass IIIw and Sandy Coastal Flat range site.

Ec—Edroy clay. This is a deep, poorly drained, nearly level soil on slightly concave uplands. It occupies weakly defined and discontinuous watercourses that are about 6 inches to 2 feet lower than the associated soils. Areas vary in width and are mostly long and irregular in shape. Some areas are nearly round. Areas range from 25 to 650 acres, and the rounded areas range from 10 to 25 acres. Slopes are 0 to 1 percent. In most years, this soil is saturated for periods of a few days to a few weeks during spring and fall.

The surface layer is dark gray, slightly acid clay about 18 inches thick. Gray, moderately alkaline, slightly saline clay is between depths of 18 to 42 inches. The layer between 42 and 50 inches is light gray, moderately alkaline, slightly saline sandy clay loam that has concretions of calcium carbonate and a few black concretions. The underlying material, to a depth of 60 inches, is light gray, moderately alkaline, slightly saline sandy clay loam that contains a few calcium carbonate concretions.

Edroy clay has medium available water capacity and very slow permeability. Surface runoff is slow to ponded.

Included with this soil in mapping are small areas of Victoria, Orelia, Papalote, and Raymondville soils and Edroy clay, depressional. Inclusions make up less than 10 percent of any one mapped area.

This Edroy soil is mainly used for range, and potential is medium for climax range vegetation. A system of controlled grazing and proper stocking rates helps keep a good vegetative cover on the surface and maintains productivity. This soil has medium potential for openland and wetland wildlife habitat.

This soil has medium potential for pasture production. Wetness is a limitation, but can be easily overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control, all of which help to keep a good surface cover and maintain productivity. Fertilization and weed control can be accomplished during the dry season. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

This soil has low potential for crops. The limitations of wetness and poor soil tilth can be overcome by proper fertilization; planting crops that produce a large amount of residue and planting cover crops, including legumes; residue management; and proper design and installation of field drains. Cover crops and crop residue left on the soil surface help to improve and maintain soil tilth, reduce soil temperature, and improve fertility. Suitable crops are grain sorghum, cotton, and corn.

Potential is low for urban uses. Wetness, very slow water intake rate, and shrink-swell properties are limitations, but they can be overcome by proper planning and installation of structures.

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

Ed—Edroy clay, depressional. This is a deep, poorly drained, nearly level soil on slightly concave uplands. Areas are mostly rounded or oval, but some areas are long and narrow. Edroy clay, depressional, is covered with water or is saturated to the surface for about 9 months out of the year in years with normal rainfall. In exceptionally wet years it is covered with water throughout the year. This soil is in concave low areas within weakly defined and discontinuous watercourses. It is about 2 to 5 feet lower than surrounding associated soils. Rounded or oval areas of this soil range from 7 to 50 acres. The long narrow areas range from 50 to 325 acres. Slopes range from 0 to 1 percent.

The surface layer is dark gray, slightly acid clay about 18 inches thick. Gray, moderately alkaline clay containing pressure faces and black concretions is between depths of 18 and 38 inches. Gray, moderately alkaline clay loam containing a few dark gray streaks, about 3 percent fine concretions of calcium carbonate, and a few black concretions is between depths of 38 and 46 inches. The underlying material, to a depth of 60 inches, is white, moderately alkaline sandy clay loam, and it contains a few black concretions.

Edroy clay, depressional, has medium available water capacity and very slow permeability. Surface runoff is ponded to very slow.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 2 percent, small areas of Victoria and Orelia soils, and some small areas of Edroy clay. Inclusions make up less than 10 percent of any one mapped area.

This soil is mainly used for range. It has medium potential for climax range vegetation. It is impractical or uneconomical to drain; however, a few of the smaller areas have been deepened to serve as livestock and wildlife watering ponds. A system of controlled grazing and proper stocking rates will help keep a good surface cover and maintain productivity. Potential is only medium for wetland wildlife habitat.

Potential is low for urban uses and recreation because of wetness and flooding.

This soil is in capability subclass Vw and Lakebed range site.

FA—Falfurrias association. These deep, nearly level to gently undulating, somewhat excessively drained soils are on terraces and uplands and along the mainland coastline, mostly in long discontinuous bands. In some areas, the soils are subjected to windblown saltwater mist; but because occurrences are infrequent, rainfall is adequate, and the soils are permeable, they are not affected by it. Areas of this association range from 20 to 500 acres in size. Slopes range from 0 to 5 percent.

Falfurrias soils make up about 80 percent of this association, and other soils make up the remaining 20 percent. The mapped areas of this unit are more variable than most other mapping units in the survey area. Mapping has been controlled well enough, however, for the anticipated use of the areas involved.

The surface layer is neutral fine sand about 26 inches thick. It is grayish brown in the upper 6 inches and light brownish gray in the lower part. The underlying material, to a depth of 80 inches, is light brownish gray, neutral fine sand.

Falfurrias fine sand has low available water capacity and rapid permeability. Surface runoff is slow.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 12 percent, small areas of Psamments on the active dunes, and small areas of Galveston, Mustang, Dietrich, Nueces, Sarita, Comitas, Leming, and Delfina soils. Inclusions make up less than 25 percent of any one mapped area.

This association is mainly used for range (fig. 7), and potential is medium for climax range vegetation. Soil blowing is the main limitation, but can be easily overcome by using a system of controlled grazing and proper stocking rates to help keep a good vegetative cover on the surface and maintain productivity. This association has only medium potential for rangeland wildlife habitat.

This association has medium potential for urban use. Seepage and stability are limitations that can be overcome by proper design and installation of structures. Potential is low for recreation because of the sandy surface layer.

This association is in capability subclass VIIe and Sand Hill range site.

GA—Galveston association. These deep, nearly level to undulating, somewhat excessively drained soils are on coastal dunes, mostly in long, and in places, discontinuous bands and some small oval areas on the barrier islands. The soils are subjected to windblown saltwater mist, but because of the permeability and frequent rain showers, they are not saline. Areas of this association range from 20 to 500 acres in size. Slopes range from 1 to 8 percent.

Galveston soils make up about 90 percent of the area, and other soils make up the remaining 10 percent. The mapped areas of this unit are more variable than most other map units in the survey area. Mapping has been controlled well enough, however, for the anticipated use of the areas involved.

The surface layer is light gray, neutral fine sand about 4 inches thick. The underlying material, to a depth of 42 inches, is light gray, mildly alkaline fine sand. To a depth of 72 inches, it is white, mildly alkaline fine sand.

Galveston soils have low available water capacity and rapid permeability. Surface runoff is very slow.

Included with these soils in mapping are small areas of similar soils that have slopes of up to 12 percent, small areas of Psamments on active dunes, small areas of Beaches, and small areas of Tatton and Dianola soils. Inclusions make up less than 15 percent of any one mapped area.

All of this association is used for range, although it has low potential for climax range vegetation. Soil blowing is the main limitation, but it can be easily overcome by controlled grazing and proper stocking rates to help keep a good vegetative cover on the surface and maintain productivity. This association has only medium potential for openland and rangeland wildlife habitat.

Potential is low for urban uses and recreation because of flooding, wetness, and the sandy surface layer.

This association is in capability subclass VIe and Coastal Sand range site.

GM—Galveston-Mustang association. These deep, nearly level, somewhat excessively to poorly drained soils are on low coastal terraces and plains, mostly in long broad areas. They are at elevations of 4 to about 30 feet above sea level.

The Galveston-Mustang association is in the protected central portion of the barrier islands and inland from and adjacent to the Falfurrias association on the mainland. Areas range from 30 to several thousand acres. Slopes range from 0 to 3 percent.

This association is about 55 percent Galveston fine sand, 31 percent Mustang fine sand, and 14 percent other soils. Because these soils are similar in use and management, mapping them separately could not be justified.

Galveston fine sand is nearly level to gently undulating and occupies convex areas of the landscape. A permanent water table that fluctuates somewhat with the tides is at a depth of 40 to 72 inches. The water table is near the surface for a few days to about a week following heavy rain. The surface layer is light gray, neutral fine sand about 4 inches thick. The underlying material, to a depth of 42 inches, is light gray, mildly alkaline fine sand. To a depth of 72 inches, it is white, mildly alkaline fine sand.

Galveston fine sand has low available water capacity and rapid permeability. Surface runoff is very slow.

Mustang fine sand is nearly level and is in concave areas of the landscape. Following heavy rains the soil is saturated to the surface or water covers the surface for periods of a few weeks to 2 or 3 months. The surface layer is light brownish gray, moderately alkaline fine sand about 5 inches thick. To a depth of 15 inches, the underlying material is white, moderately alkaline fine sand that contains brownish mottles. To a depth of 60 inches, it is white, neutral fine sand that has brownish mottles.

Mustang fine sand has very low available water capacity and rapid permeability above the water table. Surface runoff is very slow.

Included with these soils in mapping are small areas of Beaches and of Psamments on the active dunes and small areas of Dianola, Dietrich, Barrada, Tatton, Falfurrias, Nueces, and Sarita soils. These inclusions make up about 14 percent of the association.

This association is mainly used for range and it has low potential for climax range vegetation. Soil blowing is the main limitation, but it can be easily overcome by using controlled grazing and proper stocking rates to help keep a good vegetative cover on the surface and maintain productivity. Potential is only medium for wildlife habitat.

Potential is low for urban uses and recreation because of flooding, wetness, and the sandy surface layer.

The Galveston part of this association is in capability subclass VIe and Coastal Sand range site; the Mustang part is in capability subclass VIw and Low Coastal Sand range site.

Is—Ijam soils. These deep, very poorly drained to ponded nearly level to gently sloping, slightly concave or mounded soils are on coastal lowlands, mostly in long, narrow, discontinuous areas adjacent to coastal waterways and canals. They occupy smoothed-over areas, mounds, and ridges that were deposited along coastal waterways, canals, and channels during dredging operations. Most areas are less than 10 feet above sea level. These soils are saturated to the surface from 3 to 6 months during the year. A permanent water table occurs at depths of less than 36 inches and is frequently at the surface. Most areas of these soils are subject to inundation with saltwater during abnormally high tides and high tides caused by storms. Salinity of these soils varies with the length of time they are exposed to the leaching and weathering processes. Areas of these soils range from 10 to 300 acres. Slopes range from 0 to 5 percent.

Ijam soils make up about 85 percent of this map unit, and other soils make up the remaining 15 percent. These soils are not uniform and do not occur in a regular pattern.

The surface layer is gray, moderately alkaline, moderately saline clay about 6 inches thick. It contains salt crystal accumulation on the surface. The underlying material, to a depth of 60 inches, is light brownish gray, moderately alkaline, strongly saline clay. It contains brownish and grayish mottles and streaks, common threads and pockets of salt crystals, and thin lenses of loamy fine sand and fine sandy loam.

Ijam soils have medium available water capacity and very slow permeability. Surface runoff is very slow.

Included with these soils in mapping are small areas of similar soils that have slopes of up to 8 percent, small areas of Beaches, and small areas of Barrada, Tatton, and Dianola soils. Inclusions make up about 15 percent of any one mapped area.

These soils are mainly used for range and have high potential for climax range vegetation. Normally, recent deposits are barren of vegetation, but older areas have a vegetative cover that ranges from sparse to fair (fig. 8). Controlled grazing and proper stocking rates promote, improve, and keep a good vegetative cover on the surface and maintain productivity. Potential is high for wetland wildlife habitat.

These soils have low potential for urban use. Wetness, salinity, and a high water table are limitations that are difficult to overcome.

These soils are in capability subclass VIIw and Salty Prairie range site.

Ls—Leming loamy fine sand. This is a deep, nearly level to gently sloping, moderately well drained to somewhat poorly drained soil on uplands and stream terraces. It is mostly in broad, irregularly shaped areas on uplands and long, narrow, irregularly shaped strips on terraces. Areas of this soil range from 10 to 385 acres. Slopes range from 0 to 3 percent.

The surface layer is pale brown and slightly acid loamy fine sand that is about 24 inches thick. Next, to a depth of 28 inches, is very pale brown, slightly acid loamy fine sand. Below that, to a depth of 32 inches, is pale brown, slightly acid sandy clay that has grayish, brownish, and reddish mottles; to 40 inches, is pale brown, mildly alkaline sandy clay that has reddish, grayish, and yellowish mottles and black concretions; and to 54 inches, is light yellowish brown, mildly alkaline sandy clay that has yellowish, reddish, and grayish mottles. The underlying material, to a depth of 62 inches, is light yellowish brown moderately alkaline sandy clay loam that has yellowish, reddish, and brownish mottles and is about 5 percent concretions and soft bodies of calcium carbonate. To a depth of 72 inches, it is light yellowish brown and light gray, moderately alkaline sandy clay loam that has yellowish and reddish mottles and concretions of calcium carbonate.

Leming loamy fine sand has medium available water capacity and slow permeability. Surface runoff is slow.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 5 percent. Also included are small areas of Comitas, Willacy, Nueces, Delfina, Papalote, Sarita, and Falfurrias soils. Inclusions make up less than 10 percent of any one mapped area.

This Leming soil is mainly used for range, and potential is medium for climax range vegetation. Soil blowing is the main limitation, but it can be easily overcome by using controlled grazing and proper stocking rates, to keep a good vegetative cover on the surface and maintain productivity. This soil has high potential for openland and rangeland wildlife habitat.

This soil has low potential for pasture production. Soil blowing, low fertility, and medium available water capacity are limitations, but they can be easily overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control, all of which help to keep a good vegetative cover on the surface and maintain productivity. Improved varieties of bermudagrass, lovegrass, and buffelgrass are suited to this soil.

This soil has high potential for crops. The limitations of soil blowing, low fertility, low content of organic matter, and medium available water capacity can be overcome by proper fertilization; planting crops that produce a large amount of residue and planting cover crops, including legumes; and residue management. Cover crops and crop residue left on the soil surface help to conserve moisture, reduce soil temperature and soil blowing, increase organic-matter content, and improve fertility. Suitable crops are grain sorghum and watermelons.

Potential is medium for urban uses. Slow water intake rate, corrosivity to uncoated steel, and low strength are limitations, but they can be overcome by proper design and installation of structures.

This soil is in capability subclass IIIe and Sandy range site.

MoC—Monteola clay, 3 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on uplands. It has weak to moderately prominent gilgai microrelief that is generally aligned with the slope. The microhighs range from a few inches to about 12 inches higher than the microlows. This soil is susceptible to gully erosion unless protected. Areas of this soil range from 10 to 100 acres.

The surface layer is very dark gray, moderately alkaline clay about 16 inches thick that contains concretions of calcium carbonate. To a depth of 42 inches is grayish brown and brown splotched and streaked, moderately alkaline clay that contains a few gypsum crystals and soft bodies of calcium carbonate. The underlying material, to a depth of 72 inches, is pale brown, moderately alkaline, slightly saline clay. It contains a few seams and pockets of gypsum and other salts and about 5 percent concretions of calcium carbonate.

Monteola clay, 3 to 5 percent slopes, has medium available water capacity and very slow permeability. Surface runoff is slow to medium. Water enters this soil rapidly when it is dry and cracked, but very slowly when it is moist.

Included with this soil in mapping are a few small areas that have about 25 to 50 percent of the surface layer removed by water erosion. Also included are a few small areas of Victoria, Raymondville, Orelia, and Papalote soils. Inclusions make up less than 15 percent of any one mapped area.

This soil is mainly used for range, and potential is medium for climax range vegetation. Water erosion is the main limitation, but it can be overcome by controlled grazing and proper stocking rates that help keep a good surface cover and maintain productivity. The soil has medium potential for openland wildlife habitat.

This soil has medium potential for pasture production. Water erosion is the main limitation, but this can be overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control. These practices help keep a good vegetative cover, slow runoff and maintain productivity. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

This soil has low potential for crops. Water erosion and poor soil tilth are limitations, but can be overcome by proper fertilization; high-residue crops and cover crops, including legumes; residue management; farming on the contour; and proper design and installation of terrace and waterway systems. Growing cover crops and leaving crop residue on the soil surface help to conserve moisture, slow runoff, reduce soil temperature, improve and maintain soil tilth, and improve fertility. Suitable crops are grain sorghum, cotton, and corn.

Potential is low for urban uses and recreation because of low strength, shrinking and swelling caused by moisture changes, high corrosivity to uncoated steel, and a clayey surface layer.

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

MoD—Monteola clay, 5 to 8 percent slopes. This deep, sloping, moderately well drained soil is on uplands. It has weak gilgai microrelief that is generally aligned with the slope. The microhighs range to about 6 inches above the microlows. Areas of this soil range from 15 to 190 acres.

The surface layer is dark gray, moderately alkaline clay about 12 inches thick that contains concretions of calcium carbonate. Below that, to a depth of 28 inches is grayish brown, moderately alkaline, slightly saline clay that contains concretions of calcium carbonate and gypsum crystals in the lower part. The underlying material, to a depth of 60 inches, is pale brown, moderately alkaline, moderately saline clay that contains a few pockets of gypsum crystals and concretions of calcium carbonate.

This soil has medium available water capacity and very slow permeability. Surface runoff is slow to medium. This soil takes in water rapidly when dry and cracked, but very slowly when it is moist.

Included with this soil in mapping are a few small areas of Monteola clay, 5 to 8 percent slopes, that have 25 to 75 percent of the surface layer removed by water erosion. A few small areas with gullies 4 to 6 feet deep, 6 to 10 feet wide, and 5 to 30 feet apart occur around drainageways from higher-lying areas. These eroded areas have revegetated, and erosion has been stopped or greatly reduced because of improved management. Inclusions make up less than 15 percent of any one mapped area.

This soil is mainly used for range, and potential is medium for climax range vegetation. Water erosion is the main limitation, but it can be overcome by using controlled grazing and proper stocking rates to help keep a good vegetative cover on the surface and maintain productivity. This soil has low potential for wildlife habitat.

This soil has low potential for pasture production. Water erosion is the main limitation, but this can be overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control. These practices will help keep a good vegetative cover on the surface, slow runoff, and maintain productivity. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

Potential is low for urban uses and recreation because of low strength, shrinking and swelling with change in moisture content, high corrosivity to uncoated steel, and a clayey surface layer.

This soil is in capability subclass VIe and Blackland range site.

Mu—Mustang fine sand. This is a deep, poorly drained, nearly level soil. It is on slightly concave low coastal plains, mostly in broad irregular shaped areas adjacent to and below the higher parts of the mainland and the barrier islands. Some areas of this soil are periodically flooded by salt water during high tides caused by storms, and all are flooded by fresh water following heavy rains. A permanent high water table fluctuates somewhat with the tides, but is usually at a depth of less than 40 inches. This soil is rarely dry below a depth of about 10 inches, and following inundation by high tides or heavy rains, the soil is saturated to the surface or covered by water for periods of several days to several weeks. Salinity varies according to length of time since the last flooding by salt water. Normally most pedons are nonsaline.

This soil occupies a position from 3 feet to about 12 feet above sea level. Areas range from 10 to 450 acres. Slopes range from 0 to 1 percent.

The surface layer is light brownish gray, moderately alkaline fine sand about 5 inches thick. The underlying material, to a depth of 14 inches, is white, moderately alkaline fine sand that contains brownish mottles and streaks. To a depth of 60 inches, it is white, neutral fine sand that has brownish mottles.

Mustang fine sand has very low available water capacity and rapid permeability above the water table. Surface runoff is very slow.

Included with this soil in mapping are small areas of similar soils that have a loamy fine sand surface layer. Also included are small areas of Beaches, small areas of Psamments that make up the active coastal dunes, and small areas of Barrada, Tatton, Dianola, Dietrich, Galveston, Falfurrias, and Nueces soils. Inclusions make up less than 20 percent of any one mapped area.

This soil is mainly used for range, and potential is low for growing climax range vegetation. Wetness, flooding, and a high water table are limitations that are difficult to overcome. A system of controlled grazing and proper stocking rates helps keep a good vegetative cover on the surface and maintains productivity. Potential is only medium for wetland and rangeland wildlife habitat.

Potential is low for urban uses and recreation. Flooding, wetness, high corrosivity to uncoated steel, and the sandy surface layer are the main limitations.

This soil is in capability subclass VIw; Low Coastal Sand range site.

Na—Narta fine sandy loam. This is a deep, nearly level, somewhat poorly drained soil. It is on slightly concave low coastal plains, mostly in broad irregular shaped areas adjacent to and above the coastal lowlands, but below the inland portion of the mainland. Some areas of this soil are subject to periodic flooding by salt water during high tides caused by storms. A perched water table saturates the soil to the surface for extended periods during the spring and fall seasons during most years. Areas of this soil range from 10 to 1,100 acres. Slopes range from 0 to 1 percent.

The surface layer is gray, moderately alkaline, moderately saline fine sandy loam about 8 inches thick. Below that, to a depth of 14 inches, is very dark gray, moderately alkaline, extremely saline clay that contains a few black concretions; to 26 inches is gray, moderately alkaline, extremely saline clay loam that contains thin seams of salt crystals and a few black concretions; and to 36 inches is gray, strongly alkaline, extremely saline clay loam that has coatings of salt crystals on surfaces of peds and is about 4 percent soft bodies and concretions of calcium carbonate and a few black concretions. The underlying material, to a depth of 46 inches, is light brownish gray, strongly alkaline, extremely saline, clay loam that contains concretions and soft bodies of calcium carbonate and black concretions. To a depth of 60 inches, it is light gray, strongly alkaline, extremely saline clay loam that contains soft bodies and concretions of calcium carbonate and a few black concretions.

Narta fine sandy loam has very low available water capacity and very slow permeability. Surface runoff is slow to ponded.

Included with this soil in mapping are small areas of similar soils that have a loam and sandy clay loam surface layer. Also included are small areas of similar soils that have slopes up to 3 percent, and small areas of Barrada, Tatton, Dianola, Dietrich, Mustang, Aransas, Galveston, Victine, Victoria, Orelia, Raymondville, and Papalote soils. Inclusions make up less than 10 percent of any one mapped area.

This Narta soil is mainly used for range, and potential is high for growing climax range vegetation. Controlled grazing and proper stocking rates help keep a good vegetative cover on the surface and maintain productivity. This soil has medium potential for wetland wildlife habitat.

Potential is low for urban uses and recreation. Wetness, high corrosivity to uncoated steel, low strength, and shrinking and swelling with moisture changes are the main limitations.

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

Nu—Nueces fine sand. This is a deep, nearly level to gently sloping, moderately well drained soil on terraces and uplands. Areas are mostly long, moderately wide and convex and have a low, dunelike appearance.

In some areas Nueces fine sand has a hummocky surface that has low dunes ranging from 1 to 3 feet high. Areas of this soil range from 10 to 200 acres. Slopes range from 0 to 5 percent.

The surface layer is fine sand 36 inches thick. It is grayish brown and neutral in the upper 12 inches; light brownish gray and slightly acid in the middle 12 inches; and light brownish gray and neutral in the lower 12 inches. Below that, neutral sandy clay loam extends to a depth of 72 inches. To a depth of 43 inches, it is light brownish gray with brownish and reddish mottles; to 50 inches, light gray with yellowish, reddish, and brownish mottles; and to 72 inches, light gray with yellowish mottles.

Nueces fine sand has medium available water capacity and moderately slow permeability. Surface runoff is very slow.

Included with this soil in mapping are small areas of similar soils that have a loamy fine sand surface layer. Also included are small areas of similar soils that have slopes of up to 6 percent, and small areas of Comitas, Sarita, Falfurrias, Delfina, Galveston, Leming, and Odem soils. Inclusions make up less than 15 percent of any one mapped area.

This Nueces soil is mainly used for range, and potential is medium for climax range vegetation. Soil blowing is the main limitation, but it can be easily overcome by using controlled grazing and proper stocking rates to keep a good cover on the surface and maintain productivity. This soil has high potential for rangeland wildlife habitat.

This soil has low potential for pasture production. The limitations of soil blowing, low organic-matter content, and low fertility are easily overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control to help keep a good surface cover and maintain productivity. Improved varieties of lovegrass, bermudagrass, and buffelgrass are suited to this soil.

This soil has low potential for crops. Soil blowing, medium available water capacity, low fertility, and low organic-matter content are limitations, but can be overcome by proper fertilization; high-residue crops and cover crops, including legumes; and residue management. Cover crops and crop residue left on the soil surface conserve moisture, reduce soil blowing and soil temperature, increase organic-matter content, and improve fertility. Suitable crops are cotton and watermelons.

This soil has medium potential for urban use. Low strength, shrinking and swelling with changes in moisture, and wetness are the main limitations. These can be overcome with careful design and installation of structures. Potential for recreation is low because of the sandy surface layer.

This soil is in capability subclass IIIe and Sandy range site.

Od—Odem fine sandy loam. This is a deep, nearly level to gently sloping, moderately well to well drained soil on bottom lands and flood plains. Areas are mostly long and narrow and on weakly convex ridges or natural levees, or they are moderately wide and irregularly shaped and parallel and adjacent to river and creek channels. This soil is flooded 3 or 4 times in 10 years, usually following tropical storms or hurricanes during which heavy rainfall has occurred. Areas of this soil range from 10 to 110 acres. Slopes range from 0 to 3 percent.

The surface layer is dark gray fine sandy loam about 40 inches thick. It is neutral in the upper 16 inches and mildly alkaline in the lower part. The underlying material, to a depth of 60 inches, is grayish brown, moderately alkaline fine sandy loam that contains a few bedding planes and thin strata of loamy fine sand.

Odem fine sandy loam has medium available water capacity and moderately rapid permeability. Surface runoff is slow.

Included with this soil in mapping are small areas of similar soils that have a loam surface layer and small areas of Sinton, Aransas, Nueces, and Comitas soils. Inclusions make up less than 5 percent of any one mapped area.

This soil is dominantly used for range. It has high potential for growing climax range vegetation. Soil blowing is the main limitation, but it can be easily overcome by using controlled grazing and proper stocking rates to help keep a good surface cover and maintain productivity. Potential is high for openland wildlife habitat.

This soil has high potential for pasture production. Soil blowing is the main limitation, but it can be easily overcome by using proper fertilization, controlled grazing, proper stocking rates, and weed control to keep a good surface cover and maintain productivity. Improved varieties of lovegrass, bermudagrass, buffelgrass, and bluestem are suited to this soil.

This soil has medium potential for crops. Occasional flooding, susceptibility to soil blowing, medium fertility and organic-matter content, and medium available water capacity are limitations, but these can be overcome by proper design and installation of diversion terraces and by proper fertilization; high-residue crops and cover crops, including legumes; and residue management. Using cover crops and leaving crop residue on the surface help to conserve moisture, reduce soil temperature and soil blowing, increase organic-matter content, and improve fertility. Suitable crops are grain sorghum, cotton, corn, and watermelon.

Potential is low for urban uses and recreation because of flooding.

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

On—Oil-waste land. Oil-waste land consists of small areas of soils that have been affected by oilfield activity. These areas occur on many different kinds of soil. Most are barren of vegetation. Areas range from 6 to 100 acres.

Oil-waste land has been damaged by heavy machinery and the addition of oil derivatives and by-products such as brine, drilling mud, and sludge. Its productivity is drastically reduced or destroyed depending upon the kind and amount of damage received and the length of exposure to the damaging agent. Some areas have partially recovered or have been reclaimed; however, the vegetation is sparse and of poor quality.

Potential is low for any use which requires the production of vegetation.

This map unit is in capability subclass VIIIs. Not assigned to a range site.

Or—Orelia fine sandy loam. This is a deep, nearly level, somewhat poorly drained soil on slightly concave uplands. During spring and fall of most years, the upper part of the soil is saturated with water for periods of as much as 30 days. Areas of this soil range from 10 to 120 acres. Slopes range from 0 to 1 percent.

The surface layer is gray, slightly acid fine sandy loam about 5 inches thick. Below that, to a depth of 10 inches, is dark gray, neutral sandy clay loam; to a depth of 25 inches, is dark gray, mildly alkaline, moderately saline sandy clay loam that contains a few black concretions; and to 32 inches, is light gray, moderately alkaline, moderately saline sandy clay loam that contains about 5 percent weakly cemented concretions of calcium carbonate. The underlying material, to a depth of 60 inches, is light gray, moderately alkaline, strongly saline sandy clay loam that has brownish mottles and is about 5 percent weakly cemented concretions and soft bodies of calcium carbonate.

Orelia fine sandy loam has medium available water capacity and very slow permeability. Surface runoff is slow.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 3 percent or that have up to 50 percent of the surface layer removed by erosion. Also included are small areas of Orelia sandy clay loam and small areas of Edroy, Victoria, Raymondville, and Papalote soils. Inclusions make up less than 10 percent of any one mapped area.

This Orelia soil is mainly used for range, and potential is high for growing climax range vegetation. Controlled grazing and using proper stocking rates help to keep a good vegetative cover on the surface and maintain productivity. This soil has high potential for rangeland wildlife habitat.

This soil has medium potential for pasture production. Wetness is the main limitation, but it is easily overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control, all of which help to keep a good surface cover and maintain productivity. The soil can be fertilized and weeds can be controlled during the dry season. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

This soil has medium potential for crops. The limitations of wetness, salinity, and poor soil tilth can be overcome by proper design and installation of field drains and by land leveling or land smoothing. Proper fertilization; growing high-residue crops and cover crops, including legumes; and residue management help to reduce soil temperature, improve soil tilth, increase organic-matter content, and improve fertility. Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This soil has medium potential for urban use. Wetness, corrosivity to uncoated steel, very slow water intake rate, and shrink-swell properties are limitations, but they can be overcome by use of proper materials and proper design and installation of structures.

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

Os—Orelia sandy clay loam. This is a deep, nearly level, somewhat poorly drained soil on slightly concave uplands. During the spring and fall seasons of most years the upper part of the soil is saturated with water for periods ranging up to 30 days. Areas of this soil range from 10 to more than 1,000 acres. Slopes range from 0 to 1 percent.

The surface layer is gray, slightly acid sandy clay loam about 6 inches thick. Below that, to a depth of 20 inches is dark gray, neutral sandy clay loam, and to a depth of 28 inches, is gray, moderately alkaline, moderately saline sandy clay loam that is about 5 percent fine soft bodies of calcium carbonate. The underlying material, to a depth of 60 inches, is light gray, moderately alkaline, strongly saline sandy clay loam that is about 10 percent soft bodies of calcium carbonate.

This soil has medium available water capacity and very slow permeability. Surface runoff is slow.

Included with this soil in mapping are small areas of similar soils near the larger drains that are flooded for brief periods, usually 1 to 4 days, following heavy rains. Also included are small areas of similar soils that have slopes of up to 3 percent, small areas of similar soils that have up to 50 percent of the surface layer removed by erosion, small areas of Orelia fine sandy loam, and small areas of Edroy, Victoria, Raymondville, and Papalote soils. Inclusions make up less than 10 percent of any one mapped area.

This Orelia soil is mainly used for crops, and potential is medium for cultivated crops. Wetness, salinity, and poor soil tilth are limitations, but they can be overcome by proper design and installation of field drains, by land leveling, or by land smoothing for better drainage. Proper fertilization; growing high-residue crops and cover crops, including legumes; and residue management help reduce soil temperature, improve soil tilth, increase organic-matter content, and improve fertility. Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This soil has high potential for climax range vegetation. Controlled grazing and proper stocking rates help to keep a good surface cover and maintain productivity. Potential is high for rangeland wildlife habitat.

This soil has medium potential for pasture production. Wetness is the main limitation, but it can be easily overcome by using proper fertilization, controlled grazing, proper stocking rates, and weed control to help keep a good surface cover and maintain productivity. The soil can be fertilized and weeds can be controlled during the dry season. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

This soil has medium potential for urban use. Wetness, corrosivity to uncoated steel, very slow water intake rate, and shrink-swell properties are limitations. They can be overcome by using proper materials and proper design and installation of structures.

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

PaA—Papalote fine sandy loam, 0 to 1 percent slopes. This deep, nearly level, moderately well drained soil is on slightly convex uplands. Areas of this soil range from 20 to more than 1,000 acres.

The surface layer is neutral fine sandy loam about 14 inches thick. It is light brownish gray in the upper 8 inches and grayish brown in the lower part. Below that, to a depth of 17 inches, is dark gray, neutral sandy clay that has brownish mottles; to 30 inches, is grayish brown, mildly alkaline sandy clay that has grayish and reddish mottles and a few black concretions; to 36 inches, grayish brown, mildly alkaline sandy clay that has yellowish, brownish, and grayish mottles and a few black concretions; and to 48 inches, light brownish gray, moderately alkaline sandy clay loam that has reddish and grayish mottles, a few black concretions, and a few concretions and soft bodies of calcium carbonate. The underlying material, to a depth of 60 inches, is pale brown, moderately alkaline sandy clay loam that has grayish and brownish mottles and concretions and soft bodies of calcium carbonate.

This soil has medium available water capacity and slow permeability. Surface runoff is slow.

Included in mapping are small areas of similar soils that have a loamy fine sand surface layer and small areas of Papalote fine sandy loam with slopes of up to 5 percent. Also included are small areas of Edroy, Orelia, Victoria, Raymondville, Delfina, and Leming soils. Inclusions make up less than 15 percent of any one mapped area.

This soil is mainly used for crops, and potential is medium for cultivated crops. Medium available water capacity, low fertility, and low organic-matter content are limitations, but they can be easily overcome by proper fertilization; growing high-residue crops and cover crops, including legumes; and residue management. Cover crops and crop residue left on the soil surface conserve moisture, reduce soil temperature, increase organic-matter content, and improve fertility. Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This soil has medium potential for growing climax range vegetation. Controlled grazing and proper stocking rates help keep a good vegetative cover on the surface and maintain productivity. It has high potential for open-land and rangeland wildlife habitat.

This soil has high potential for pasture production. Proper fertilization, controlled grazing, proper stocking rates, and weed control all help to keep a good surface cover and maintain productivity. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

This soil has medium potential for urban use. The limitations of low strength, slow water intake rate, corrosivity to uncoated steel, and shrink-swell properties can be overcome by use of proper materials and proper design and installation of structures. Potential for recreation is high.

This soil is in capability subclass IIs and Tight Sandy Loam range site.

PaB—Papalote fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping, moderately well drained soil is on slightly convex uplands. Occasional shallow gullies that are crossable with farm machinery are in many cultivated fields. Areas of this soil range from 20 to 600 acres.

The surface layer is neutral fine sandy loam about 12 inches thick. It is light brownish gray in the upper 8 inches and grayish brown in the lower part. Below that, to a depth of 16 inches, is dark grayish brown, neutral sandy clay that contains brownish mottles; to 30 inches, is grayish brown, mildly alkaline sandy clay that contains grayish and reddish mottles and a few black concretions; to 36 inches, is grayish brown, mildly alkaline sandy clay that contains yellowish, grayish, and brownish mottles and black concretions; and to 45 inches, is light brownish gray, moderately alkaline sandy clay loam that contains reddish and grayish mottles, a few black concretions, and about 2 percent concretions and soft bodies of calcium carbonate. The underlying material, to a depth of 60 inches, is white, moderately alkaline sandy clay loam that contains grayish and brownish mottles, a few black concretions, and about 10 percent concretions and soft bodies of calcium carbonate.

This soil has medium available water capacity and slow permeability. Surface runoff is slow to moderate.

Included with this soil in mapping are small areas of Papalote fine sandy loam that has up to 5 percent slopes. Also included are small areas of similar soils in which 25 to 50 percent of the surface layer was removed by erosion, small areas of similar soils that have a loamy fine sand surface layer, and small areas of Delfina, Leming, Victoria, Raymondville, Orelia, Willacy, and Pharr soils. Inclusions make up less than 15 percent of any one mapped area.

This Papalote soil is mainly used for crops, and potential is medium for cultivated crops. Water erosion, medium available water capacity, low fertility, and low organic-matter content are limitations, but they can be easily overcome by proper fertilization; growing high-residue crops and cover crops, including legumes; residue management; contour farming; and proper design and installation of a terrace and waterway system. Cover crops and crop residue left on the soil surface help to conserve moisture, slow runoff, reduce soil temperature, increase organic-matter content, and improve fertility.

Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This soil has high potential for climax range vegetation. Water erosion is the main limitation, but it can be easily overcome by controlling grazing and using proper stocking rates to help keep a good surface cover and maintain productivity. It has high potential for openland and rangeland wildlife habitat.

This soil has high potential for pasture production. Water erosion and low fertility are limitations, but they can be easily overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control to help keep a good vegetative cover on the surface and maintain productivity. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

This soil has medium potential for urban use. Slow water intake rate, corrosivity to uncoated steel, low strength, and shrink-swell properties are limitations, but they can be overcome by use of proper materials and proper design and installation of structures. Potential for recreation is high.

This soil is in capability subclass IIe and Tight Sandy Loam range site.

PaC—Papalote fine sandy loam, 3 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on uplands. Shallow gullies are in some places. Areas of this soil range from 20 to 100 acres.

The surface layer is grayish brown, neutral fine sandy loam in the upper 6 inches. The soil is grayish brown, neutral sandy clay loam to a depth of 9 inches. Below that, to a depth of 13 inches, is grayish brown, neutral sandy clay that contains brownish mottles and a few black concretions; to 28 inches, is light brownish gray, moderately alkaline sandy clay loam; and to 38 inches, is light gray, moderately alkaline sandy clay loam that is about 2 percent concretions and soft bodies of calcium carbonate. The underlying material, to a depth of 60 inches, is white, moderately alkaline fine sandy loam that has grayish and brownish mottles.

Papalote fine sandy loam, 3 to 5 percent slopes, has medium available water capacity and slow permeability. Surface runoff is moderate to rapid.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 8 percent, small areas of soils in which 50 to 75 percent of the surface layer was removed by erosion, and small areas with V-shaped gullies 4 to 10 feet deep, about 10 to 20 feet wide, and about 75 to 200 feet apart. Also included are small areas of Papalote fine sandy loam, 1 to 3 percent slopes, and Delfina, Willacy, Pharr, and Monteola soils. Inclusions make up less than 15 percent of any one mapped area.

This Papalote soil is mainly used for range, and potential is medium for climax range vegetation. Water erosion is the main limitation, but it can be easily overcome by using a system of controlled grazing and proper stocking rates to keep a good vegetative cover on the surface and maintain productivity. Potential is high for openland and rangeland wildlife habitat.

Potential for cultivated crops is low. Erodibility, medium available water capacity, and low organic-matter content are the main limitations. High-residue crops and cover crops are needed to help control erosion. Also needed is a properly designed and installed terrace and waterway system.

This soil has medium potential for pasture. The limitations of water erosion and low fertility can be easily overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control, all of which help to keep a good cover on the surface and maintain productivity. Improved varieties of bluestem, bermudagrass, and kleingrass are suited to this soil.

Potential is medium for urban uses of the soil because of its corrosivity to uncoated steel, low strength for local roads and streets, and shrink-swell properties. Potential is high for recreation.

This soil is in capability subclass IIIe and Tight Sandy Loam range site.

PeB—Pettus loam, 0 to 3 percent slopes. This shallow, nearly level to gently sloping, well drained soil is on slightly convex uplands. Because it is shallow and has restricted water storage capacity, this soil is droughty; and because it has a high lime content, cultivated crops show signs of chlorosis soon after they emerge. Areas of this soil range from 10 to 100 acres.

The surface layer is grayish brown, moderately alkaline loam about 6 inches thick. Below that, to a depth of 18 inches, is light brownish gray, moderately alkaline sandy clay loam that contains a few concretions of calcium carbonate. The underlying material, to a depth of 24 inches, is white, weakly cemented, platy and fractured caliche that contains solution channels. To a depth of 65 inches, it is white, moderately alkaline sandy clay loam that contains concretions of calcium carbonate.

Pettus loam, 0 to 3 percent slopes, has medium available water capacity and moderate permeability. Surface runoff is medium.

Included with this soil in mapping are small areas of similar soils that have slopes up to 5 percent, and small areas of Pharr, Willacy, and Raymondville soils. Inclusions make up less than 10 percent of any one mapped area. About 25 percent of the acreage is large, deep, open pits from which caliche is taken for industrial and construction purposes. The pits range from 10 to 150 acres and are 5 feet to about 80 feet deep.

This Pettus soil is mainly used for range, and potential is low for climax range vegetation. A shallow rooting zone and medium available water capacity are limitations that are difficult to overcome. Controlled grazing, proper stocking rates, and brush control will help keep a good vegetative cover on the surface and maintain productivity. The soil has medium potential for openland and rangeland wildlife habitat.

This soil has low potential for pasture production. A shallow rooting zone and medium available water capacity are limitations that are difficult to overcome. Proper fertilization, controlled grazing, proper stocking rates, and weed and brush control help keep a good vegetative cover on the surface and maintain productivity. Improved varieties of bermudagrass, kleingrass, and buffelgrass are suited to this soil.

This soil has low potential as cropland. The most limiting features are the shallow rooting depth and medium available water capacity. Use of cover crops is needed to help control erosion and add organic matter to the soil.

This soil has high potential for urban use. Corrosivity to uncoated steel and depth to a weakly cemented pan are limitations that can be easily overcome by use of proper materials and proper design and installation of structures. The weakly cemented pan is easily broken with hand tools and machinery. Potential for recreation is high.

This soil is in capability subclass IIIe and Shallow Ridge range site.

PfC—Pharr fine sandy loam, 1 to 5 percent slopes. This deep, gently sloping, well drained soil is on stream terraces and uplands. Areas of this soil range from 12 to 135 acres.

The surface layer is dark grayish brown, moderately alkaline fine sandy loam about 18 inches thick. Below that, to a depth of 32 inches, is brown, moderately alkaline sandy clay loam with films and threads of calcium carbonate. To a depth of 42 inches, is pale brown, moderately alkaline sandy clay loam that contains about 7 percent soft bodies of calcium carbonate. The underlying material, to a depth of 72 inches, is very pale brown, moderately alkaline sandy clay loam that contains about 10 percent soft bodies of calcium carbonate.

Pharr fine sandy loam, 1 to 5 percent slopes, has medium available water capacity and moderate permeability. Surface runoff is slow.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 8 percent. Also included are small areas of similar soils in which 25 to 50 percent of the surface layer has been removed by erosion, soils that have an occasional shallow gully, and small areas of Willacy, Comitas, Pettus, and Raymondville soils. Inclusions make up less than 10 percent of any one mapped area.

This Pharr soil is mainly used for range (fig. 9), and potential is medium for climax range vegetation. Soil blowing and water erosion are limitations, but they can be easily overcome by using controlled grazing, proper stocking rates, and brush control to help keep a good cover on the surface and maintain productivity. This soil has high potential for openland and rangeland wildlife habitat.

This soil has medium potential for pasture. Soil blowing, medium fertility, and water erosion are limitations, but they can be easily overcome by proper fertilization, controlled grazing, proper stocking rates, and weed and brush control, all of which help to keep a good cover on the surface and maintain productivity. Improved varieties of bluestem, bermudagrass, kleingrass, and buffelgrass are suited to this soil.

This soil has low potential for crops. Soil blowing, water erosion, medium available water capacity, and medium fertility are limitations, but they can be overcome by proper fertilization; growing high-residue crops and cover crops, including legumes; residue management; farming on the contour; and proper design and installation of terrace and waterway systems. Cover crops and crop residue left on the soil surface help conserve moisture, reduce soil temperature and soil blowing, improve fertility, and slow runoff. A limitation which is difficult to overcome is the high lime content. This causes chlorosis in plants soon after they emerge. Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This soil has high potential for urban use. Corrosivity to uncoated steel is the main limitation, but it can be easily overcome by using proper materials. Potential is high for recreation.

This soil is in capability subclass IIIe and Gray Sandy Loam range site.

Ps—Psamments. This map unit consists of deep, sloping to strongly sloping, excessively drained sands on rolling active coastal dunes. Areas are mostly long, narrow bands inland from, adjacent to, and parallel to the coastal beach. They are highly susceptible to soil blowing. The largest area of Psamments is on the east side of the barrier islands and varies from 200 feet to 0.5 mile wide and is about 20 miles long. The areas on the west side of the barrier islands are small and discontinuous. The dunes in most areas range from 3 to 30 feet high, 6 to 300 feet wide, and 10 feet to 0.5 mile or more long. Salt spray blown from the gulf makes the dunes adjacent to the coast saline. They become less saline about 300 feet inland. Areas of these soils range from 15 to 360 acres. Slopes range from 2 to 12 percent.

These active sand dunes are excessively drained and lack the soil colors associated with wetness or weathering. They are mostly devoid of vegetation. Present and potential use does not justify more detailed examination or mapping.

Psamments in this survey area are very pale brown, moderately alkaline, loose fine sand to a depth of 100 inches.

Psamments have low available water capacity and rapid permeability. Surface runoff, if there is any, is very slow.

Included in some mapped areas of Psamments are small areas of Beaches and Galveston, Mustang, Tatton, and Dianola soils. Inclusions make up less than 20 percent of any one mapped area.

All of the accessible areas of these soils are used for recreation and scenery (fig. 10), and potential is very low for recreational development. Psamments are barren or have sparse vegetation. They are constantly being moved and shifted by the wind. The sparse vegetation that does occur consists of seaoats, bitter panicum, groundsel, and goatfoot vines. Soil blowing, low fertility, low organic-matter content, salinity, and low available water capacity are limitations that are most difficult to overcome for any kind of development other than temporary facilities.

This map unit is in capability subclass VIIIs. Not in a range site.

RaA—Raymondville clay loam, 0 to 1 percent slopes. This deep, nearly level, moderately well drained soil is on uplands. Areas of this soil range from 10 to 425 acres.

The surface layer is moderately alkaline clay loam about 14 inches thick. In the upper 6 inches, it is dark gray and contains a few cracks and fine concretions of calcium carbonate; in the lower part, it is very dark gray and contains concretions of calcium carbonate. To a depth of 25 inches is gray, moderately alkaline clay that contains soft bodies of calcium carbonate; to 38 inches, is light gray, moderately alkaline clay that contains soft bodies of calcium carbonate. The underlying material, to a depth of 60 inches, is light gray, moderately alkaline clay loam that is about 5 percent soft bodies of calcium carbonate.

Raymondville clay loam, 0 to 1 percent slopes, has medium available water capacity and slow permeability. Surface runoff is slow.

Included with this soil in mapping are small areas of Raymondville clay loam, 1 to 3 percent slopes, and small areas of Victoria, Orelia, Papalote, Edroy, Willacy, and Pharr soils. Inclusions make up less than 10 percent of any one mapped area.

This soil is mainly used for crops, and potential is high for growing cultivated crops. Proper fertilization; high-residue crops and cover crops, including legumes; and residue management will help to improve and maintain soil tilth, reduce soil temperature, maintain organic-matter content, and improve productivity. Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This soil has medium potential for pasture production. Proper fertilization, controlled grazing, proper stocking rates, and weed and brush control help keep a good cover on the surface and maintain productivity. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

This soil has medium potential for climax range vegetation. Controlled grazing, proper stocking rates, and brush control help keep a good cover on the surface and maintain productivity. Potential for openland wildlife habitat is high.

This soil has low potential for urban use. Slow water intake rate and shrink-swell properties are limitations, but they can be overcome by proper design and installation of structures. Potential for recreation is medium because the surface layer is too clayey.

This soil is in capability subclass IIs and Clay Loam range site.

RaB—Raymondville clay loam, 1 to 3 percent slopes. This deep, gently sloping, moderately well drained soil is on slightly convex uplands. Areas of this soil range from 10 to 100 acres.

The surface layer is dark gray, moderately alkaline clay loam about 10 inches thick. Below that, to a depth of 20 inches, is gray, moderately alkaline clay that contains a few films and threads of calcium carbonate; to 32 inches, is light brownish gray, moderately alkaline clay that is about 2 percent soft bodies of calcium carbonate; and to 52 inches, is light gray, moderately alkaline clay that is about 7 percent soft bodies of calcium carbonate. The underlying material, to a depth of 62 inches, is light gray, moderately alkaline clay that contains a few soft bodies of calcium carbonate.

Raymondville clay loam, 1 to 3 percent slopes, has medium available water capacity and slow permeability. Surface runoff is slow.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 5 percent and small areas of similar soils in which 25 to 50 percent of the surface layer has been removed by erosion. Also included are small areas of Raymondville clay loam, 0 to 1 percent slopes, and small areas of Edroy, Orelia, Pharr, Willacy, Monteola, Victoria, and Papalote soils. Inclusions make up less than 10 percent of any one mapped area.

This Raymondville soil is mainly used for crops. Potential is high for cultivated crops. Water erosion is the main limitation, but it can be easily overcome by proper fertilization; growing high-residue crops and cover crops, including legumes; residue management; farming on the contour; and proper design and installation of terraces and waterways. Growing cover crops and leaving crop residue on the soil surface help to slow runoff, reduce soil temperature, and improve and maintain soil tilth and fertility. Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This soil has medium potential for pasture. Water erosion is the main limitation, but can be easily overcome by using proper fertilization, controlled grazing, proper stocking rates, and weed and brush control to help keep a good cover on the surface and maintain productivity. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

This soil has medium potential for climax range vegetation. Water erosion is the main limitation, which can be easily overcome by using controlled grazing, proper stocking rates, and brush control to help keep a good cover on the surface and maintain productivity. Potential for openland wildlife habitat is high.

This soil has low potential for urban use. Slow water intake rate and shrink-swell properties are limitations that can be overcome by proper design and installation of structures. Potential is medium for recreation because the surface layer is too clayey.

This soil is in capability subclass IIe and Clay Loam range site.

Sa—Sarita-Nueces complex. The deep, nearly level to gently undulating, well drained soils in this complex are on terraces and uplands. This complex is between nearly level uplands and the flood plain of rivers and creeks, usually on the inside bends and curves of stream channels. Areas of this complex range from 60 to 245 acres. Slopes range from 0 to 5 percent.

Sarita fine sand makes up about 55 percent of the complex, Nueces fine sand about 21 percent, and other soils make up the remaining 24 percent. Areas of duned Sarita fine sand and nearly level Nueces fine sand are intermingled in such an intricate pattern that it is impractical to map them separately at the scale used.

Sarita fine sand is on the slightly higher, gently undulating dunes. This soil is droughty, and it is highly susceptible to soil blowing unless protected. The surface layer is light brownish gray, slightly acid fine sand about 12 inches thick. To a depth of 48 inches, is very pale brown, slightly acid fine sand. Below that, to a depth of 52 inches, is light brownish gray, neutral sandy clay loam that has brownish mottles; to 66 inches, is pale brown, neutral sandy clay loam with brownish mottles; and to a depth of 80 inches, is very pale brown, moderately alkaline fine sandy loam that has brownish mottles.

Sarita fine sand has low available water capacity and moderately rapid permeability. Surface runoff is slow or very slow.

Nueces fine sand is on the lower, nearly level to gently undulating part of the landscape. The surface layer is about 36 inches of fine sand. It is pale brown and neutral in the upper 12 inches, grayish brown and slightly acid to a depth of 21 inches, and light brownish gray and neutral in the lower 11 inches. Below that, neutral sandy clay loam extends to a depth of 72 inches. To a depth of 40 inches, it is grayish brown with brownish and reddish mottles; to 46 inches, it is grayish brown with yellowish, reddish, and brownish mottles; and to 72 inches, it is brown and has dark coatings on the peds.

Nueces fine sand has medium available water capacity and moderately slow permeability. Surface runoff is very slow.

Included with these soils in mapping are small areas of Falfurrias, Comitas, Leming, and Odem soils.

This complex is mainly used for range and has medium potential for climax range vegetation. Soil blowing is the main limitation, but it can be overcome by using controlled grazing and proper stocking rates to help keep a good surface cover and maintain productivity. Potential is medium for openland and rangeland wildlife habitat.

Potential for crops is low. Soil blowing, low available water capacity, and low organic-matter content are the main limiting features. If the complex is used for crops, cover crops are needed to help control soil blowing.

Potential for urban uses is medium. Low strength and shrink-swell properties are the main limitations, but they can be overcome by careful planning and installation of structures. Potential is low for recreation because the surface is too sandy.

This complex is in capability subclass IVe and Sandy range site.

Sn—Sinton loam. This is a deep, nearly level, well drained soil on slightly convex bottom lands and flood plains. It is mostly in long, narrow bands and crescent shaped areas along rivers and creeks. Most areas of this soil occur along the inside curve of rivers and creeks. Sinton loam is occasionally flooded during periods of very high rainfall that accompany tropical storms or hurricanes. Flooding occurs 1 or 2 times in 5 years. Areas of this soil range from 10 to 200 acres. Slopes range from 0 to 1 percent.

The surface layer is moderately alkaline loam about 28 inches thick. It is very dark gray and contains a few films of calcium carbonate in the upper 15 inches, and the lower part is dark gray and contains a few thin strata and lenses of sandy clay loam and a few films and threads of calcium carbonate. The underlying material, to a depth of 44 inches, is light gray, moderately alkaline loam that contains a few bedding planes and a few thin strata and lenses of fine sandy loam and loamy fine sand. To a depth of 72 inches, it is white, moderately alkaline loamy fine sand that contains a few bedding planes and thin strata of fine sandy loam.

Sinton loam has medium available water capacity and moderate permeability. Surface runoff is slow.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 3 percent. Also included are a few small areas of similar soils that have a loamy surface layer and clayey substratum and small areas of Odem and Aransas soils. Inclusions make up less than 15 percent of any one mapped area.

This Sinton soil is mainly used for range (fig. 11), and potential is high for climax range vegetation. Controlled grazing, proper stocking rates, and brush control help keep a cover on the surface and maintain productivity. Potential is high for openland and rangeland wildlife habitat.

This soil has high potential for pasture. Proper fertilization, controlled grazing, proper stocking rates, and brush control help keep a good cover on the surface and maintain productivity. Improved varieties of bermudagrass, bluestem, and kleingrass are suited to this soil.

This soil has high potential for crops. Occasional damaging floods are a limitation, which can be overcome, with some difficulty, by proper design and installation of a diversion terrace system. A planned system of fertilization; high-residue crops and cover crops, including legumes; and residue management helps reduce soil temperature and maintain and improve soil tilth and productivity. Suitable crops are grain sorghum, cotton, and corn.

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

Tn—Tatton complex. The deep, nearly level, poorly drained soils in this complex are on slightly concave coastal lowlands. Long, narrow areas occur on the bay side of the barrier islands and along the mainland shoreline around numerous inlets, coves, and bays. This barren or sparsely vegetated complex is at an elevation of sea level to about 10 feet above sea level. Where the elevation is about 1 foot, the complex is inundated by normal high tides and wave action at low tides and is continually saturated to the surface. Periodically, areas more than 1 foot in elevation are inundated by abnormally high tides and high tides caused by storms. The soil is never dry below a depth of 6 inches. Areas of this complex range from 10 to 150 acres. Slopes range from 0 to 1 percent.

Tatton loamy sand makes up about 60 percent of the complex and other soils the remaining 40 percent. These soils do not occur in a regular pattern.

The surface layer is light gray, extremely saline, moderately alkaline loamy sand about 5 inches thick. The underlying material, to a depth of 20 inches, is white, extremely saline, moderately alkaline loamy sand that has brownish and grayish mottles. To a depth of 60 inches, it is white, extremely saline, moderately alkaline loamy sand with black streaks.

Tatton loamy sand has very low available water capacity and rapid permeability. Surface runoff is very slow.

Included with this complex in mapping are areas of Dianola, Mustang, Galveston, and Barrada soils, and small areas of Beaches. Included soils make up less than 45 percent of any one mapped area.

This complex is mainly used for wildlife (fig. 12), and potential is medium for wetland wildlife habitat. Parts of this complex are barren and others have sparse to good vegetation. Native vegetation consists of pickleweed, bushy-sea-ox-eye, seashore saltgrass, gulf cordgrass, marshhay cordgrass, buckwheat, and salt- and water-tolerant sedges and reeds. Frequent flooding by saltwater, salinity, wetness, and a high water table are limitations most difficult to overcome. Potential for range is low.

Potential is low for urban uses and recreation because of flooding, wetness, corrosivity to uncoated steel and concrete, and a too-sandy surface layer.

This soil is in capability subclass VIIIs; not assigned to a range site.

Va—Victine clay. This is a deep, nearly level, somewhat poorly drained soil on low coastal terraces. Some areas are subject to infrequent flooding by high tides caused by storms. Periods of inundation are of short duration, usually a few hours to a day or two. Areas of this soil range from 10 to 250 acres. Slopes range from 0 to 1 percent.

The surface layer is dark gray, slightly saline, moderately alkaline clay about 40 inches thick that contains a few concretions of calcium carbonate. It is slightly saline in the upper 12 inches and moderately saline in the lower part. Below that, to a depth of 60 inches, is light gray, strongly saline, moderately alkaline clay that contains concretions and soft bodies of calcium carbonate and a few gypsum crystals. The underlying material, to a depth of 72 inches, is white, strongly saline, strongly alkaline clay that contains concretions and soft bodies of calcium carbonate and crystals of gypsum and other salts.

Victine clay has low available water capacity and very slow permeability. Surface runoff is slow to very slow. Water enters the soil rapidly when it is dry and cracked and very slowly when it is moist.

Included with this soil in mapping are small areas of similar soils that have a silty clay surface layer. Also included are small areas of similar soils that have a clay loam surface layer, small areas of similar soils that have slopes of up to 3 percent, and small areas of Narta, Victoria, Orelia, and Raymondville soils. Inclusions make up less than 10 percent of any one mapped area.

This Victine soil is mainly used for range, and potential is high for climax range vegetation. Wetness and salinity are limitations, but they can be overcome by using controlled grazing and proper stocking rates to keep a good vegetative cover on the surface and maintain productivity. This soil has low potential for wildlife habitat.

Potential is low for crops. Salinity, wetness, and low available water capacity are the main limitations.

This soil has low potential for urban use. Wetness, very slow water intake rate, corrosivity to uncoated steel, very high shrink-swell properties, and salinity are limitations, but they can be overcome by use of proper materials and proper design and installation of structures. Potential is low for recreation because the surface is too clayey.

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

VcA—Victoria clay, 0 to 1 percent slopes. This deep, nearly level, somewhat poorly drained soil is on uplands. In undisturbed areas this soil has distinct gilgai microrelief. When dry it has cracks 0.4 to 3.0 inches wide at the surface that extend into the C horizon. Areas of this soil range from 10 to 2,800 acres.

The surface layer is dark gray, moderately alkaline clay about 38 inches thick that contains a few concretions of calcium carbonate. Below that, to a depth of 58 inches, is light gray, moderately alkaline, moderately saline clay that has vertical dark gray streaks, a few concretions of calcium carbonate, and a few pockets and seams of gypsum crystals in the lower part. The underlying material, to a depth of 72 inches, is light gray, moderately alkaline, strongly saline clay that has a few gray streaks, a few concretions of calcium carbonate, and a few pockets and seams of gypsum and other salts.

This soil has high available water capacity and very slow permeability. Surface runoff is slow to very slow. Water intake is rapid when the soil is dry and cracked but very slow when moist.

Included with this soil in mapping are small areas of similar soils that have a silty clay surface layer. Also included are small areas of similar soils that have a clay loam surface layer, small areas of Victoria clay, depressional, and small areas of Edroy, Orelia, Raymondville, and Papalote soils. Inclusions make up less than 15 percent of any one mapped area.

This Victoria soil is mainly used for crops (fig. 13), and potential is high for growing cultivated crops. Poor tilth and wetness are limitations, but they can be overcome by using proper fertilization; high-residue crops and cover crops, including legumes; residue management; and proper design and installation of field drains. Growing cover crops and leaving crop residue on the soil surface help reduce soil temperature and improve and maintain soil tilth and productivity. Suitable crops are grain sorghum, cotton, corn, and vegetables.

This soil has medium potential for pasture. Proper fertilization, controlled grazing, proper stocking rates, and weed control help keep a good vegetative cover on the surface and maintain productivity. Improved varieties of bluestem, bermudagrass, and kleingrass are suited to this soil.

This soil has medium potential for climax range vegetation. Controlled grazing, proper stocking rates, and brush control help to keep a good cover on the surface and maintain productivity. Potential is medium for openland wildlife habitat.

This soil has low potential for urban use. Very high shrink-swell properties, wetness, very slow water intake rate, and corrosivity to uncoated steel are limitations, but they can be overcome by use of proper materials and proper design and installation of structures. Potential is low for recreation because the surface layer is too clayey.

This soil is in capability subclass IIs and Blackland range site.

VcB—Victoria clay, 1 to 3 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on uplands. This soil, in undisturbed areas, has distinct gilgai microrelief, generally aligned with the slope. Areas of this soil range from 10 to 130 acres.

The surface layer is dark gray, moderately alkaline clay about 38 inches thick. It contains a few concretions of calcium carbonate, and in the lower 19 inches, a few seams and pockets of gypsum and other salt crystals. Below that, to a depth of 52 inches, is gray, moderately alkaline, moderately saline clay with a few concretions of calcium carbonate and a few pockets of gypsum crystals. The underlying layer, to a depth of 60 inches, is light gray, moderately alkaline, strongly saline clay with a few concretions of calcium carbonate and a few seams and pockets of gypsum crystals and other salts.

This soil has high available water capacity and very slow permeability. Surface runoff is slow. Water intake is rapid when the soil is dry and cracked, but very slow when the soil is moist.

Included with this soil in mapping are areas of soils that are similar but have a silty clay or clay loam surface layer or that have slopes of up to 5 percent. In small areas 25 to 75 percent of the surface layer has been removed by erosion, and there are a few gullies that range from 2 to 6 feet deep, 5 to 15 feet wide, and are 50 to 250 feet apart. Also included are areas of Victoria clay, 0 to 1 percent slopes; Victoria clay, depressional; and small areas of Edroy, Orelia, Monteola, Raymondville, and Papalote soils. Inclusions make up less than 10 percent of any one mapped area.

This soil is mainly used for crops, and potential is high for cultivated crops. Water erosion and poor soil tilth are limitations, but they can be easily overcome by using proper fertilization; high-residue crops and cover crops, including legumes; residue management; farming on the contour; and proper design and installation of terrace and waterway systems. Leaving cover crops and crop residue on the soil surface helps to reduce soil temperature, slow runoff, and improve and maintain soil tilth and productivity. Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This Victoria soil has medium potential for pasture. Water erosion is the main limitation, but it can be easily overcome by using proper fertilization, controlled grazing, proper stocking rates, and weed control to keep a good cover on the surface and maintain productivity. Improved varieties of bluestem, bermudagrass, and kleingrass are suited to this soil.

This soil has medium potential for growing climax range vegetation. Water erosion is the main limitation, but it can be easily overcome by using controlled grazing, proper stocking rates, and brush control to keep a good cover on the surface and maintain productivity. Potential is medium for openland wildlife habitat.

This soil has low potential for urban use. Very high shrink-swell properties, very slow water intake rate, and corrosivity to uncoated steel are limitations that can be overcome by use of proper materials and proper design and installation of structures. Potential is low for recreation because the surface layer is too clayey.

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

Vd—Victoria clay, depressional. This deep, nearly level, somewhat poorly drained soil is on slightly concave uplands, mostly in irregular round, oblong, or rectangular areas within larger areas of Victoria clay, 0 to 1 percent slopes. Areas are 0.5 to 1 foot lower in elevation than the surrounding Victoria clay, 0 to 1 percent slopes. They range from 10 to 160 acres. Slopes range from 0 to 1 percent.

The surface layer is dark gray, moderately alkaline clay about 40 inches thick. It contains a few concretions of calcium carbonate and between depths of 18 and 40 inches, has brownish mottles. Below that, to a depth of 66 inches, is light brownish gray, moderately alkaline, moderately saline clay that contains about 20 percent vertical dark gray streaks and a few concretions of calcium carbonate. The underlying material, to a depth of 72 inches, is light gray, moderately alkaline, strongly saline clay that contains a few concretions of calcium carbonate and a few pockets and seams of gypsum crystals.

Victoria clay, depressional, has high available water capacity and very slow permeability. Surface runoff is ponded to very slow. Water enters this soil rapidly when it is dry and cracked, but very slowly when it is moist.

Included with this soil in mapping are small areas of soils that have a silty clay or clay loam surface layer. Also included are small areas of Victoria clay, 0 to 1 percent slopes, and small areas of Edroy, Orelia, and Raymondville soils. Inclusions make up less than 10 percent of any one mapped area.

This soil is mainly used for crops along with the larger areas of better drained soils, mainly because it cannot be conveniently excluded. It has high potential for growing cultivated crops during years with normal rainfall. Wetness, flooding, and poor soil tilth are limitations that can be overcome by proper fertilization; high-residue crops and cover crops, including legumes; residue management; and proper design and installation of field drains or land smoothing operations (fig. 14). Leaving cover crops and crop residue on the soil surface helps to reduce soil temperature and improve and maintain soil tilth and productivity. Suitable crops are grain sorghum, cotton, corn, and flax.

This soil has medium potential for pasture. Wetness and flooding are limitations that can be overcome easily by using proper fertilization, controlled grazing, proper stocking rates, and weed control. The soil can be fertilized and weeds controlled during the dry season. Improved varieties of bluestem and kleingrass are suited to this soil.

This soil has medium potential for climax range vegetation. Controlled grazing, proper stocking rates, and brush control help keep a good cover on the surface and maintain productivity. Potential is medium for openland wildlife habitat.

Potential is low for urban uses and recreation. Shrinking and swelling with moisture changes, corrosivity to uncoated steel, wetness, low strength, and the clayey surface layer are the major limiting features.

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

WfA—Willacy fine sandy loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on slightly convex terraces and uplands. Areas of this soil range from 10 to 140 acres.

The surface layer is mildly alkaline fine sandy loam about 14 inches thick. It is grayish brown in the upper 6 inches and dark grayish brown in the lower part. Below that, to a depth of 19 inches, is dark grayish brown, mildly alkaline sandy clay loam; to 36 inches, is brown, mildly alkaline sandy clay loam; and to 40 inches, is brown, moderately alkaline sandy clay loam that has a few films and threads of calcium carbonate in the lower part. The underlying material, to a depth of 50 inches, is pale brown, moderately alkaline sandy clay loam that is about 3 to 5 percent concretions and soft bodies of calcium carbonate. To a depth of 60 inches, it is pale brown, moderately alkaline sandy clay loam that is about 3 percent concretions and soft bodies of calcium carbonate.

This Willacy soil has high available water capacity and moderate permeability. Surface runoff is medium.

Included with this soil in mapping are small areas of similar soils that have a loam surface layer, small areas of Willacy fine sandy loam, 1 to 3 percent slopes, and small areas of Odem, Pharr, Comitas, Raymondville, and Papalote soils. Inclusions make up less than 10 percent of any one mapped area.

This soil is mainly used for crops. It has high potential for cultivated crops. Climate is the main limitation and cannot be overcome. However, by using proper fertilization; high-residue crops and cover crops, including legumes; and residue management, good yields can be obtained. Growing cover crops and leaving crop residue on the soil surface help to reduce soil temperature and soil blowing, conserve moisture, and improve and maintain fertility and productivity. Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This soil has high potential for pasture. Soil blowing is the main limitation, but it can be easily overcome by proper fertilization, controlled grazing, proper stocking rates, and weed control that help keep a good cover on the surface and maintain productivity. Improved varieties of bermudagrass, bluestem, kleingrass, and buffelgrass are suited to this soil.

This soil has medium potential for climax range vegetation. Soil blowing is the main limitation, and it can be overcome by using controlled grazing, proper stocking rates, and brush control to keep a good cover on the surface and maintain productivity. Potential is high for openland and rangeland wildlife habitat.

This soil has high potential for urban use. Seepage and moderate strength are limitations that can be easily overcome by proper design and installation of structures. Potential for recreation is high.

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

WfB—Willacy fine sandy loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on slightly convex terraces and uplands. Areas of this soil range from 10 to 95 acres.

The surface layer is mildly alkaline fine sandy loam about 12 inches thick. It is grayish brown in the upper 6 inches and dark grayish brown in the lower part. Below that, to a depth of 18 inches, is dark grayish brown, mildly alkaline sandy clay loam; to 38 inches, is grayish brown, mildly alkaline sandy clay loam; and to 44 inches, is grayish brown, moderately alkaline fine sandy loam that has a few films and threads of calcium carbonate in the lower part. The underlying material, to a depth of 56 inches, is light brownish gray, moderately alkaline fine sandy loam that is about 3 to 5 percent concretions and soft bodies of calcium carbonate. To a depth of 72 inches, it is light brownish gray, moderately alkaline fine sandy loam that is 1 to 3 percent concretions and soft bodies of calcium carbonate.

Willacy fine sandy loam, 1 to 3 percent slopes, has high available water capacity and moderate permeability. Surface runoff is medium.

Included with this soil in mapping are small areas of similar soils that have a loam surface layer and small areas of Willacy fine sandy loam, 0 to 1 percent slopes. Also included are small areas of Willacy fine sandy loam, 3 to 5 percent slopes, and small areas of Pharr, Comitas, Raymondville, and Papalote soils. Inclusions make up less than 10 percent of any one mapped area.

This soil is used mainly for crops, and potential is high for growing cultivated crops. Soil blowing and water erosion are limitations that can be overcome by proper fertilization; high-residue crops and cover crops, including legumes; residue management; and proper design and installation of terraces and waterways. Growing cover crops and leaving crop residue on the soil surface help to reduce soil temperature and soil blowing, slow runoff, and improve and maintain productivity. Suitable crops are grain sorghum, cotton, corn, flax, and vegetables.

This soil has medium potential for pasture. Soil blowing and water erosion are limitations that can be easily overcome by using proper fertilization, controlled grazing, proper stocking rates, and weed control to keep a good cover on the surface and maintain productivity. Improved varieties of bermudagrass, bluestem, kleingrass, and buffelgrass are suited to this soil.

This soil has medium potential for climax range vegetation. The limitations of soil blowing and water erosion can be easily overcome by using controlled grazing, proper stocking rates, and brush control to help keep a good surface cover and maintain productivity. Potential is high for openland and rangeland wildlife habitat.

This soil has high potential for urban use. Seepage and moderate strength are limitations that can be easily overcome by proper design and installation of structures. Potential is high for recreation.

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

WfC—Willacy fine sandy loam, 3 to 5 percent slopes. This deep, gently sloping, well drained soil is on convex terraces and uplands. Areas of this soil range from 10 to 175 acres.

The surface layer is dark grayish brown, mildly alkaline fine sandy loam about 16 inches thick. Below that, sandy clay loam extends to a depth of about 45 inches. To a depth of 20 inches, it is grayish brown and mildly alkaline; to 36 inches, it is brown and mildly alkaline; and to 45 inches, it is brown and moderately alkaline and the lower part contains a few films and threads of calcium carbonate. The underlying material, to a depth of 60 inches, is pale brown, moderately alkaline fine sandy loam that is about 5 percent concretions and soft bodies of calcium carbonate. To a depth of 72 inches, it is very pale brown, moderately alkaline fine sandy loam that is about 3 percent concretions and soft bodies of calcium carbonate.

This soil has high available water capacity and moderate permeability. Surface runoff is medium.

Included with this soil in mapping are small areas of similar soils that have slopes of up to 8 percent. In small areas 25 to 75 percent of the surface layer has been removed by erosion and there are a few gullies that range from 1 to 6 feet deep, 2 to 10 feet wide, and 100 to 300 feet apart. Also included are small areas of Willacy fine sandy loam, 1 to 3 percent slopes, and small areas of Pharr, Comitas, Raymondville, and Papalote soils. Inclusions make up less than 10 percent of any one mapped area.

This Willacy soil is mainly used for range, and potential is medium for climax range vegetation. The limitations of soil blowing and water erosion can be easily overcome by using controlled grazing, proper stocking rates, and brush control to help keep a good cover on the surface and maintain productivity. Potential is high for openland and rangeland wildlife habitat.

Potential for cropland is medium. Soil blowing and water erosion are limitations that can be overcome by use of cover crops and leaving crop residue on the surface. Proper design and installation of terrace and waterway systems can control water erosion. Suitable crops are grain sorghum and cotton.

This soil has medium potential for pasture. Soil blowing and water erosion are limitations that can be easily overcome by using proper fertilizaton, controlled grazing, proper stocking rates, and weed control to help keep a good surface cover and maintain productivity. Improved varieties of bermudagrass, bluestem, kleingrass, and buffelgrass are suited to this soil.

Potential for urban uses and recreation is high.

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

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture and rangeland; as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities; and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

Gerald Darby, conservation agronomist, Soil Conservation Service, assisted in preparing this section.

The major management concerns when using the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best adapted to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the predicted yields of the main crops and pasture are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and needed management practices. The information is useful to those in the agribusiness sector—equipment dealers, drainage contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." When making plans for management systems for individual fields or farms, check the detailed information given in the description of each soil.

More than 271,000 acres in the survey area was used for crops and pasture in 1967 (*9*). Of this total 33,000 acres was used for permanent pasture; 208,000 acres for row crops, mainly grain sorghum; 6,000 acres for close-grown crops, mainly flax; the rest was idle cropland.

The potential of the soils in San Patricio and Aransas counties for increased production of food is good. About 110,000 acres of potentially good cropland is currently used as range and about 30,000 acres as pasture. In addition to the reserve productive capacity represented by this land, food production could be increased considerably by using the latest crop production technology on all cropland in the survey area. This soil survey can greatly facilitate the application of such technology.

Acreage in crops and pasture has gradually decreased as more and more land is used for urban development. It was estimated that in 1967 there were about 32,000 acres of urban and built-up land in the survey area; this figure has been growing at the rate of about 1,000 acres per year.

Soil erosion is the major soil problem on about 11 percent of the cropland and pasture in San Patricio and Aransas counties. If the slope is more than 2 percent, erosion is a hazard. Papalote, Pettus, Pharr, Raymondville, Victoria, and Willacy soils, for example, have slopes of 2 to 5 percent.

Loss of the surface layer through erosion is damaging for two reasons: productivity is reduced and the eroded soil enters the streams as sediment. Loss of the surface layer is especially damaging on soils with a clayey subsoil, such as the Papalote soils, and on soils with a layer in or below the subsoil that limits the depth of the root zone. Such layers include weakly cemented, platy and fractured caliche as in Pettus soils. Erosion also reduces productivity on soils that tend to be droughty, such as Pharr and Willacy soils. Control of erosion is necessary for crops, and by minimizing the pollution of streams by sediment, it improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, preparing a good seedbed and tilling are difficult on clayey or hardpan spots where the original friable surface soil has been eroded away. Such spots occur in areas of moderately eroded Papalote soils.

Erosion control provides protective surface cover, reduces runoff, and increases infiltration of the soil. A cropping system that keeps vegetative cover on the soil for extended periods can hold soil loss to amounts that will not reduce its productive capacity. On livestock farms, where pasture and hay are needed, the legume and grass forage crops in the cropping system reduce erosion on sloping land and also provide nitrogen and improve tilth for the following crop.

Slopes are so short and irregular that contour tillage or terracing is not practical on some of the sloping Papalote soils. On these soils, cropping systems that provide substantial vegetative cover are required to control erosion unless minimum tillage is practiced. Minimizing tillage and leaving crop residues on the surface help to increase infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area, but are more difficult to use successfully on the eroded soils and on the soils that have a clayey surface layer, such as Raymondville and Victoria soils.

Terraces and diversions reduce the length of slope and reduce runoff and erosion. They are most practical on deep, well-drained soils that have regular slopes. Papalote, Pharr, Raymondville, Victoria, and Willacy soils are suitable for terraces. The other soils are less suitable for terracing and diversions because they have irregular slopes, excessive wetness in the terrace channels, thick sandy surface layers, a clayey subsoil which would be exposed in terrace channels, or weakly cemented, platy, fractured caliche at a depth of less than 40 inches.

Contour farming is a widespread method of erosion control on the sloping soils in the survey area. It is best adapted to soils with smooth, uniform slopes, including most areas of the sloping Papalote, Pettus, Pharr, Raymondville, Victoria, and Willacy soils.

Soil blowing is a hazard on the sandy Comitas, Delfina, Dietrich, Falfurrias, Galveston, Leming, Nueces, and Sarita soils. It can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining a vegetative cover or surface mulch minimizes soil blowing on these soils.

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

Soil drainage is the major management need on about 82 percent of the acreage used for crops and pasture in the survey area. This figure includes soils that have internal and surface drainage problems and salinity problems. Some soils are naturally so wet that the production of crops common to the area is generally not possible. These are the poorly drained and very poorly drained Aransas, Edroy, and Victoria, depressional soils, which make up about 42,500 acres in the survey area.

Unless artificially drained, the somewhat poorly drained soils are so wet that crops are damaged during most years. In this category are the Dietrich, Leming, Orelia, Victine, and Victoria soils which make up about 180,000 acres. Delfina soils have good natural drainage most of the year, but they tend to dry out slowly after rains. Small areas of wetter soils along drainageways and in swales are commonly included in areas of the moderately well drained Papalote and Raymondville soils, especially those that have slopes of 2 to 5 percent. Artificial drainage is needed in some of these wetter areas.

The design of surface drainage systems varies with the kind of soil. Surface drainage is needed in most areas of the poorly drained and very poorly drained soils used for row cropping. Drains have to be more closely spaced in soils with slow permeability than in the more permeable soils. Finding adequate outlets for drainage systems is difficult in many areas of Edroy, Orelia, and Victoria soils.

Information and assistance on drainage design for each kind of soil are available in local offices of the Soil Conservation Service.

Soil fertility is naturally high in most soils of the uplands in the survey area. Most of the soils are naturally neutral or alkaline. The soils on flood plains, such as Aransas, Odem, and Sinton soils, range from neutral to moderately alkaline and are naturally higher in plant nutrients than most upland soils. Edroy, Leming, Orelia, and Victoria soils in low swales and drainageways are slightly acid to moderately alkaline.

Many upland soils are naturally neutral to moderately alkaline. A few, such as Delfina, Edroy, Leming, and Orelia soils, are slightly acid in the surface layer but do not need liming for crop production. The level of available phosphorus is naturally low and the level of potash is naturally medium or high in most of these soils. On all soils, additions of fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension

Service can help in determining the kinds and amounts of fertilizer to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous.

Some of the soils used for crops in the survey area have a fine sandy loam surface layer that is light in color and low in content of organic matter. Generally the structure of such soils is weak. The soils of the survey area are generally fall plowed and the crop residue returned to the soil to add organic matter, improve and maintain tilth, and allow storage of moisture for spring planting. It is also helpful, and for some crops necessary, to control crop damaging insects. Only about 4 percent of the cropland consists of sloping soils that are subject to damaging erosion if they are plowed in the fall.

Tilth is a problem on the dark colored, clayey Edroy, Orelia, Raymondville, and Victoria soils because they often stay wet until late in spring. If they are wet when plowed, they tend to be very cloddy when dry, and good seedbeds are difficult to prepare. Fall plowing generally results in good tilth in the spring.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Grain sorghum and cotton are the principal row crops. Corn, sunflowers, soybeans, and similar crops can be grown if economic conditions are favorable.

Flax is the most common close-growing crop. Rye, barley, forage sorghum, wheat, and oats could be grown, and grass seed could be produced from various species of bluestem, kleingrass, and Rhodesgrass.

Special crops grown commercially in the survey area are vegetables and nursery plants. Cucumbers, onions, and cabbage are grown in the large, nearly level areas of Orelia, Papalote, and Victoria soils northeast of Sinton. A small acreage throughout the survey area is used for melons, canteloups, squash, okra, turnips, sweet corn, tomatoes, peppers, and other vegetables. In addition, large areas can be adapted to other special crops such as spinach, carrots, and many other vegetables. Citrus is the most important tree fruit grown in the survey area, but not on a commercial basis.

Deep soils that have good natural drainage and that warm up early in spring are especially well suited to many vegetables and small fruits. In the survey area these are Delfina, Nueces, Papalote, and Raymondville soils that have slopes of less than 5 percent, and they total about 105,000 acres. If irrigated, about 12,300 acres of the Comitas, Pharr, and Willacy soils that have slopes of less than 5 percent are also suited to vegetables and small fruits. Crops can generally be planted and harvested earlier on all these soils than on the other soils in the survey area.

When adequately drained, the poorly and somewhat poorly drained soils in the survey area are well suited to a wide range of vegetable crops. Edroy, Orelia, and Victoria soils make up about 110,000 acres in the survey area.

Most of the well-drained soils in the survey area are suitable for orchards and nursery plants. Soils in low positions where late frost occurs and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and orchards.

Latest information and suggestions for growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

About 33,000 acres in San Patricio and Aransas counties are pastureland and hayland. Introduced species of perennial grasses normally are planted and used for forage production.

The more important grasses are coastal bermudagrass, angleton bluestem, medio bluestem, kleingrass, buffelgrass, and weeping lovegrass. Harvest is accomplished by grazing domestic animals or by mechanical hay harvest.

The important management practices needed on pastureland are fertilization, proper grazing and weed control. The amount of fertilizer needed is related to soil type, plant species, and the desired level of forage production. Proper grazing consists of balancing the number of grazing animals with the productive capacity of the grass. Weeds, which compete with the desirable vegetation for water and nutrients, can be controlled by mowing or by using adapted herbicides. Weeds normally are a minor problem on well fertilized and properly grazed pastures.

Irrigation potential

Irrigation in San Patricio and Aransas Counties is of minor importance. It is an intermittent and supplemental operation generally used during periods of extended dry weather. Most of the water is of low quality.

In 1963 there were about 75 irrigation wells in use on about 17,500 acres. In 1974 there were about 90 wells in use on about 25,000 acres. Most of the irrigated areas are in the Mathis and St. Paul areas of San Patricio County. There is no irrigation in Aransas County.

Most of the water used for irrigation comes from deep wells. Depth of these wells is from 200 to 600 feet, and production is 600 to 1,400 gallons per minute. Although all the water is of poor quality, wells that are 200 to about 300 feet deep produce a better quality water than the deeper wells. In some areas where the soils are suitable for irrigation, the available water is of such poor quality that it would harm the crops and the soil. The harmful salts in the water of the survey area are sodium chloride, sodium sulfate, magnesium sulfate, and sodium bicarbonate. Other salts contained in the water are calcium sulfate, calcium carbonate, and magnesium carbonate.

Both furrow and sprinkler irrigation are used in the survey area. Furrow irrigation requires nearly level soils, and land leveling may be necessary before this type system can be used. This system is most often used on the nearly level, fine and medium textured soils in the survey area. Sprinkler irrigation is satisfactory on most soils, but is mainly used on the more sloping and sandier soils.

Yields produced under irrigation can be expected to be higher than those obtained by dryland farming. More information on irrigation can be obtained from the representatives of the Soil Conservation Service who serve the San Patricio and Copano Bay Soil and Water Conservation Districts.

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 6. 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. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 6.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; 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 residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils 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 6 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small or data is lacking. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. Two of these levels are defined in the following paragraphs. A survey area may not have soils of all classes.

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. (There are no Class I soils in the survey area)

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

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

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

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

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

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

The acreage of soils in each capability class and subclass is indicated in table 7. All soils in the survey area except those named at a level higher than the series are included. Some of the soils that are well suited to crops and pasture are now in range or other low-intensity use, for example, soils in capability classes II and III. Data in this table can be used to determine the farming potential of such soils.

The capability subclass is identified in the description of each map unit in the section "Soil maps for detailed planning."

Range

Stanley T. Reinke and Les Ethetton, range conservationists, Soil Conservation Service, assisted in preparing this section.

About 35 percent of the land area of San Patricio and Aransas Counties, or 214,000 acres, is in native vegetation and is used as range. There are a number of large ranches and some smaller ones. Some livestock farms also use small areas of native vegetation for forage. On these farms, the stock receive supplemental forage from feed grown on cropland and from grazing pasture. The livestock consists almost exclusively of cattle with predominantly cow-calf operations. Some horses are raised for ranch work. In favorable years a few stocker type animals are raised.

The original plant cover in San Patricio and Aransas Counties consisted primarily of mid and tall grasses and forbs. Continuous heavy grazing for many years resulted in deterioration of the climax plant community and a lower total forage production. Many of the better forage plants have declined and have been replaced by less palatable grasses, weeds, and brush.

Forage production is highest in April, May, and June. In most years this is the period when the rainfall is adequate and the temperature most favorable. Another growth period occurs in the fall, usually during September, October, and early November. Rainfall is usually good during this period, but production is limited as a result of cooler temperatures and shorter days.

Three different types of range are in the survey area. The sandy soils near the coast produce tall grasses, sedges, and salt-tolerant plants. The saline soils of coastal lowlands generally grow cordgrass and are most useful for winter grazing. The more elevated soils further inland produce a prairie of tall and mid grasses, mainly big and little bluestem, switchgrass, and indiangrass. This vegetation has been modified by past grazing and cultivation.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 8 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community. Soils not listed cannot support a natural plant community of predominately grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. The following are explanations of column headings in table 8.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture 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.

Total production refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic species of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Engineering

G. P. Johnson, Jr., civil engineer, Soil Conservation Service, assisted in preparing this section.

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 9 shows, for each kind of soil, the degree and kind of limitations for building site development; table 10, for sanitary facilities; and table 12, for water management. Table 11 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

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

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 9. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 9 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Slope is also an important consideration in the choice of sites for these structures and was considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 9 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, and shrink-swell potential are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, and depth to very compact layers affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 10 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability as cover for landfill is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, and susceptibility to flooding. Stones, boulders, and shallowness to a cemented pan interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or cemented pan is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material.

Aerobic lagoons generally are designed to hold 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. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 10 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 11 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 16 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 11 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 16.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 12 the degree of soil limitation and soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Soil and site limitations are expressed as slight, moderate, and severe. *Slight* means that the soil properties and site features are generally favorable for the specified use and that any limitation is minor and easily overcome. *Moderate* means that some soil properties or site features are unfavorable for the specified use but can be overcome or modified by special planning and design. *Severe* means that the soil properties and site features are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Town and country planning

In San Patricio and Aransas Counties, industrialization and a greater influx of seasonal residents have made more people aware of how soils and soil conditions directly affect their health and life style. This is especially true in the rural-urban fringe areas where people are building homes to enjoy the pleasures of country living with the conveniences of city life.

The extension of public utilities into residential subdivisions has brought out the need for soils information for other than agricultural purposes. Individuals who are outside the limits of public utilities need soils information in order to use their limited tracts to the best advantage. This is especially true for recreational facilities used intensively during the vacation season.

City planners, builders, land appraisers, realtors, land developers, and individuals need soil information to help select sites for specific uses. Soil properties important to town and country planning are also important to engineering. The sections "Engineering" and "Engineering Properties and Classification" should be referred to for tables and explanations of soil interpretations and properties. The information in the engineering sections does not eliminate the need for onsite study and investigation of the soils. Some tracts have areas of contrasting soils too small to be shown separately on the soil map, but which would affect the use of the tract.

This section briefly discusses the importance of site selection, soils with potential problems for building foundations, considerations for sewage disposal systems, soils that have potential to corrode underground utility lines, control of erosion and runoff, the influence of soils on health, and landscaping and gardening.

Site selection

In selecting a site for the construction of houses, businesses, and other urban works and structures, the site should be carefully studied and the soils thoroughly investigated. If either is poorly suited for the intended use, construction may not be feasible. In some cases, structures can be designed to overcome the limitations of the soil, but the difficulty must be recognized before construction begins in order to effectively combat the problem. Also, in some cases the expense of changing the site may be prohibitive.

One of the first considerations is whether the soil is subject to flooding by fresh water or salt water or both. In San Patricio and Aransas Counties, the Aransas, Odem, and Sinton soils are subject to frequent or occasional flooding by fresh water. Aransas clay, saline, is subject to flooding by both fresh water and salt water. The Barrada, Dianola, Ijam, Mustang, Narta, and Tatton soils and Beaches are subject to occasional or frequent flooding by salt water. These soils are poorly suited as sites for permanent structures. They are better suited for parks, recreational areas, wildlife habitat, outdoor study areas, green belts, or sound barriers.

Some of the soils in the survey area have a permanent or seasonal high water table. See table 18 for soil and water features.

Other factors affecting site selection are soil permeability, available water capacity, drainage, soil reaction (pH), shrink-swell properties, corrosivity to uncoated steel and concrete, hydrologic classification, suitability for building foundations, and cost of streets and roads. Erosion, runoff and drainage problems, suitability for growing plants, and the influence of the soil on the overall general health of residents are also important considerations. The sections on engineering and recreation give many of these soil properties, features, and interpretations.

Foundations

The soils of San Patricio and Aransas Counties should be closely inspected when considered as sites for building foundations. Some of the clayey soils have a high content of the clay mineral montmorillonite, which causes them to swell or expand when wet and shrink and crack when dry. The stress and pressure brought to bear by this action causes walls and foundations to crack unless specially designed and reinforced. Sometimes such extreme pressures build up that cracks occur in spite of reinforcement. This change in soil volume is referred to as "shrink-swell potential" in table 17.

Soils likely to shrink and swell enough to cause damage are those that have a high liquid limit and high plasticity index or those classified CH in the Unified System of Classification. See table 16 for estimated engineering properties and classifications, table 19 for engineering test data, and table 9 for a rating of the soils for construction sites.

The soils most likely to damage foundations are the Aransas, Barrada, Edroy, Ijam, Monteola, Raymondville, Victine, and Victoria soils. Soils that have the potential to cause damage because of shrink-swell properties in lower layers are the Delfina, Dietrich, Leming, Narta, Nueces, Orelia, Papalote, and Sarita soils.

The suitability of a soil for foundations is also affected by flooding, drainage, soil strength, and corrosivity.

Sewage disposal systems

Rapid expansion has placed some individuals, businesses, and residential areas beyond the limits of existing municipal sewage lines; others are outside these limits by choice. In any case, these areas must have onsite sewage disposal systems, the proper operation and effectiveness of which depend on a number of soil-related factors. Some of the things to consider when installing a sewage disposal system are soil texture and depth, the underlying material, slope, flood hazard, ground-water level, and drainage. These factors, in turn, affect the absorptive capacity, permeability, percolation rate, wetness, and seepage of the soils in the absorption field. Nearness to wells and streams or other bodies of water must be taken into account before installation can begin.

The soils of San Patricio and Aransas Counties are, in general, severely limited as sites for septic tank absorption fields. Some soils are clay and very slowly permeable, others have a permanent high water table, some soils are poorly drained and remain wet for extended periods, while still others are shallow and have an impervious lower layer.

Table 10 rates the soils of San Patricio and Aransas Counties for sanitary facilities. Careful onsite study of the soils should be made, however, to help insure proper functioning and guard against health hazards.

Underground utilities

Water, gas, and sewer pipelines and electrical and telephone cables buried in the ground are subject to corrosion and, in high shrink-swell soils, breaking if not protected against certain inherent properties in soils.

All metals corrode to some extent when buried in the soil. Some metals corrode more rapidly than others, some soils have higher corrosive action than others, and some metals corrode more rapidly in a particular soil than in others. Corrosivity depends on the physical, chemical, electrical, and biological characteristics of the soil. Some of the factors that contribute to soil corrosivity are oxygen content, concentrations of anaerobic bacteria, moisture content, and alkalinity or acidity. Some nonsoil factors, such as manmade electric currents, type of material used, and design and construction of a project also have some influence on the corrosivity. On occasion corrosion is intensified by connecting two different metals, burying metal structures at varying depths, or extending metal structures through different kinds of soils.

Electrical resistivity is only one factor in corrosion, but measurement of that property provides a way to classify the corrosivity of a soil. Electrical resistivity is the measure of the resistance to the flow of an electrical current by a soil when it is wet to field capacity. Measurement is in ohms per cubic centimeter, and a low value indicates low resistivity or high conductivity and a high corrosion potential. Table 18 rates the soils in the survey area as to corrosive potential for uncoated steel and concrete.

Soils that have a high shrink-swell potential create pressures by expansion and contraction that can break or rupture utility pipelines. Packing larger lines in sand or other material that does not shrink and swell and using flexible material for smaller lines helps prevent or at least reduce costly breakage repairs. Table 17 gives the estimated shrink-swell potential of the soils in the survey area.

Control of erosion and runoff

During construction, whether for a large residential or urban development area or an individual, the natural vegetation is generally removed from large areas and replaced by pavement, concrete, and buildings. Removal of vegetation causes changes in runoff patterns. Runoff generally increases in amount and concentrates in streets and gutters, causing erosion in the higher areas and flooding and sedimentation in low lying areas. Refer to table 12 for soil limitations and features affecting water management.

Control of erosion and runoff should be a part of the development plan, and as such the problems and losses brought on by soil erosion, runoff, sedimentation, and flooding can usually be avoided, or at least controlled to a great extent.

Two kinds of control are available to combat erosion, runoff, and sedimentation—mechanical and vegetative.

Some of the mechanical measures that can be used on large projects or by individuals on small tracts include the following:

1. Land grading—Clear only those areas that are going to be used immediately. Grade and smooth the surface so that it is level or gently sloping. Topsoil should be removed and stockpiled so that it can be replaced on the graded surface.
2. Contouring—Locate and construct driveways, sidewalks, fences, retaining walls, and bench terraces on the contour to break long slopes and slow the flow of runoff. If this is not feasible, build straight across the slope.
3. Diversions—Construct across the slope to intercept and divert runoff from flowing across erodible areas. The diversions should be protected with grass.
4. Outlets and Waterways—Construct to prevent erosion and gullying. These areas should be shaped and smoothed, and sod should be established.
5. Drainage—Seep spots, waterlogged areas, and ponded areas should be drained. Large areas can be drained with ditches; small areas may be filled with topsoil. In some places a ditch may not be feasible, or it may be necessary to fill the existing natural drainage channel. In these cases the installation of subsurface tiles or drains helps remove excess ground water.
6. Storm sewers and lined channels—Where large amounts of water are concentrated or where slopes are too steep or soils too unstable for control with vegetation alone, these measures should be employed.
7. Sediment basins—These structures should be a part of every drainage system. Permanent sediment basins in storm sewers and lined channels trap sediment and prevent clogging and downstream damage and allow the sodded portions of the waterway to become established well enough to function properly.

Some of the vegetative measures that can be used include the following:

1. Mulches.—Small grain straw, hay, or other such litter, and commercially processed materials can be used to protect slopes and other critical areas until they can be seeded or sodded to permanent vegetation. Mulches need to be anchored by asphalt or netting or other methods to effectively protect the soil. When the time is favorable, seeding or sodding can be done without removing the mulch. Hydromulching, in which seed, fertilizer, and mulch are applied as a slurry, is a fast operation that requires little labor.

2. Temporary cover.—Fast-growing plants, such as annual ryegrass or small grain, can be used where a quick cover for a short time is desired.

3. Permanent cover.—Adapted grasses, legumes, trees, shrubs, and vines make good permanent ground cover. Most grasses and legumes require maintenance, such as weeding, fertilization, and mowing.

Care should be taken in planning, designing, and installing measures to control erosion and runoff. They should fit into the surroundings as unobtrusively as possible without impairing efficient function.

Public health

Soils affect public health in a number of ways. Their use in sanitation facilities, such as sewage absorption fields and sanitary landfills, is directly related to health, and some soils are best known as a place for breeding and incubation of disease-carrying insects. Soils are vital to the production of food, fiber, and building materials, and they are the sites upon which shelters are built.

Sanitary landfills.—In selecting a site for a sanitary landfill a number of things need to be taken into consideration. Among these are topography, drainage, and soils of the prospective site. The characteristics of the soil that should be investigated include texture, permeability, reaction, and nature of the underlying material. Table 10 rates the soils of the survey area for sanitary landfills. Since ratings apply only to a depth of 5 or 6 feet and excavations for sanitary landfills are generally more than 6 feet deep, onsite investigation is also required.

Disease carrying insects.—Insects of all kinds, some of them disease carriers, breed and incubate in the soil or in some other medium supported by the soil. The most significant of these is the mosquito because it is almost universal. Mosquitoes breed in stagnant water. By use of the soil map and soil descriptions, it is possible to identify areas subject to flooding and areas likely to be ponded due to topography or poor drainage. These potential trouble spots can be corrected or controlled either through chemical or mechanical means.

Food, fiber, and building materials.—Proper diet, clothing, and shelter are important to good health. All of these are derived from the soil.

Shelter.—Adequate housing is important to the protection of good health. Homes and businesses should not be built where there is danger of flooding or ponding of surface runoff.

Using the soil for the purpose to which it is best suited is an important consideration in the selection, planning, and design of any residential or urban expansion project or homesite. Those areas not suited to the production of crops may be ideal sites for residential or urban areas and homes.

Landscaping and gardening

D. P. Pawlik, county extension agent and Joe Benson, nurseryman assisted in preparing this section.

Homeowners landscape to make their homes as attractive and pleasant as possible. They need information on the grasses, flowers, shrubs, vines, and trees best adapted to their soil types and conditions. In some areas plants may be needed to control runoff and erosion as well as for beautification.

Soils well suited to yard and garden plants are those that have a deep root zone, a loamy texture, a balanced supply of plant nutrients, plenty of organic matter in various stages of decomposition, adequate available water capacity, and structure that allows for free movement of air, water, and roots. The degree of alkalinity or acidity (pH) is also important. Some plants, such as roses, most grasses, vegetables, and annual flowers, grow best in soils that are neutral or slightly acid; while gardenias, azaleas, camellias, and similar plants do best in acid soils. Some plants grown on soils high in lime, such as Pharr and Pettus soils, develop chlorosis, which is a yellowing of the leaves; nevertheless, many plants are well suited to alkaline soils. Some of these are petunia, gladiolus, crapemyrtle, and pecan.

Table 13 gives some of the flowers, vines, shrubs, trees, and vegetables that are suited to the soils and climate of the survey area. Some of the plants listed are native to the survey area. For more information on other plants suitable for survey area soils consult your county extension agent or local nurseryman.

The soils of San Patricio and Aransas Counties differ, some of them considerably, in their suitability for growing landscape and garden plants. The soils range from clay to sand in texture, from very poorly drained to excessively drained, from very slowly permeable to rapidly permeable, from slightly acid to strongly alkaline, from extremely saline to nonsaline, and from granular structure to massive or single grained. They also have different levels of fertility and organic matter. Refer to the section "Soil maps for detailed planning" to determine the suitability of soils for specific plants and for information on soil texture, drainage, permeability, and other characteristics. Table 17 shows soil reaction (pH), permeability, and available water capacity.

It is generally cheaper and easier to condition the native soil than to replace it with manmade soil material or soil from another location. A soil test should first be obtained to determine deficiencies so that amendments can be incorporated into the soil. The most important soil amendment is organic matter. This may be cotton burs, peat moss, compost, or manure. At least 2 inches of organic matter should be added to the soil. For clayey soils, also add at least 2 inches of sand, vermiculite, or other such material. In addition, broadcast the required fertilizer as determined by the soil test. All of this material should be mixed thoroughly into the top 6 to 8 inches of native soil. If an acid soil is desired, sulfur may be used. If it is too strongly acid, bonemeal, lime, or wood ashes may be used to neutralize the acidity.

In some parts of the survey area the soils are so saline, so clayey, or so poorly drained that it may be necessary to construct raised beds in order to grow flowers and some shrubs. Beds should be filled with good soil material and required amendments added to produce the desired effect.

Good management and careful maintenance are required, especially during the period of plant establishment. These include fertilization, watering, weed control, and insect control.

The potential of the soil for landscaping and gardening should be a prime consideration when selecting sites for residential or urban expansion and construction. Care and protection of the existing vegetation during construction saves time and money during landscaping, and this vegetation often proves to be an irreplaceable asset.

Recreation

People who live in cities are turning to outdoor activities for recreation in ever increasing numbers. Since the survey area has medium to high potential for the development of various recreational enterprises, land within easy driving distance of heavily populated areas affords the opportunity for a new and potentially profitable undertaking.

The nature of the soils affects the suitability of an area for recreational purposes. The development of facilities for camping, picnicking, fishing, paths and trails, hunting, playgrounds, and golfing requires, for best results, different soil conditions.

The soils of the survey area are rated in table 14 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the 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 14 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 10, and interpretations for dwellings without basements and for local roads and streets, given in table 9.

Camp areas require such site preparation as shaping and leveling for 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 for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will 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 or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

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

Wildlife habitat

James Henson, biologist, Soil Conservation Service, and Frank Johnson, manager, Aransas National Wildlife Refuge, U.S. Fish and Wildlife Service, helped in preparing this section.

San Patricio and Aransas Counties have some of the most unusual varieties of wildlife in Texas. The soils in these counties support two broad categories of wildlife habitat, wetland and upland.

The wetland areas, which include tidal marshes and estuaries, provide habitat for various species of waterfowl, shorebirds, wading birds, gulls, terns, rails, cranes, reptiles, and amphibians.

The upland areas afford habitat for various species of openland and rangeland wildlife. Several species of mammals inhabit these areas, including white-tailed deer (fig. 15), javalina, raccoon, oppossum, rabbit, skunk, armadillo, nutria, bobcat, wild boar, and numerous species of rodents and reptiles. There are also many species of birds, for example, bobwhite quail, mourning dove, wild turkey, blue jay, horned lark, vermillion flycatcher, and western kingbird. Also present are numerous species of hawks, owls, woodpeckers, flycatchers, swallows, thrashers, thrushes, warblers, buntings, and sparrows.

The Aransas National Wildlife Refuge is located in the northeast part of the survey area. This refuge is the winter home of the whooping crane, and it provides habitat for other endangered or threatened species such as the brown pelican, southern bald eagle, American peregrine falcon, Atwater's prairie chicken, the American alligator, and the reddish egret. The major soils on the refuge are the Galveston, Mustang, Narta, Victine, and Dianola soils.

The plant and animal life of the refuge makes it a major tourist attraction. Every year about 100,00 visitors come to the refuge to view the plant, animal, and bird life; study nature; and observe wildlife management in the area (fig. 16).

The Welder Wildlife Refuge is located in the north-central part of the survey area, near the town of Sinton. The soils on this refuge support several unique plant communities. These plant communities are habitat for a large variety of birds, mammals, reptiles, and amphibians. The research facilities at the refuge have attracted scholars from all over the world.

In addition to the two large refuges, there are a number of small bird and wildlife sanctuaries located in the area, especially along the coast.

The soils in San Patricio and Aransas Counties support unique plant life which provides habitat for a wide variety of wildlife. These wildlife resources are of great importance to the overall economy of San Patricio and Aransas Counties.

In table 15, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and 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* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

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

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, oats, rye, and millet.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are kleingrass, blue panicum, johnsongrass, clover, and vetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, panicum, aster, ragweed, croton, and partridgepea.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are guajillo, blackbrush, condalia, live oak, and mesquite.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, and cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, cottontail rabbit, and coyote.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, kingfishers, and nutria.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include white-tailed deer, javelina, quail, songbirds, coyote, and bobcat.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features, engineering test data, and data obtained from laboratory analyses of soils.

Engineering properties

Table 16 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 16 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 16 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 soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 19. The estimated classification, without group index numbers, is given in table 16.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 17 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity 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 the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 17. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Soil and water features

Table 18 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. 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 that have a layer that impedes the downward movement of water or soils that have 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 clay soils 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 is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding; and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 18 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Engineering test data

Table 19 contains the results of engineering tests performed by the Texas Highway Department on some of the soils in San Patricio and Aransas Counties. The table shows the specific location where samples were taken, the depth to which sampling was done, and the results of tests to determine particle-size distribution and other properties significant in soil engineering.

As moisture is removed, the soil shrinks and decreases in volume in direct proportion to the loss in moisture until a condition of equilibrium, called the *shrinkage limit,* is reached. At this point shrinkage stops, although additional moisture is removed. Shrinkage limit is reported as the percentage of moisture in ovendry soil.

Shrinkage ratio is the volume change that results from the drying of soil material divided by the moisture loss caused by drying. It is expressed numerically.

Lineal shrinkage is the decrease in one dimension of the soil mass that occurs when the moisture content is reduced from the liquid limit to the shrinkage limit. It is expressed as a percentage of the original dimension.

Mechanical analysis shows the percentages, by weight, of soil particles that pass sieves of specified sizes. Sand and other coarser materials do not pass the No. 200 sieve, as do the finer silt and clay particles.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from solid to plastic. If the moisture content is further increased, the material changes from plastic to liquid. The plastic limit is the moisture content at which the soil material passes from solid to plastic. The liquid limit is the moisture content at which the material changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Classification of the soils in the *AASHTO* and *Unified* systems of classification is based on data obtained by mechanical analyses and by test to determine liquid limits and plastic limits.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*12*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 20, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to 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 expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Ochraqualfs (*Ochr*, meaning a surface horizon that is light in color, plus *aqualf*, the suborder of Alfisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceeding the name of the great group. The adjective *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Ochraqualfs.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, hyperthermic, Typic Ochraqualfs. Orelia fine sandy loam is a member of this family.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition. An example is the Orelia series, which consists of Orelia fine sandy loam and Orelia sandy clay loam.

Soil series and morphology

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

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*11*). Unless otherwise noted, colors described are for dry soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Aransas series

The Aransas series consists of nearly level clayey soils that formed in calcareous clayey alluvium. These soils are on coastal and inland flood plains. Slopes range from 0 to 1 percent.

Typical pedon of Aransas clay, saline; from the intersection of U.S. Highways 181 and 77 on the east side of Sinton, 7.4 miles northeast on U.S. Highway 77 to the Welder Wildlife Refuge, 6.5 miles east of Refuge headquarters on private road to Yegua tank, and 200 feet south of the Yegua Tank in the Mare Pasture, in range:

A11—0 to 1 inch; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine and very fine granular structure; hard, firm, plastic and sticky; many fine roots; many fine pores; few worm casts; contains about 5 percent by volume of partially decomposed organic residue; moderately saline; calcareous; moderately alkaline; clear smooth boundary.

A12—1 inch to 22 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium and fine subangular and angular blocky structure; very hard, very firm, plastic and sticky; cracks about 1 inch wide extend through lower boundary; common fine roots; common fine pores; common very fine threads and very fine bodies of calcium carbonate; moderately saline; calcareous; moderately alkaline; gradual wavy boundary.

A13—22 to 40 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium and fine angular blocky structure; extremely hard, extremely firm, plastic and sticky; few fine roots; few very fine pores; few weak slickensides that do not intersect; few fine concretions of calcium carbonate; few fine weakly cemented black concretions in lower part; moderately saline; calcareous; moderately alkaline; gradual wavy boundary.

C—40 to 66 inches; gray (N 5/0) clay, dark gray (N 4/0) moist; massive; extremely hard, very firm, plastic and sticky; few very fine pores; few fine concretions of calcium carbonate; few fine weakly cemented black concretions; few crystals of salt; strongly saline; calcareous; moderately alkaline.

Thickness of the solum ranges from 35 to 50 inches. Reaction is moderately alkaline or strongly alkaline. The soil is moderately saline or strongly saline.

The A horizon is dark gray, very dark gray, or black. The C horizon contains a few calcium carbonate concretions 0.5 cm to 1.0 cm in diameter. Color of the C horizon is gray or dark gray.

Barrada series

The Barrada series consists of nearly level, clayey soils that formed in saline, clayey marine sediments. These soils are on coastal lowlands that are subject to flooding by sea water during daily high tide. Slopes range from 0 to 1 percent.

Typical pedon of Barrada clay in an area of Barrada-Tatton association; from the north end of the Copano Bay Causeway, 5.5 miles north on Texas Highway 35, 2.0 miles east on private road to St. Charles Bay, 0.4 mile northwest on St. Charles Bay beach road, and 50 feet north in tidal flat:

C1—0 to 4 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; massive; very plastic and very sticky; extremely saline; calcareous; strongly alkaline; abrupt smooth boundary.

C2—4 to 20 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; common fine and medium distinct brownish yellow (10YR 6/6) and gray (5Y 5/1) mottles; massive; saturated soil flows somewhat easily between fingers when squeezed; very sticky; extremely saline; calcareous; strongly alkaline; diffuse smooth boundary.

C3—20 to 36 inches; light gray (2.5Y 7/2) silty clay, light brownish gray (2.5Y 6/2) moist; common fine and medium distinct brownish yellow (10YR 6/6) and gray (5Y 5/1) mottles; massive; saturated soil flows between fingers somewhat easily when squeezed; very sticky; few very firm gray clay balls; extremely saline; calcareous; strongly alkaline; diffuse smooth boundary.

C4—36 to 60 inches; light gray (2.5Y 7/2) silty clay, light brownish gray (2.5Y 6/2) moist; common fine and medium yellowish brown (10YR 5/6) and gray (5Y 5/1) mottles; massive; very firm, plastic and sticky; few firm brown clay balls 1 to 3 cm across; extremely saline; calcareous; strongly alkaline.

Thickness of the soil to loamy material is 36 to more than 50 inches. The soil is extremely saline, calcareous, and strongly or very strongly alkaline.

The C1, C2, and C3 horizons are clay or silty clay; the C4 is silty clay, silty clay loam, or loam. In some pedons all horizons contain thin lenses of fine sand and fine sandy loam. Color of all horizons is light brownish gray, light gray, grayish brown, or gray, and they have common to many mottles in shades of gray, brown, and yellow.

Comitas series

The Comitas series consists of nearly level to gently sloping, sandy soils that formed in sandy and loamy sediments. They are on terraces along major streams and their tributaries. Slopes range from 0 to 5 percent.

Typical pedon of Comitas loamy fine sand; from San Patricio, 1.25 miles north on Farm Road 666 and 150 feet west, in pasture:

Ap—0 to 8 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; single grained; slightly hard, very friable; common fine and medium roots; few snail shells and snail shell fragments; neutral; abrupt smooth boundary.

A1—8 to 28 inches; brown (10YR 4/3) loamy fine sand, dark brown (10YR 3/3) moist; single grained; slightly hard, very friable; common fine and medium roots; few snail shell fragments; neutral; clear smooth boundary.

B21t—28 to 36 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; few fine roots; few snail shell fragments; thin patchy clay films on surfaces of prisms; mildly alkaline; gradual smooth boundary.

B22t—36 to 55 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; few fine roots; few thin patchy clay films on surfaces of prisms; moderately alkaline; gradual smooth boundary.

B3—55 to 80 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine concretions and soft bodies of calcium carbonate; calcareous; moderately alkaline.

Thickness of the solum ranges from 55 to 90 inches. Depth to accumulated calcium carbonate is about 40 inches to more than 60 inches.

The A horizon is brown, grayish brown, or dark grayish brown. It is slightly acid or neutral. The B horizon is fine sandy loam or sandy clay loam that is less than 24 percent clay. It is brown, light brown, pale brown, or dark grayish brown. It is slightly acid through mildly alkaline in the upper part; the lower part is moderately alkaline.

Delfina series

The Delfina series consists of nearly level to gently sloping, sandy soils that formed in loamy sediments. The Delfina soils are on uplands and stream terraces. Slopes range from 0 to 3 percent.

Typical pedon of Delfina loamy fine sand; from San Patricio, 6.0 miles north on Farm Road 666 and 200 feet east, in pasture:

A1—0 to 14 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; single grained; loose; common fine roots; slightly acid; abrupt wavy boundary.

B21t—14 to 17 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; few fine and medium distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; moderate fine and medium blocky structure; extremely hard, firm; few fine roots; clay films on faces of peds; few fine black concretions; slightly acid; gradual wavy boundary.

B22t—17 to 30 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; common fine and medium distinct yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), and yellowish red (5YR 5/6) mottles; moderate fine and medium blocky structure; extremely hard, firm; clay films on faces of peds; few fine black concretions; neutral; gradual wavy boundary.

B23t—30 to 40 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; few fine faint brownish yellow mottles; weak fine and medium subangular blocky and blocky structure; very hard, friable; patchy clay films on faces of peds; few fine black concretions; neutral; clear wavy boundary.

B24tca—40 to 60 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; weak fine subangular blocky structure; hard, friable; about 3 to 5 percent concretions and soft bodies of calcium carbonate; calcareous; moderately alkaline.

Thickness of the solum ranges from 60 to 90 inches. Depth to an horizon containing accumulations of calcium carbonate ranges from 36 to 50 inches.

The A horizon is grayish brown, dark grayish brown, or brown. It is slightly acid through mildly alkaline. The B horizon is sandy clay loam or clay loam that is slightly acid through moderately alkaline. The Bt horizon is grayish brown, brown, or yellowish brown mottled in shades of red, yellow, gray, or brown. The Btca horizon is light brownish gray, brownish yellow, or pink sandy clay loam or fine sandy loam. It is mildly alkaline or moderately alkaline.

Dianola series

The Dianola series consists of nearly level, sandy soils that formed in sandy, saline, marine sediments. The Dianola soils are on coastal lowlands. Slopes range from 0 to 1 percent.

Typical pedon of Dianola loamy sand, in an area of Dianola soils; from the boathouse on Isla de San Jose, 0.25 mile north along the beach and 100 feet east, in range:

A1g—0 to 6 inches; gray (10YR 6/1) loamy sand, dark gray (10YR 4/1) moist; single grained; loose, very friable; many fine and medium roots; extremely saline; moderately alkaline; clear smooth boundary.

C1g—6 to 15 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; few fine faint yellowish brown mottles; single grained; loose, very friable; common fine roots; extremely saline; moderately alkaline; gradual smooth boundary.

C2g—15 to 35 inches; light gray (10YR 7/2) loamy sand, light brownish gray (10YR 6/2) moist; few fine faint yellowish brown mottles and streaks; single grained; loose, very friable; extremely saline; moderately alkaline; clear smooth boundary.

C3g—35 to 60 inches; light gray (10YR 7/2) loamy sand, grayish brown (10YR 5/2) moist; few fine distinct yellow mottles and streaks; single grained; loose, very friable; extremely saline; moderately alkaline.

Thickness of the sandy soil material is more than 60 inches. It is moderately alkaline or strongly alkaline.

The A horizon is gray, light brownish gray, or light gray. Texture of the Cg horizon is loamy sand, fine sand, or sand. It is light brownish gray, gray, light gray, or white.

Dietrich series

The Dietrich series consists of nearly level, sandy soils that formed in loamy, saline, marine sediments. These soils are on coastal terraces. Slopes range from 0 to 1 percent.

Typical pedon of Dietrich fine sand; from the intersection of Farm Roads 1781 and 3036, which is 2.8 miles north of Rockport, 0.75 mile north on Farm Road 1781 and 100 feet west, in range:

A1—0 to 9 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grained; hard, very friable; common fine and medium roots; neutral; clear wavy boundary.

A2—9 to 12 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grained; slightly hard, very friable; few fine and medium roots; neutral; abrupt wavy boundary.

B21tg—12 to 18 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; common fine and medium distinct red, yellow, and gray mottles; moderate coarse columnar structure parting to moderate fine and medium blocky; thin caps of fine sandy loam on columns; very hard, very firm, plastic and sticky; few roots between peds; surfaces of peds partially coated with thin very dark gray (10YR 3/1) clay films; mildly alkaline; clear wavy boundary.

B22tg—18 to 30 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; few fine and medium distinct red, yellow, and gray mottles; moderate medium and coarse angular blocky structure; very hard, very firm, plastic and sticky; peds partially coated with thin dark gray (10YR 4/1) clay films; few fine white powdery salt crystals; slightly saline; moderately alkaline; gradual smooth boundary.

B3—30 to 45 inches; light gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; few fine and medium distinct yellow and brown mottles; weak coarse blocky structure; very hard, firm; few thin patches of clay films on surfaces of peds; few streaks of gray sandy material; few fine black concretions; slightly saline; moderately alkaline; gradual smooth boundary.

C—45 to 72 inches; light gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; few fine distinct yellow and brown mottles; massive; very hard, firm; few fine black concretions; few fine and medium concretions of calcium carbonate; moderately saline; calcareous; moderately alkaline.

Thickness of the solum ranges from 34 to 60 inches. The soil is nonsaline through moderately saline. Many pedons contain a few threads of salt crystals.

The A horizon is slightly acid or neutral. Color of the A1 horizon is grayish brown, light brownish gray, or gray. Where there is an A2 horizon, it is light gray or light brownish gray. The B horizon is clay loam, loam, or sandy clay loam. It is dark grayish brown, grayish brown, light brownish gray, light gray, or gray. Mottles range from few to many, fine to medium and distinct in shades of red, yellow, brown, and gray. Clay films and organic coatings on faces of peds are very dark gray, dark gray, gray, or black. Reaction is mildly alkaline or moderately alkaline. The C horizon is loam or sandy clay loam. It is light brownish gray or light gray. Some pedons contain up to 3 percent by volume calcium carbonate in the form of nodular concretions or soft bodies.

Edroy series

The Edroy series consists of nearly level, clayey soils that formed in clayey sediments over sandy or loamy materials. The Edroy soils are on uplands. Some areas are slightly depressional. Slopes range from 0 to 1 percent.

Typical pedon of Edroy clay; from the intersection of U.S. Highways 181 and 77 on the east side of Sinton, 7.4 miles northeast on U.S. Highway 77 to the Welder Wildlife Refuge, 5.5 miles southeast of headquarters on private road, 0.25 mile northeast of Conejo Windmill, and 150 feet north, in range:

A1—0 to 18 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak fine blocky structure; very hard, very firm, plastic and sticky; many fine roots in upper part; few brown root stains; few uncoated sand grains on surface crust; slightly acid; gradual wavy boundary.

B2g—18 to 42 inches; gray (10YR 6/1) clay, gray (10YR 5/1) moist; weak fine and medium blocky structure; very hard, very firm, plastic and sticky; few brown root stains; few fine concretions of calcium carbonate in lower 4 inches; slightly saline; moderately alkaline; gradual wavy boundary.

B3gca—42 to 50 inches; light gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; weak angular blocky structure; very hard, very firm, plastic and sticky; about 3 percent by volume concretions of calcium carbonate; few fine black concretions; slightly saline; calcareous; moderately alkaline; gradual wavy boundary.

Cg—50 to 60 inches; light gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; massive; very hard, very firm, plastic and sticky; few concretions of calcium carbonate; slightly saline; calcareous; moderately alkaline.

Thickness of the solum ranges from 40 to 70 inches. Texture of the control section between 10 and 40 inches is clay or clay loam.

The A horizon is dark gray or very dark gray, slightly acid or neutral, clay. The B2g horizon is clay, sandy clay, or clay loam that is mildly alkaline or moderately alkaline. It is gray, grayish brown, or light brownish gray. The B3g horizon is loam, clay loam, or sandy clay loam. It is calcareous or noncalcareous, moderately alkaline, and contains 2 to 5 percent by volume concretions and soft bodies of calcium carbonate. It is gray, light gray, or light brownish gray. The Cg horizon is clay loam or sandy clay loam. Some pedons have a IICg horizon that is fine sandy loam or loamy fine sand. The Cg or IICg horizon is calcareous or noncalcareous and contains few fine concretions of calcium carbonate. Reaction is moderately alkaline. The Cg or IICg horizon is gray, light gray, or white.

Falfurrias series

The Falfurrias series consists of nearly level to gently undulating, sandy soils that formed in deep eolian sands. These soils are on terraces along major streams and their tributaries, along the mainland coast line, and on uplands. Slopes range from 0 to 5 percent.

Typical pedon of Falfurrias fine sand, in an area of Falfurrias association; from the intersection of U.S. Highways 181 and 77 on the east side of Sinton, 7.4 miles northeast on U.S. Highway 77 to the Welder Wildlife Refuge, 1.5 miles east of Headquarters, 1.25 miles northeast of Lagarto Tank on private road, and 660 feet west of Pollito Lake Road intersection, in range:

A11—0 to 6 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; single grained; soft, very friable; many fine roots; contains organic matter in various stages of decomposition; neutral; clear smooth boundary.

A12—6 to 26 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grained; loose, very friable; few fine roots; neutral; diffuse smooth boundary.

C—26 to 80 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose, very friable; neutral.

Thickness of the soil is 80 to more than 100 inches. Reaction throughout the profile is slightly acid through moderately alkaline. The A horizon is fine sand or loamy fine sand. It is grayish brown, light brownish gray, brown, light brown, or pinkish gray. The C horizon is fine sand or loamy fine sand. It is light brownish gray, very pale brown, light yellowish brown, yellow, pink, or pale brown.

Galveston series

The Galveston series consists of nearly level to undulating, sandy soils on duned coastal plains and barrier islands. These soils formed in sandy sediments that have been reworked by wind and wave action. Slopes range from 0 to 8 percent.

Typical pedon of Galveston fine sand, in an area of Galveston association; from the headquarters of Aransas Wildlife Refuge, 4.0 miles south on main road, 0.3 mile west from intersection of Refuge roads, and 50 feet north, in range:

A1—0 to 4 inches; light gray (10YR 6/1) fine sand, gray (10YR 5/1) moist; single grained; loose; few fine roots; neutral; clear smooth boundary.

C1—4 to 42 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; few fine faint yellow streaks; single grained; loose; few fine roots; few shell fragments; mildly alkaline; diffuse smooth boundary.

C2—42 to 72 inches; white (10YR 8/2) fine sand, light gray (10YR 7/2) moist; few fine faint yellow mottles and streaks; single grained; loose; few fine roots; few shell fragments; mildly alkaline.

Depth to loamy strata is more than 72 inches and less than 140 inches in most pedons. A few marine shells and shell fragments occur throughout the soil.

The A horizon is fine sand, sand, or loamy fine sand. The control section between depths of 10 and 40 inches is fine sand or sand. Reaction is medium acid through mildly alkaline. Some pedons are slightly saline. Color of the soil is light brownish gray, light gray, very pale brown, or white.

The Galveston soils in this survey area are taxadjuncts to the Galveston series because they have a lower content of weatherable minerals than is defined as the range for the series. This difference has not affected the kind and amount of vegetation or the behavior and use of the soils.

Ijam series

The Ijam series consists of nearly level to gently sloping clayey soils that formed in calcareous, saline, clayey sediments dredged or pumped from the floor of bays and lagoons during the construction of canals and waterways. The Ijam soils are on slightly concave flats or mounds and ridges adjacent to coastal waterways, ditches, and canals. Slopes range from 0 to 5 percent.

Typical pedon of Ijam clay, in an area of Ijam soils; from the intersection of Texas Highway 35 and Farm Road 1069 north of Aransas Pass 1.5 miles north on Texas Highway 35 and 775 feet southeast, in range:

A1—0 to 6 inches; gray (10YR 6/1) clay, dark gray (10YR 4/1) moist; massive; extremely hard, very firm; few fine roots; salt crystal accumulation on surface; moderately saline; calcareous; moderately alkaline; gradual smooth boundary.

Cg—6 to 60 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; common fine and medium distinct yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles and streaks; massive; very firm, very plastic and sticky; few marine shell fragments; common threads and a few pockets of salt crystals; thin lenses of loamy fine sand and fine sandy loam; strongly saline; calcareous; moderately alkaline.

Pockets, lenses, or thin strata of sand or loamy sediments occur at depths of less than 50 inches. Reaction ranges from neutral through strongly alkaline throughout the soil.

The A horizon is clay, clay loam, or loam. It is light gray, gray, dark gray, or dark grayish brown. The Cg horizon is dark gray, gray, light brownish gray, or light olive gray.

Leming series

The Leming series consists of nearly level to gently sloping, sandy soils that formed in old alluvium that is interbedded with shale and weakly consolidated sandstone. The Leming soils are on uplands and stream terraces. Slopes range from 0 to 3 percent.

Typical pedon of Leming loamy fine sand; from the intersection of Texas Highway 359 and Farm Road 666 in Mathis, 5.5 miles south on Farm Road 666 and 50 feet west, in a cultivated field:

A1—0 to 24 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; single grained; loose, very friable; common fine roots; slightly acid; clear wavy boundary.

A2—24 to 28 inches; very pale brown (10YR 8/3) loamy fine sand, very pale brown (10YR 7/3) moist; few fine faint yellowish brown mottles in lower 2 inches; single grained; loose, very friable; common fine roots; slightly acid; abrupt wavy boundary.

B21t—28 to 32 inches; pale brown (10YR 6/3) sandy clay, brown (10YR 5/3) moist; few fine and medium faint gray (10YR 5/1) mottles, and common fine and medium distinct yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), and red (2.5YR 4/6) mottles; moderate medium columnar structure; extremely hard, very firm; few fine roots; few fine pores; thin clay films on surfaces of peds; slightly acid; clear wavy boundary.

B22t—32 to 40 inches; pale brown (10YR 6/3) sandy clay, brown (10YR 5/3) moist; common medium distinct brownish yellow (10YR 6/6) and red (2.5YR 4/6) mottles and a few fine distinct gray mottles; weak coarse blocky structure; extremely hard, very firm; few fine pores; few fine black concretions; thin clay films on surfaces of peds; mildly alkaline; gradual smooth boundary.

B23t—40 to 54 inches; light yellowish brown (10YR 6/4) sandy clay, yellowish brown (10YR 5/4) moist; common fine and medium distinct brownish yellow (10YR 6/6) and red (2.5YR 4/6) and a few fine faint gray mottles; weak medium blocky structure; extremely hard, very firm; organic stains and clay films on surfaces of peds; mildly alkaline; gradual smooth boundary.

C1ca—54 to 62 inches; light yellowish brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) moist; common fine and medium distinct brownish yellow (10YR 6/6), grayish brown (10YR 5/2), and red (2.5YR 4/6) mottles; massive; very hard, very firm; about 5 percent by volume soft bodies and concretions of calcium carbonate; moderately alkaline; gradual smooth boundary.

C2—62 to 72 inches; light yellowish brown (10YR 6/4) and light gray (10YR 7/1) sandy clay loam, yellowish brown (10YR 5/4) and gray (10YR 6/1) moist; common medium distinct brownish yellow (10YR 6/6) and red (2.5YR 4/6) mottles; massive; very hard, very firm; few fine concretions of calcium carbonate; moderately alkaline.

Thickness of the solum ranges from 40 to 72 inches.

The A horizon is slightly acid or neutral. The A1 horizon is grayish brown, light brownish gray, pale brown, or brown. In some pedons that have no A2 horizon, the A horizon is less than 25 inches thick. The A2 horizon is light brownish gray, pale brown, light gray, or very pale brown. The B2t horizon is clay, sandy clay, or clay loam. It is slightly acid through moderately alkaline. The C horizon is sandy clay, sandy clay loam, or clay loam. Some pedons have a Cca horizon that is 3 to 6 percent by volume concretions of calcium carbonate. Reaction is neutral through moderately alkaline. The matrix color of the Bt and C horizons is grayish brown, light brownish gray, light gray, very pale brown, pale brown, brown, yellowish brown, or light yellowish brown with mottles in shades of gray, red, yellow, and brown.

Monteola series

The Monteola series consists of gently sloping to sloping, clayey soils that formed in thick beds of clay and shaly clay sediments. The Monteola soils are on uplands that form the breaking point between the nearly level uplands and the lowland terraces and bottom lands along streams. Slopes range from 3 to 8 percent.

Typical pedon of Monteola clay, 3 to 5 percent slopes, at the center of a microdepression; from the intersection of U.S. Highways 181 and 77 on the east side of Sinton, 7.4 miles northeast on U.S. Highway 77 to the Welder Wildlife Refuge, 4.0 miles east of Refuge headquarters on private road, and 0.5 mile northwest of Paloma Tank, in range:

A1—0 to 16 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and very fine granular and subangular blocky structure; very hard, very firm, very plastic and sticky; many fine roots; common insect tunnels and worm casts; few thin parallelepipeds in lower portion; cracks 0.8 inch wide or more; few snail shells and fine shell fragments; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

AC—16 to 42 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; about 30 percent brown (10YR 5/3) streaks and splotches becoming lighter in color with increasing depth; moderate fine angular blocky structure; extremely hard, very firm, very plastic and sticky; distinct parallelepipeds tilted about 30 degrees from horizontal; common pressure faces; few grooved intersecting slickensides; old cracks filled with very dark gray soil; few fine shell fragments; few fine soft bodies of calcium carbonate; few gypsum crystals in lower part; calcareous; moderately alkaline; gradual wavy boundary.

C—42 to 74 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak very fine angular blocky structure; extremely hard, extremely firm; common pressure faces; few fine vertical cracks filled with very dark gray soil; few seams and pockets of gypsum crystals and other salts; about 5 percent fine concretions of calcium carbonate; slightly saline; calcareous; moderately alkaline.

Thickness of the solum ranges from 40 to 60 inches. The soil is moderately alkaline in the upper part and ranges from moderately alkaline to strongly alkaline in the lower part. The soil is nonsaline in the A horizon, increasing with depth to slightly saline in the C horizon.

The A horizon is thinnest on the microknolls and thickest in the microdepressions. It is dark gray or very dark gray. The AC horizon has gypsum crystals and concretions of calcium carbonate ranging from few to common. It is light brownish gray, grayish brown, dark grayish brown, pale brown, brown, light olive brown, or dark brown with streaks of gray to very dark gray. The C horizon is moderately alkaline or strongly alkaline. It is white, light gray, very pale brown, pale yellow, pale brown, pale olive, light brownish gray, light olive brown, or olive yellow.

Mustang series

The Mustang series consists of nearly level, sandy soils that formed in sandy sediments reworked by waves and wind. The Mustang soils are on low coastal plains. Slopes range from 0 to 1 percent.

Typical pedon of Mustang fine sand; from the Big House on Isla de San Jose, 2.75 miles south along the beach and 0.25 mile west of the beach behind active sand dune area:

A1—0 to 5 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose; many fine and medium roots; few fine shell fragments; moderately alkaline; gradual smooth boundary.

C1g—5 to 14 inches; white (10YR 8/2) fine sand, light brownish gray (10YR 6/2) moist; common fine and medium distinct yellowish brown (10YR 5/6) mottles and streaks along root channels; single grained; loose; common fine and medium roots; few fine shell fragments; moderately alkaline; gradual smooth boundary.

C2g—14 to 60 inches; white (10YR 8/2) fine sand, light gray (10YR 7/2) moist; few fine and medium distinct yellowish brown (10YR 5/6) mottles; single grained; loose; neutral.

Depth to thin loamy strata or layers of marine shells is 40 to more than 100 inches. Salinity varies depending on length of time since the last flooding by salt water. The soil is neutral through moderately alkaline. Most pedons contain few to common, fine to medium, brown or yellow mottles and streaks.

The A horizon is dark gray, dark grayish brown, light brownish gray, or light gray. The Cg horizon is sand or fine sand. It is gray, grayish brown, light gray, or white.

The Mustang soils in this survey area are taxadjuncts to the Mustang series because they have a lower content of weatherable minerals than is defined as the range for the Mustang series. Mineral studies in nearby areas to the north and south indicate a higher percentage of weatherable minerals. No changes in kind and amount of vegetation has been observed, and the lower content of weatherable minerals has not affected the behavior and use of the soils.

Narta series

The Narta series consists of nearly level, loamy soils that formed in clayey and loamy marine sediments. Narta soils are on low coastal plains. Slopes range from 0 to 1 percent.

Typical pedon of Narta fine sandy loam; from the north end of the Copano Bay Causeway, 5.7 miles north on Texas Highway 35, 1.7 miles west on private ranch road, 0.4 mile south to artesian well, and 0.6 mile southeast, in range:

A1—0 to 8 inches; gray (10YR 5/1) fine sandy loam, dark gray (10YR 4/1) moist; massive; hard, friable; moderately saline; moderately alkaline; abrupt smooth boundary.

B21tg—8 to 14 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak coarse columnar structure parting to moderate medium blocky; extremely hard, firm; many fine roots between peds; few fine pores; thin patchy clay films; white to gray coatings on upper surface of columns; few fine black concretions; extremely saline; moderately alkaline; clear smooth boundary.

B22tg—14 to 26 inches; gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) moist; moderate fine and medium blocky structure; extremely hard, firm; few fine roots between peds; few fine pores; patchy clay films; few thin seams of powdery salt crystals; few fine black concretions; extremely saline; moderately alkaline; gradual smooth boundary.

B3gca—26 to 36 inches; gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) moist; weak medium blocky and fine subangular blocky structure; extremely hard, firm; powdery salt crystal coatings on faces of peds; common fine and medium concretions and soft bodies of calcium carbonate; few fine black concretions; extremely saline; calcareous; strongly alkaline; gradual smooth boundary.

C1ca—36 to 46 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; massive; hard, firm; many fine concretions and soft bodies of calcium carbonate; common fine black concretions; extremely saline; calcareous; strongly alkaline; gradual smooth boundary.

C2ca—46 to 60 inches; light gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) moist; few fine yellow mottles; massive; hard, firm; few fine concretions and soft bodies of calcium carbonate; few fine black concretions; extremely saline; calcareous; strongly alkaline.

The soil is nonsaline or slightly saline in the A horizon and extremely saline in the B and C horizons (fig. 17).

The A horizon is neutral through moderately alkaline. It is dark gray, gray, grayish brown, or light brownish gray. The Bt horizon is silty clay, clay, or silty clay loam. It is mildly alkaline through strongly alkaline. It is very dark gray, very dark grayish brown, dark gray, dark grayish brown, or gray. The C horizon is clay loam, sandy clay, or clay. It is moderately alkaline or strongly alkaline. It is gray, light brownish gray, light gray, or white.

Nueces series

The Nueces series consists of nearly level to gently sloping, sandy soils that formed in sands and sandy clay loams of eolian origin. The Nueces soils are on terraces along rivers and creeks and on uplands. Slopes range from 0 to 5 percent.

Typical pedon of Nueces fine sand; from the intersection of U.S. Highways 181 and 77 on the east side of Sinton, 7.4 miles northeast on U.S. Highway 77 to the Welder Wildlife Refuge, 2.0 miles northeast of Refuge headquarters on main road, 2,000 feet northeast on Big Lake Road, and 700 feet east, in range:

A11—0 to 12 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; single grained; loose, very friable; many fine roots; neutral; gradual smooth boundary.

A12—12 to 24 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose, very friable; few fine and coarse roots; slightly acid; gradual smooth boundary.

A13—24 to 36 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose, very friable; neutral; abrupt wavy boundary.

B21t—36 to 43 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; many fine and few medium distinct yellowish brown (10YR 5/6) and red (2.5YR 4/6) mottles; moderate coarse prismatic structure parting to moderate medium blocky; extremely hard, firm, slightly plastic and sticky; few fine and medium pores; dark organic coatings and clay films on surfaces of prisms; neutral; gradual smooth boundary.

B22t—43 to 50 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; few to common fine and medium brownish yellow (10YR 5/6), strong brown (7.5YR 5/6), and red (2.5YR 4/6) mottles; moderate coarse prismatic structure parting to weak fine and medium blocky; extremely hard, very firm, slightly plastic and sticky; few roots mainly between prisms; few fine roots in peds; few fine and medium pores; clay films on surfaces of prisms; neutral; gradual smooth boundary.

B23t—50 to 72 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; few fine faint yellow mottles; moderate coarse prismatic structure; very hard, friable; few fine roots; dark organic coatings on surface of prisms; neutral.

Thickness of the solum ranges from 60 to about 100 inches. Reaction is slightly acid or neutral in the upper part of the solum and ranges from neutral through moderately alkaline in the lower part.

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

Odem series

The Odem series consists of nearly level to gently sloping, loamy soils that formed in loamy and sandy alluvium. The Odem soils are on natural levees between main stream channels and backwater areas adjacent to uplands along rivers and creeks. Slopes range from 0 to 3 percent.

Typical pedon of Odem fine sandy loam; from the intersection of U.S. Highways 181 and 77 on the east side of Sinton, 7.4 miles northeast on U.S. Highway 77 to the Welder Wildlife Refuge, 0.5 mile west of Venado Tank, and 0.3 mile south of the Aransas River, in range:

A11—0 to 16 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine and very fine granular structure; slightly hard, friable; many fine roots; many fine and medium pores; neutral; diffuse smooth boundary.

A12—16 to 40 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; moderate coarse prismatic structure parting to weak fine subangular blocky; slightly hard, friable; few fine roots; few fine and medium pores; noncalcareous; mildly alkaline; gradual smooth boundary.

C—40 to 60 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; few fine pores; few bedding planes; few thin strata of loamy fine sand; calcareous; moderately alkaline.

The A horizon is dark gray, very dark gray, dark grayish brown, or very dark grayish brown. The C horizon is fine sandy loam or loamy fine sand. It is mildly alkaline or moderately alkaline. It is grayish brown, light gray, or light brownish gray.

Orelia series

The Orelia series consists of nearly level, loamy soils that formed in loamy sediments. They are on slightly concave uplands. Slopes range from 0 to 1 percent.

Typical pedon of Orelia fine sandy loam; from the intersection of U.S. Highway 181 and Farm Road 3089 in St. Paul, 8.0 miles west on Farm Road 3089, 5.4 miles north on Farm Road 796, and 50 feet east, in pasture:

A1—0 to 5 inches; gray (10YR 5/1) fine sandy loam, dark gray (10YR 4/1) moist; massive; hard, friable; common fine roots; few fine pores; few insect tunnels; slightly acid; abrupt smooth boundary.

B21tg—5 to 10 inches; dark gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; moderate coarse prismatic structure parting to moderate medium blocky; very hard, firm; common roots between peds; few patchy clay films on surfaces of peds; neutral; clear smooth boundary.

B22tg—10 to 25 inches; dark gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; weak coarse prismatic structure parting to moderate medium blocky; extremely hard, very firm; few roots between peds; few dark root stains; nearly continuous clay films on surfaces of peds; few fine black concretions; moderately saline; mildly alkaline; gradual smooth boundary.

B3cag—25 to 32 inches; light gray (10YR 6/1) sandy clay loam, gray (10YR 5/1) moist; weak fine subangular blocky structure; very hard, friable, slightly sticky; about 5 percent fine weakly cemented concretions of calcium carbonate; moderately saline; calcareous; moderately alkaline; gradual smooth boundary.

Cca—32 to 60 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; few fine faint yellowish brown mottles; massive; hard, friable; about 5 percent weakly cemented concretions and soft lumps of calcium carbonate; strongly saline; calcareous; moderately alkaline.

Thickness of the solum ranges from 28 to 50 inches. The soil is nonsaline through strongly saline. Some pedons have a few faint yellowish and brownish mottles and black concretions in the lower part of the B2t horizon and in the B3 and C horizons.

The A horizon is fine sandy loam or sandy clay loam. It is neutral or mildly alkaline. It is dark gray, gray, or grayish brown. The B2tg horizon is sandy clay loam or clay loam. It is mildly alkaline or moderately alkaline. It is gray, dark gray, or very dark gray. The B3 horizon is gray, light gray, or white. The Cca horizon is sandy clay loam or loam. It is light gray, white, or light brownish gray.

Papalote series

The Papalote series consists of nearly level to gently sloping, loamy soils on slightly convex uplands. Slopes range from 0 to 5 percent.

Typical pedon of Papalote fine sandy loam, 0 to 1 percent slopes; from the intersection of U.S. Highway 181 and Farm Road 881 east of Sinton, 15.4 miles east on Farm Road 881, 1.0 mile north on Farm Road 136, 0.2 mile east on county road, and 200 feet north, in cultivated field:

Ap—0 to 8 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak fine granular and very fine subangular blocky structure; hard, friable; common fine roots; neutral; abrupt smooth boundary.

A1—8 to 14 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular and weak fine subangular blocky structure; hard, friable; common fine roots; neutral; abrupt smooth boundary.

B21t—14 to 17 inches; dark gray (10YR 4/1) sandy clay, very dark gray (10YR 3/1) moist; common fine distinct strong brown mottles; moderate coarse prismatic structure parting to moderate fine and medium blocky; very hard, firm, plastic and sticky; common fine roots between peds; few fine and medium pores; patchy clay films; few uncoated sand grains between peds; neutral; clear smooth boundary.

B22t—17 to 30 inches; grayish brown (10YR 5/2) sandy clay, dark grayish brown (10YR 4/2) moist; common fine and medium faint to prominent gray (10YR 5/1) and yellowish red (5YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium blocky; very hard, very firm, plastic and sticky; few fine roots between peds; few fine pores; continuous clay films; few black concretions 2 to 5 mm in diameter; mildly alkaline; gradual smooth boundary.

B23t—30 to 36 inches; grayish brown (10YR 5/2) sandy clay, dark grayish brown (10YR 4/2) moist; few to many fine and medium, faint and distinct brownish yellow (10YR 6/8), strong brown (7.5YR 5/8), and dark gray (10YR 4/1) mottles; moderate medium blocky structure; very hard, very firm, slightly plastic and sticky; few fine roots; few fine pores; continuous clay films; few black concretions 2 to 5 mm in diameter; mildly alkaline; gradual smooth boundary.

B3ca—36 to 48 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; few fine distinct yellowish red (5YR 5/8) and dark gray (10YR 4/1) mottles; weak fine and medium subangular and angular blocky structure; hard, firm, slightly sticky; few fine roots; patchy clay films; few black concretions 2 to 5 mm in diameter; few fine concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cca—48 to 60 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; few fine distinct gray and yellowish brown mottles; massive; hard, firm; fine concretions and soft masses of calcium carbonate; few fine black concretions; calcareous; moderately alkaline.

Thickness of the solum ranges from 40 to 60 inches. Depth to secondary carbonates is 28 to 50 inches.

The A horizon is slightly acid through mildly alkaline. It is light brownish gray, grayish brown, brown, gray, or dark gray. Some pedons have an A2 horizon that is light gray, gray, or white and is 1 to 6 inches thick. The B2t horizon is clay, sandy clay, or clay loam that is slightly acid through moderately alkaline. It is gray, grayish brown, brown, light gray, light brownish gray, dark brown, dark gray, or very dark gray. The B3 horizon is sandy clay loam or sandy clay that is neutral through moderately alkaline. It is light brownish gray, grayish brown, brown, light brown, red, reddish yellow, pale brown, or light gray. The C horizon is sandy clay loam or sandy clay. It is light brownish gray, light gray, pale brown, yellowish brown, very pale brown, light brown, light yellowish brown, reddish yellow, pink, yellowish red, or white.

Pettus series

The Pettus series consists of nearly level to gently sloping, loamy soils that formed in beds of calcareous loamy sediments. They are on upland ridgetops and side slopes. Slopes range from 0 to 3 percent.

Typical pedon of Pettus loam, 0 to 3 percent slopes; from the intersection of Interstate Highway 37 and Texas Highway 359 east of Mathis, 1.8 miles northwest on east service road of Interstate Highway 37, 1.5 miles northeast on County Road 5, and 50 feet west, in range:

A1—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine and very fine granular and subangular blocky; slightly hard, friable; many fine roots; few snail shells; calcareous; moderately alkaline; gradual wavy boundary.

B2—6 to 18 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; common fine roots; few fine and medium concretions and soft bodies of calcium carbonate below 12 inches; calcareous; moderately alkaline; abrupt wavy boundary.

C1ca—18 to 24 inches; white (10YR 8/2) weakly cemented, platy and fractured caliche, light gray (10YR 7/2) moist; hard, brittle; few roots in fractures and solution channels; hard crust is 1 to 3 cm thick; can be cut with a sharpshooter (spade) after hard crust is broken; cemented layer is discontinuous; gradual wavy boundary.

C2ca—24 to 65 inches; white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) moist; massive; about 10 percent nodular concretions of calcium carbonate up to about 1 cm across; calcareous; moderately alkaline.

Thickness of the solum ranges from 11 to 20 inches.

The A horizon is dark grayish brown, grayish brown, or brown. The B horizon is loam or sandy clay loam. It is grayish brown, light brownish gray, brown, or pale brown. The C horizon is weakly or moderately cemented, fractured, platy caliche that becomes softer with depth. The fine earth fraction is sandy clay loam or loam. Color of the C horizon is light gray, pale brown, or white.

Pharr series

The Pharr series consists of gently sloping, loamy soils that formed in calcareous loamy sediments of alluvial or eolian origin. They are on slightly convex stream terraces and uplands. Slopes range from 1 to 5 percent.

Typical pedon of Pharr fine sandy loam, 1 to 5 percent slopes; from the junction of U.S. Highway 77 and Interstate Highway 37, 2.4 miles north on the west service road and 50 feet west, in range:

A1—0 to 18 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and very fine subangular blocky and granular structure; slightly hard, very friable; common fine roots; few fine pores; few insect tunnels and worm casts; few snail shells and shell fragments; calcareous; moderately alkaline; diffuse smooth boundary.

B2t—18 to 32 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak very fine and fine subangular blocky; slightly hard, very friable; few fine roots; few fine pores; few snail shells and shell fragments; few fine films and threads of calcium carbonate; few thin patchy discontinuous clay films, mostly on surfaces of prisms; calcareous; moderately alkaline; diffuse smooth boundary.

B3ca—32 to 42 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; few fine pores; few snail shell fragments; about 7 percent soft bodies of calcium carbonate; calcareous; moderately alkaline; diffuse smooth boundary.

Cca—42 to 72 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; weak very fine subangular blocky and granular structure; slightly hard, very friable; few snail shell fragments; about 10 percent soft bodies of calcium carbonate; calcareous; moderately alkaline.

Thickness of the solum ranges from 40 to 80 inches.

The A horizon is dark grayish brown, grayish brown, brown, or dark brown. The B horizon is sandy clay loam or clay loam. It is grayish brown, brown, or pale brown. The C horizon is sandy clay loam or clay loam that is 3 to 25 percent soft bodies of calcium carbonate. It is very pale brown, pale brown, or light gray.

Raymondville series

The Raymondville series consists of nearly level to gently sloping, loamy soils that formed in calcareous clayey and loamy sediments of alluvial or eolian origin. They are on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Raymondville clay loam, 0 to 1 percent slopes; from the intersection of U.S. Highways 77 and 181 on the west side of Sinton, 7.0 miles northwest on U.S. Highway 181 and 500 feet west, in cultivated field:

Ap—0 to 6 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; weak fine and very fine subangular blocky structure; slightly hard, very friable, plastic and sticky; few small cracks; few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

A1—6 to 14 inches; very dark gray (10YR 3/1) clay loam, black (10YR 2/1) moist; weak subangular blocky structure; very hard, very firm, plastic and sticky; common fine pressure faces; common worm casts; old cracks filled with surface material; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

B21—14 to 25 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate fine subangular and angular blocky structure; very hard, very firm, plastic; common pressure faces; old cracks filled with darker material; few snail shells; few soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

B22ca—25 to 38 inches; light gray (10YR 6/1) clay, gray (10YR 5/1) moist; weak medium blocky and fine subangular blocky structure; very hard, very firm, plastic and sticky; few pressure faces; few shell fragments; few fine and medium soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

Cca—38 to 60 inches; light gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) moist; massive; very hard, very firm, plastic and sticky; about 5 percent fine and medium soft bodies of calcium carbonate; calcareous; moderately alkaline.

Thickness of the solum ranges from 32 to 50 inches. Depth to a calcic horizon is 25 to 40 inches.

The A horizon is gray, dark gray, or dark grayish brown. The B horizon is clay or clay loam. It is light gray, gray, or light brownish gray. The C horizon is clay or clay loam. It is light gray, light brownish gray, or pale brown.

Sarita series

The Sarita series consists of nearly level to gently undulating, sandy soils that formed in sandy and loamy sediments of eolian and alluvial origin. They are on terraces along rivers and creeks and on uplands. Slopes range from 0 to 5 percent.

Typical pedon of Sarita fine sand, in an area of Sarita-Nueces complex; from the intersection of U.S. Highways 181 and 77 on the east side of Sinton, 7.4 miles northeast on U.S. Highway 77 to the Welder Wildlife Refuge, and 0.25 mile southwest of Venado Windmill, in range:

A1—0 to 12 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grained; loose; common fine roots; slightly acid; abrupt smooth boundary.

A2—12 to 48 inches; very pale brown (10YR 8/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; few to common fine roots; slightly acid; abrupt smooth boundary.

B21t—48 to 52 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; common fine faint yellowish brown mottles; moderate coarse prismatic structure parting to weak medium blocky; hard, friable; common fine pores; neutral; clear smooth boundary.

B22t—52 to 66 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; many coarse distinct strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to weak medium blocky; hard, friable; thin patchy clay films on surfaces of peds; neutral; gradual smooth boundary.

B3—66 to 80 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; few fine faint yellowish brown mottles; weak fine subangular blocky and granular structure; slightly hard, friable; moderately alkaline.

Thickness of the solum ranges from 60 to more than 80 inches. Reaction is slightly acid or neutral in the upper part and slightly acid through moderately alkaline in the lower part.

The A1 horizon is grayish brown, light brownish gray, pale brown, or light brown. The A2 horizon is light gray, very pale brown, or light brown. The Bt horizon is sandy clay loam or fine sandy loam. It is light brownish gray, pale brown, very pale brown, or light yellowish brown with reddish and brownish mottles. The B3 horizon is sandy clay loam or fine sandy loam. It is very pale brown, pale brown, light brownish gray, or light yellowish brown.

Sinton series

The Sinton series consists of nearly level, loamy soils that formed in calcareous loamy stratified sediments. They are on bottom lands. Slopes range from 0 to 1 percent.

Typical pedon of Sinton loam; from the intersection of U.S. Highways 181 and 77 on the east side of Sinton, 7.4 miles northeast on U.S. Highway 77 to the Welder Wildlife Refuge, 1.25 miles northeast of Chiva Windmill, and 660 feet northwest of the Aransas River channel, in range:

A11—0 to 15 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate fine subangular blocky and granular structure; hard, firm, but crumbles easily to a mass of granules when moist, slightly plastic and sticky; many fine roots; common fine and few medium pores; common fine insect tunnels; few films of calcium carbonate; calcareous; moderately alkaline; diffuse smooth boundary.

A12—15 to 28 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate and weak fine subangular blocky structure; hard, firm, but crumbly when moist; many fine roots; common fine pores; common fine insect tunnels; common fine worm casts; few thin strata and lenses of sandy clay loam in lower part; few fine films and threads of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

C1—28 to 44 inches; light gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; massive; hard, friable; few fine roots; few insect tunnels; few bedding planes and thin strata of fine sandy loam and loamy fine sand; calcareous; moderately alkaline; gradual smooth boundary.

C2—44 to 72 inches; white (10YR 8/2) loamy fine sand, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable; few strata of fine sandy loam; few bedding planes; calcareous; moderately alkaline.

The A horizon is very dark gray, very dark grayish brown, or dark gray. The C horizon is loam, fine sandy loam, sandy clay loam, or loamy fine sand with evident bedding planes and thin lenses of various textures. It is gray, light gray, light brownish gray, or white.

Tatton series

The Tatton series consists of nearly level, sandy soils that formed in several feet of saline sandy sediments. They are on undulating low coastal tidelands. Slopes range from 0 to 1 percent.

Typical pedon of Tatton loamy sand, in an area of Tatton complex; from the north end of the Copano Bay Causeway, 5.5 miles north on Texas Highway 35, 2.0 miles east on private road to St. Charles Bay, 0.4 mile northwest on beach road, and 150 feet north of beach road between low vegetated mounds, slightly below high tide contour:

A1g—0 to 5 inches; light gray (10YR 7/2) loamy sand, grayish brown (10YR 5/2) moist; single grained; loose, very friable; common fine fragments of marine shell; extremely saline; calcareous; moderately alkaline; clear smooth boundary.

C1g—5 to 20 inches; white (10YR 8/1) loamy sand, gray (10YR 6/1) moist; single grained; loose, very friable; few fine distinct yellowish brown and faint gray mottles; common fine white shell fragments; extremely saline; calcareous; moderately alkaline; diffuse boundary.

C2g—20 to 60 inches; white (10YR 8/1) loamy sand, gray (10YR 6/1) moist; single grained; loose, very friable; common fine and medium black streaks; common white shell fragments; extremely saline; calcareous; moderately alkaline.

Salinity of the soil solution is approximately that of seawater. Shell fragments make up about 1 to 15 percent of the volume. Reaction is moderately alkaline or strongly alkaline throughout.

The A horizon is dark gray, gray, grayish brown, or light gray. It is loamy sand or fine sand. The Cg horizon is fine sand, loamy fine sand, or loamy sand. It is dark gray, dark grayish brown, grayish brown, gray, light brownish gray, light gray, or white, and has few to many brownish or yellowish mottles and black streaks.

Victine series

The Victine series consists of nearly level, clayey soils that formed in saline clayey marine sediments. They are on low coastal terraces, inland from the sandy soils of the coast line, and adjacent to the inland bays. Slopes range from 0 to 1 percent.

Typical pedon of Victine clay; from the headquarters of the Aransas National Wildlife Refuge, 4.0 miles west on Refuge road, 0.5 mile north on shell road, and 50 feet east, in range at the center of a microdepression:

A11—0 to 12 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine angular and subangular blocky structure; hard, firm, plastic and sticky; many fine roots; few fine concretions of calcium carbonate; slightly saline; calcareous; moderately alkaline; gradual smooth boundary.

A12—12 to 40 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine and medium angular blocky structure forming parallelepipeds tilted about 35 degrees from horizontal; very hard, very firm, plastic and sticky; common fine roots; common intersecting slickensides; few fine concretions of calcium carbonate; moderately saline; calcareous; moderately alkaline; gradual wavy boundary.

AC—40 to 60 inches; light gray (10YR 6/1) clay, gray (10YR 5/1) moist; common vertical dark gray (10YR 4/1) streaks; moderate fine angular blocky structure forming parallelepipeds tilted about 35 degrees from horizontal; very hard, very firm, plastic and sticky; few fine roots; common intersecting slickensides; common fine concretions and soft bodies of calcium carbonate; few fine gypsum crystals; strongly saline; calcareous; strongly alkaline; gradual wavy boundary.

C—60 to 72 inches; white (2.5Y 8/2) clay, light gray (2.5Y 7/2) moist; common vertical gray (10YR 6/1) streaks; weak fine angular blocky structure; very hard, very firm, plastic and sticky; common fine concretions and soft bodies of calcium carbonate; common fine crystals of gypsum and other neutral salts; strongly saline; calcareous; strongly alkaline.

The A and AC horizons combined have a thickness of 50 to 72 inches. The soil is calcareous throughout more than half the pedon, but some pedons in microdepressions are noncalcareous to a depth of 18 inches. Reaction is moderately alkaline or strongly alkaline. Salinity increases with depth and is nonsaline or slightly saline in the upper 12 inches of the A horizon, moderately saline or strongly saline in the lower part of the A horizon, and strongly saline or extremely saline in the AC and C horizons.

The A horizon is dark gray or very dark gray. The AC horizon is clay or silty clay. It is grayish brown, light brownish gray, pale brown, or gray. The C horizon is clay or silty clay. It is light gray, light brownish gray, pale brown, very pale brown, or white.

Victoria series

The Victoria series consists of nearly level and gently sloping, clayey soils that formed in calcareous clayey marine sediments. They are on uplands. Slopes range from 0 to 3 percent.

Typical pedon of Victoria clay, 0 to 1 percent slopes; from the intersection of Farm Road 631 and U.S. Highway 77 in Odem, 0.8 mile northeast on U.S. Highway 77 1.9 miles east on country road, and 75 feet north, in cultivated field:

Ap—0 to 8 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak very fine subangular blocky structure; very hard, very firm, plastic and sticky; surface cracks 0.75 inch wide; few fine concretions of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

A11—8 to 14 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine angular and subangular blocky structure; very hard, very firm, plastic and sticky; common 0.5 inch wide cracks; few pressure faces; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

A12—14 to 38 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine and very fine angular blocky structure; very hard, very firm, plastic and sticky; common pressure faces; intersecting slickensides; parallelepipeds tilted 30 to 40 degrees from horizontal axis; few old cracks filled with uncoated sand grains; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

AC—38 to 58 inches; light gray (10YR 6/1) clay, gray (10YR 5/1) moist; common vertical dark gray (10YR 4/1) streaks; moderate fine subangular blocky structure; very hard, very firm, plastic and sticky; common pressure faces; intersecting slickensides; distinct parallelepipeds tilted about 30 to 40 degrees from horizontal; few fine concretions of calcium carbonate; few pockets and seams of gypsum crystals in lower part; moderately saline; calcareous; moderately alkaline; gradual wavy boundary.

C—58 to 72 inches; light gray (10YR 7/2) clay, light brownish gray (10YR 6/2) moist; few gray (10YR 6/1) streaks; weak fine subangular blocky structure; very hard, very firm; few fine concretions of calcium carbonate; few pockets and seams of gypsum crystals and other salts; strongly saline; calcareous; moderately alkaline.

The thickness of the A and AC horizons combined is 50 to 72 inches. The soils are calcareous throughout, but the A horizon of some pedons in microdepressions may be noncalcareous to a depth of about 18 inches. Salinity is nonsaline through moderately saline in the A horizon, moderately saline or strongly saline in the AC horizon, and moderately saline through extremely saline in the C horizon.

The A horizon is dark gray or very dark gray. The AC horizon is clay or silty clay. It is gray, grayish brown, or light brownish gray and contains 2 to 20 percent dark gray or very dark gray streaks and splotches in partially filled cracks. The C horizon is clay or silty clay. It is light gray, light brownish gray, pale brown, or very pale brown.

Willacy series

The Willacy series consists of nearly level to gently sloping, loamy soils that formed in loamy alluvial sediments. The Willacy soils are on stream terraces and uplands. Slopes range from 0 to 5 percent.

Typical pedon of Willacy fine sandy loam, 3 to 5 percent slopes; from San Patricio, 3.25 miles north on Farm Road 666 and 50 feet west, in pasture:

A1—0 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak very fine and fine granular and subangular blocky structure; slightly hard, very friable; many fine and medium roots; common fine pores; common fine insect tunnels; many worm casts; mildly alkaline; clear wavy boundary.

B21t—16 to 20 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable; many fine and medium roots; common fine pores; common fine insect tunnels; few thin patchy clay films; mildly alkaline; clear wavy boundary.

B22t—20 to 36 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to weak fine subangular blocky; hard, friable; common fine and medium roots; common fine pores; few thin patchy clay films; mildly alkaline; gradual wavy boundary.

B3—36 to 45 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable; few fine roots; few films and threads of calcium carbonate in lower part; calcareous; moderately alkaline; gradual wavy boundary.

Cca—45 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; about 3 to 5 percent by volume soft bodies and concretions of calcium carbonate; calcareous; moderately alkaline; gradual wavy boundary.

C—60 to 72 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; about 1 to 3 percent by volume soft bodies and concretions of calcium carbonate; calcareous; moderately alkaline.

Thickness of the solum ranges from 39 to 60 inches. Secondary carbonates occur at depths of 34 to 50 inches.

The A horizon is very dark grayish brown, dark grayish brown, or grayish brown. The B horizon is fine sandy loam or sandy clay loam that is mildly alkaline or moderately alkaline. It is dark grayish brown, grayish brown, or brown. The C horizon is fine sandy loam or sandy clay loam. It is pale brown, very pale brown, or light brownish gray.

Formation of the soils

This section discusses the factors of soil formation and relates them to the formation of soils in the survey area. It also explains the processes of soil formation.

Factors of soil formation

Soil is the product of the action and interaction of the five major soil-forming factors. These five factors are climate, living organisms (especially vegetation), parent material, relief, and time. The interaction among the five factors is complex and continuous. The dominance of one or more of these factors in an area causes the soils of that area to differ from the soils of other areas.

Climate

The climate of the survey area ranges from humid subtropical along the coast to dry subhumid in the western part with warm summers and mild winters. Temperature and amount and distribution of precipitation have played important roles in the formation of soils in the survey area. Mild temperatures, adequate moisture, and a long growing season encourage the development and growth of soil organisms; and these, in turn, rapidly break down much of the plant residue in and on the soil to organic matter. Because of the mild temperature, bacterial activity continues throughout the year in most years.

Living organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. These organisms are directly responsible for the addition of organic matter and nitrogen to the soil, gains or losses of plant nutrients in the soil, and changes in the structure and porosity in the soil.

Vegetation, mainly mid and tall grasses, has affected soil formation in the survey area more than other living organisms. The abundance of vegetation has contributed toward the accumulation of organic matter and consequent darkening of the soils. Organic matter helps improve fertility, structure, and workability of soils.

Man's influence on soil formation, in general, has been negative. Through overuse he has permitted the more desirable vegetation to be replaced by the less desirable. This, in turn, contributes to the depletion of organic matter and plants. It also causes deterioration of soil structure and tilth, erosion and soil loss, and a decrease in bacterial action.

Parent material

Parent material is the unconsolidated mass from which soil is formed. It determines the limits of the chemical and mineralogical composition of the soil. In San Patricio and Aransas Counties the parent material of most of the soils consists of terrace or beach material that has been deposited by water. It ranges from sand to clay. The geology of the parent materials is discussed in more detail in the "Geology" section.

Relief

Relief affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. Soils that have steep slopes absorb less moisture and normally have less well developed profiles than soils in nearly level areas. Less moisture means a thinner plant cover and increases the susceptibility of the soil to erosion, which, in turn, retards soil formation.

Soil temperature varies slightly with the position of the slope. Slopes that face north are slightly cooler in the summer than south-facing slopes.

Time

Time is required for soil formation, and many characteristics of a soil are determined by the length of time that the soil-forming processes have had to act. The length of time that parent materials have been in place generally affects the degree of development of the soil profile. The soils of San Patricio and Aransas Counties are geologically young. Young soils have little profile development, while older soils have better expressed soil horizons.

Processes of soil horizon differentiation

Several processes are involved in the formation of soil horizons in San Patricio and Aransas Counties. These processes include the accumulation of organic matter, the leaching of calcium carbonate and bases, and the formation and translocation of silicate clay minerals. In most soils, more than one of these processes has been active in the formation of horizons.

Accumulation of organic matter in the upper part of the profile is particularly important. The organic-matter content of the soils of the survey area ranges from very low in the sandy coastal and terrace soils to high in the remaining soils of the area.

Leaching of carbonates and bases has occurred in such soils as the Delfina, Papalote, and Willacy soils. Some of the soils in the survey area, such as the Pharr and Sinton soils, are only slightly leached. They have an A horizon that is high in carbonates.

In Delfina and Papalote soils, there has been some translocation of clay minerals. This has contributed to horizon formation. The B horizon generally has accumulations of clay (clay films) in pores and on surfaces of peds. These soils were probably leached of carbonates and soluble salts before the translocation of the silicate clays took place.

Geology

This section prepared by Dr. Saul Aronow, Department of Geology, Lamar University, Beaumont, Texas.

San Patricio and Aransas Counties are located in the Western Gulf section of the Coastal Plain, in which the sedimentary formations dip gulfward at low angles. The soils of the two counties occur on the uppermost formations which are of Pliocene, Pleistocene, and Holocene (Recent) age. The parent materials of the soils are sediments of fluvio-deltaic, coastal, shallow-water marine, and eolian origin. The geologic features will be discussed mainly with reference to the general soil map. The several geologic units and their respective areas are listed in table 21.

Several features of surface or geomorphic interest in the two-county area include pimple mounds, clay dunes, and shallow undrained depressions (*5*). Other geomorphic features are considered in the discussion of Isla de San Jose of Holocene, Recent, age.

Pimple mounds are circular knolls, generally less than 200 feet in diameter and less than 5 feet in height. They are widespread on the coastal plains in Texas. Locally they are most numerous on the mainland part of the sandy Galveston-Mustang-Dianola map unit and on the sandy and loamy soils adjacent. Many ideas on their origin have been advanced, some of the more plausible ones being that they are residual patches left after sheetflood erosion or deflation of the surface by the wind; accumulations of wind-transported sand, silt, and clay around clumps of vegetation; or wind-accumulated material started, or later topographically enhanced, by erosional processes. Some mounds in the two-county area have soils with a buried A1 horizon or humified zone, which suggests a partly eolian origin.

Clay dunes (*7*) are windbuilt ridges and hills which locally are as much as 20 feet in height. The two-county area is close to their northern limit, and they are not locally abundant. Conspicuous examples of recent origin occur along the northwestern shore of the McCampbell Slough extension of Port Bay in San Patricio County and along the northeastern shore of Egery Flats, on the southwestern rim of Copano Bay in Aransas County. Clay dunes accumulate in areas around intermittently wet coastal basins and tidal flats. When these areas dry out, pellets or granules of clay- to sand-sized particles are formed by the breaking up of surface crusts and are carried by the wind to adjacent higher areas. Successive accumulations of pellets are broken down and "homogenized" by rain, and later stabilized by salt-tolerant vegetation. Clay dunes are usually the sites of saline soils such as those of the Narta and Victine series. Some of the low hills in the Narta-Aransas-Victine map unit on the upland northwest and southwest of McCampbell Slough are very old, considerabley modified, clay dunes.

Several groups of undrained depressions can be distinguished on the older surfaces, of vertisols, clayey and loamy soils, and sandy soils.

The vertisols, such as the soils in the Victoria-Raymondville-Orelia map unit, shrink and swell upon wetting and drying. This results in a gilgaied, or "hog-wallowed," surface.

The clayey and loamy soils in depressions, such as those of the Edroy series, seem to have a more complex origin. Suggestions on their genesis depict them variously as wind deflation hollows, or "blowouts"; segmented and nearly filled stream channels, oxbows, and point bar swales, all relict from an original fluviatile topography; or subsidence depressions resulting from the solution of subsurface materials, like calcium carbonate, or from subsurface erosion (piping).

The sandy soils on old barrier ridges, the mainland parts of the Galveston-Mustang-Dianola map unit, have depressions of several likely origins: blowouts, swales among dunes, and blocked and segmented tidal and washover channels.

As shown in table 21, the soil map units of San Patricio and Aransas Counties can be divided into four geologic groups according to age. These geologic age groups are described in the paragraphs that follow.

Pliocene

Goliad Formation.—The oldest exposed rock formation in the survey area is the Goliad, which is of fluvio-deltaic origin and outcrops only in the vicinity of Mathis in the extreme western part of San Patricio County. The formation is 3 million to 10 million years old.

The subsurface of the Goliad Formation is mostly porous, permeable sandstone interbedded with clay and conglomerate (gravel) that yields small to large quantities of water to wells. Goliad exposures are rare in San Patricio County. In most surface exposures (road cuts, pits, and gullies) the upper part of the Goliad Formation is massive to highly fractured or rubbly caliche or limestone that is more than 25 feet thick in places. The caliche is a resistant bed which holds up a plateau surface around Mathis. It is locally gullied by tributaries to the Nueces River. This plateau, known in the older literature as the Reynosa Plateau, extends from the Rio Grande to the Guadalupe River.

The origin of thick caliche deposits has been debated for many years. Several processes probably involved (*6*) include the solution, downward transportation, and precipitation of original calcium carbonate in the sediments by percolating rainwater; the upward transportation and precipitation of original calcium carbonate by capillary effects and evaporation; and surface deposition of calcareous loess by the wind. The processes may all have been operative, at different climatic conditions.

Caliche seems to be the parent material, or at least underlies, the Pettus-Pharr and parts of the Victoria-Raymondville-Orelia map units.

Pleistocene

The history and origin of the post-pliocene formations and deposits of the Texas and Louisiana Coastal Plain propose that the several Pleistocene ("ice age") formations were laid down as fluvio-deltaic, coastal, and shallow water marine deposits during a time of high sea level similar to the present. The intervals of high sea level were the "interglacials", the times of glacial retreat and comparatively warm climates. During the glacial intervals, or times of spreading and advance of continental ice sheets, sea level fell, perhaps as much as 450 feet, as part of the world's moisture was locked up in glacial ice. During the intervals of low sea level, previously deposited formations were incised and dissected by streams, many with channels cut well below present-day sea level, flowing across a partly exposed continental shelf to the Gulf of Mexico.

Montgomery Formation.—The oldest Pleistocene surface in the two-county area is the Montgomery Formation; its age is not known, but the order of magnitude is in hundreds of thousands of years. It crops out mainly in San Patricio County west of Sinton. The surface of the formation towards the gulf is bounded by a poorly defined scarp or break in slope west, northeast, northwest, and southwest of Sinton. The western edge of the outcrop area is the scarp of the Reynosa Plateau.

The Montgomery Formation is made up of calcareous clay, silt, and sand of fluvio-deltaic origin, probably locally wind-worked by both deflationary and accretionary processes. Parts of the Victoria-Raymondville-Orelia and Orelia-Papalote map units are derived from the Montgomery Formation.

Beaumont Formation.—The youngest extensively exposed Pleistocene formation in the survey area, the Beaumont, crops out in the upland area of all of Aransas County, the upland area of San Patricio County east of Sinton, as well as in the sandy areas that make up Live Oak Ridge and Lamar and Blackjack Peninsulas.

The surface of the formation has preserved a relict depositional topography, considerably modified by sheetflooding, masswasting, and eolian processes. Three principal facies or environments of deposition recognized in the surface materials of the Beaumont Formation are fluvio-deltaic, lagoonal, and barrier island.

Most of the Beaumont surface belongs to the fluvio-deltaic environment of deposition. A pattern of distributaries or meander belts (*4*) heads north and northeast toward Chiltipin Creek, Aransas River, and Copano Bay from the region of Nueces and Corpus Christi Bays and records the deposition of surface sediments from a Pleistocene Nueces River. In some places the distributaries are topographically low ridges; in other places, their presence is indicated by lineations of small basins and irregular topography. The distributary areas are underlain mainly by soils of the Orelia, Papalote, and Edroy series; the interdistributary areas, which may be interpreted as backswamps of the alluvial plain or as the shallow water parts of a delta, are underlain by the Victoria series. No clearly defined pattern can be traced to the present-day Aransas or Mission Rivers, but the westernmost parts of Aransas County were probably deposited by the Pleistocene ancestors of these streams.

The fluvio-deltaic part of the Beaumont Formation forms most of the Victoria-Raymondville-Orelia and part of the Orelia-Papalote map units.

The relict lagoonal areas, seaward of this fluvio-deltaic part, are mainly underlain by soils of the Narta-Aransas-Victine map unit. The parent materials of the area are probably not lagoonal bottom sediments, but are materials of eolian, tidal delta, and washover fan origin laid down during the final filling of the lagoon.

The barrier island facies, consisting of the sandy parts of Live Oak Ridge and the Lamar and Blackjack Peninsulas, are part of the Pleistocene Ingleside barrier island system. The system extends discontinuously from Kleberg County, south of Corpus Christi Bay, to an area north of Lake Charles in western Louisiana. The relict barrier and lagoonal deposits are analogous to Isla de San Jose and Aransas Bay and other bays landward of it.

Both the ancient barriers and the recent Isla de San Jose have soils of the Galveston-Mustang-Dianola map unit. This suggests that the older Ingleside barrier surface has been recently reworked by the wind, thus precluding a more mature profile development. Contrasting profiles on recent versus older barrier sands can be found in less arid parts of the Ingleside barrier in Chambers and Jefferson Counties.

The several soil series on the mainland and restricted to the Ingleside barrier show a gradual change in the thickness of the barrier island sand. The thickest parts are in the Falfurrias, Mustang, and Galveston series on the gulfward side of the barrier. The sand thins landward through the Nueces, Leming, and Dietrich series, possibly as a result of the lagoonward washing of sand during great storms as well as of wind action.

The deposition of this complex of Beaumont-age sediments is probably similar to that in the Rio Grande region to the south. In a series of course changes, the Rio Grande deposited a large alluvial or deltaic plain in a shallow coastal area while the offshore Padre Island was accumulating.

Radiocarbon dates on organic materials from the Beaumont Formation elsewhere in the Gulf Coast have yielded only "dead" dates, that is, the sediments are beyond the range of this dating method, and over 40,000 years in age. The formation was probably deposited during the Sangamon interglacial, a time of high sea level between the major Illinoian and Wisconsin Glaciations over 70,000 years ago.

Early Holocene or Late Pleistocene

Deweyville Formation.—The terrace deposits along the north side of the Nueces River in San Patricio County can be placed in the Deweyville Formation. The terraces are intermediate in elevation between the Holocene flood plain, or alluvial deposits of the Nueces River, and the Beaumont-upland surface. Also included are some deposits underlying high "islands" surrounded by alluvium in the Nueces River Valley south of Edroy.

Lithologically, the terrace deposits consist of gravel, sand, silt, and clay, all fluvial materials of channel, point bar, levee, and backswamp origin. Many sand and gravel pits have been opened in these deposits; especially west and north of San Patricio.

The deposits are coarser than the recent alluvium of the Nueces River. Also the relict meander patterns on the surface of the deposits and the meander scars cut into the adjacent uplands are much larger than those of the present-day Nueces River. All this suggests that the Deweyville-age Nueces River had a much greater discharge than the contemporary stream. This contrast in the caliber of the deposits and the size of the meander patterns is found along many gulf coast streams.

The higher discharge can most simply be attributed to the high world-wide rainfall associated with glacial expansion and the fall of sea level. Radiocarbon dates on samples of the Deweyville Formation from other places in the gulf coast range from about 12,000 to 34,000 years ago, well within the time span of continental glaciers.

The outcrop area of the Deweyville Formation only roughly corresponds with the Papalote-Delfina-Leming map unit. The unit also includes some colluvial and caliche slopes along the wasted and gullied edges of the Goliad, Montgomery, and Beaumont Formations.

Holocene (Recent)

The Holocene deposits and landforms can conveniently be divided into two groups: flood plain, or alluvial, and coastal.

The flood plain deposits in the survey area are principally along the Nueces River, the Aransas River, and Chiltipin Creek and include sand, silt, and clay of channel, point bar, levee, and backswamp origin. Estuarine deltas at the mouths of these streams contain marsh deposits. All of the flood plain and marsh deposits fall within the Aransas-Sinton-Odem map unit.

Along the Texas coast, the local Nueces, Corpus Christi, Copano, and Port Bays were first excavated by the streams now entering them when sea level was considerably lower than at present. Because of their comparatively low discharge and load these streams have not yet filled their bays, in contrast to the Rio Grande and Brazos Rivers, which have done so during the past 3,500 to 5,000 years of stable sea level.

The coastal deposits are found mostly on and around the large recent barrier, Isla de San Jose, in Aransas County. Isla de San Jose and Matagorda Island to the northeast are the broadest barrier islands along the coasts of the United States and have been the objects of considerable study (*3, 8*).

The core, or nucleus, of the island is the sand deposits, less than a mile in width in most places, on the seaward or southeastern part of the island. These deposits consist of an active beach, dune ridges, and a sand plain.

The sand deposited on the active beach by waves is brought into the area by longshore currents from the northeast and is derived from many coastal streams and from erosion of older Pleistocene deposits along the coast. The sand dries out between the tides and is blown landward where it accumulates in a series of discontinuous dune ridges parallel to the shore, and is partly stabilized by vegetation. The succession of three to five dune ridges, sometimes called "beach ridges," may record the gradual seaward prograding of the barrier. Sand not trapped in the ridges is blown further landward into a variety of dune forms, some fixed by vegetation and some active, that make up the dune plain.

The landward part of the island, outside of the sandy core and sometimes referred to as a barrier flat, widens to the northeast. It consists of many kinds of deposits and landforms including mudflats, marshes, elongate lakes, truncated or discontinuous channels, and low, irregular vegetation-stabilized eolian mounds, or washarounds. The barrier flat has accumulated as a series of washover fans and tidal deltas, and it accounts for most of the island's great width.

Washover fans are deposited during hurricane storm surges when sea level is briefly elevated and the core of the barrier is breached by one or more temporary channels which subdivide the landward part of the island in a fanwise pattern of distributaries. Elongate lakes occupy some distributaries; eolian mounds, the higher areas between distributaries.

Tidal deltas are accumulations of sediment at the lagoonward ends of inlets through which tidally generated currents pass and deposit sediments. Aransas Pass, the tidal inlet terminating the island on the southwest, is at the head of a large, active tidal delta extending into Aransas and Redfish Bays. Similar deltas, now part of the barrier flat, were abandoned as the southern end of the island moved in a southwestern direction and the former mouths of the tidal inlets were sealed off by the active beach. The great tidal delta and washover fan at the northeastern end of the island has been studied in detail.

The complex pattern of soils on Isla de San Jose is the result of the diverse methods of accumulating sediments which occur in the remaining part of the Galveston-Mustang-Dianola map unit.

References

(1) American Association of State Highway and Transportation Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Andrew, P.B. 1970. Facies and Genesis of Hurricane-Washover Fan, St. Joseph Island, Central Texas Coast. Univ. Tex., Bur. Econ. Geol. Dep. Invest. 67, 147 pp.

(4) Aronow, S. 1971. Nueces River Delta Plain of Pleistocene Beaumont Formation, Corpus Christi Region, Texas. Bull. Am. Assoc. Petrol. Geol., vol 55, pp. 1231-1248.

(5) Bernard, H.A. and R.J. LeBlanc. 1965. A resume of the quaternary geology of the northwestern Gulf of Mexico Province. Quaternary of the U.S. Princeton Univ. Press, pp. 137-185.

(6) Birkeland, P.W. 1974. Pedology, weathering, and geomorphological research. Oxford Univ. Press. 285 pp.

(7) Price, W.A. 1963. Physiochemical and environmental factors in clay dune genesis. J. Sediment. Petrol. vol. 33, pp. 776-778.

(8) Shepard, F.P., and H.R. Wanless. 1971. Our changing coastlines. McGraw-Hill Book Co., New York, 579 pp.

(9) Texas Conservation Needs Committee. 1970. Conservation needs inventory. U.S. Dep. Agric., Soil Conserv. Serv., 297 pp., illus.

(10) The Dallas Morning News Staff. 1973. Texas counties and towns. Tex. Almanac pp. 260 and 355, illus.

(11) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. Supplements replacing pp. 173-188 issued May 1962

(12) United States Department of Agriculture. 1975. Soil taxonomy, a basic system of soil classification for making and interpreting soil surveys. U.S. Dep. Agric., Handb. 436, 754 pp., illus.

(13) Webb, Walter Prescott and H. Bailey Carroll. 1952. The handbook of Texas. Vol. 1, Aransas County, pp. 56-57 and vol. 2, San Patricio County, pp. 559-560. The Texas Hist. Assoc., Lakeside Press.

Glossary

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.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Medium	6 to 9
High	More than 9

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil 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 coat, 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.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

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 for 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, as for example in "hillpeats" and "climatic moors."

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions; occasional that it occurs on an average of once or less in 2 years; and frequent that it occurs on an average of more than once in 2 years. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, and long if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Gilgai. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming 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.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks 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 from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

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.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Microrelief. Small-scale local differences in topography, including mounds (knolls) and swales (depressions) that are only a few feet in diameter and with elevation differences of up to 6 feet.

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).

Parallelepipeds. Six-sided prisms having faces that are parallelegrams.

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.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water of subsurface tunnels or pipelike cavities in 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 a semisolid to a plastic state.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

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.

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.

Soil. A natural, three-dimensional body at the earth's surface that 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.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining 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).

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 or management.

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, silt loam, 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."

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

ILLUSTRATIONS

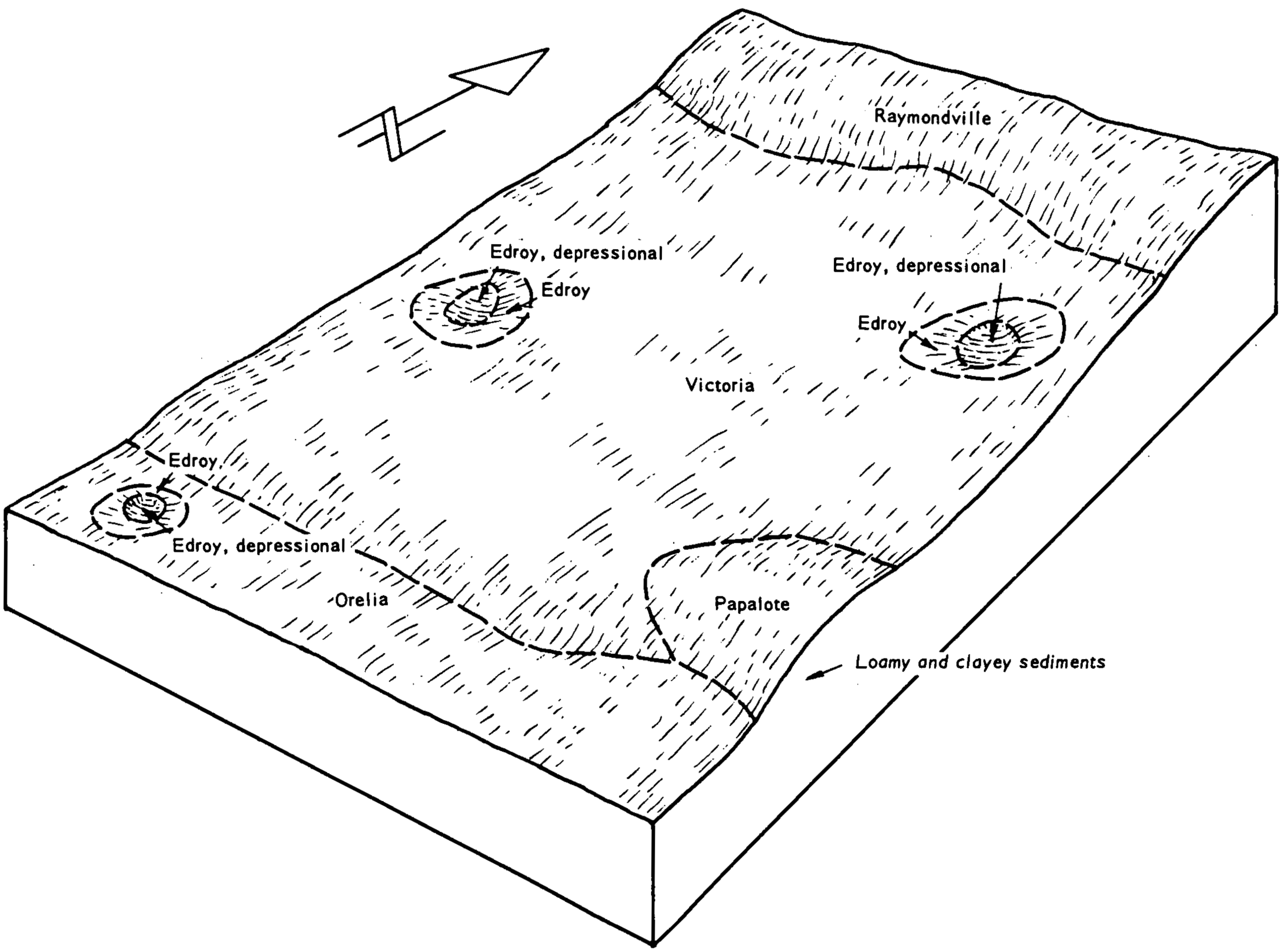


Figure 1.—Typical pattern of soils and underlying material in the Victoria-Raymondville-Orelia unit.

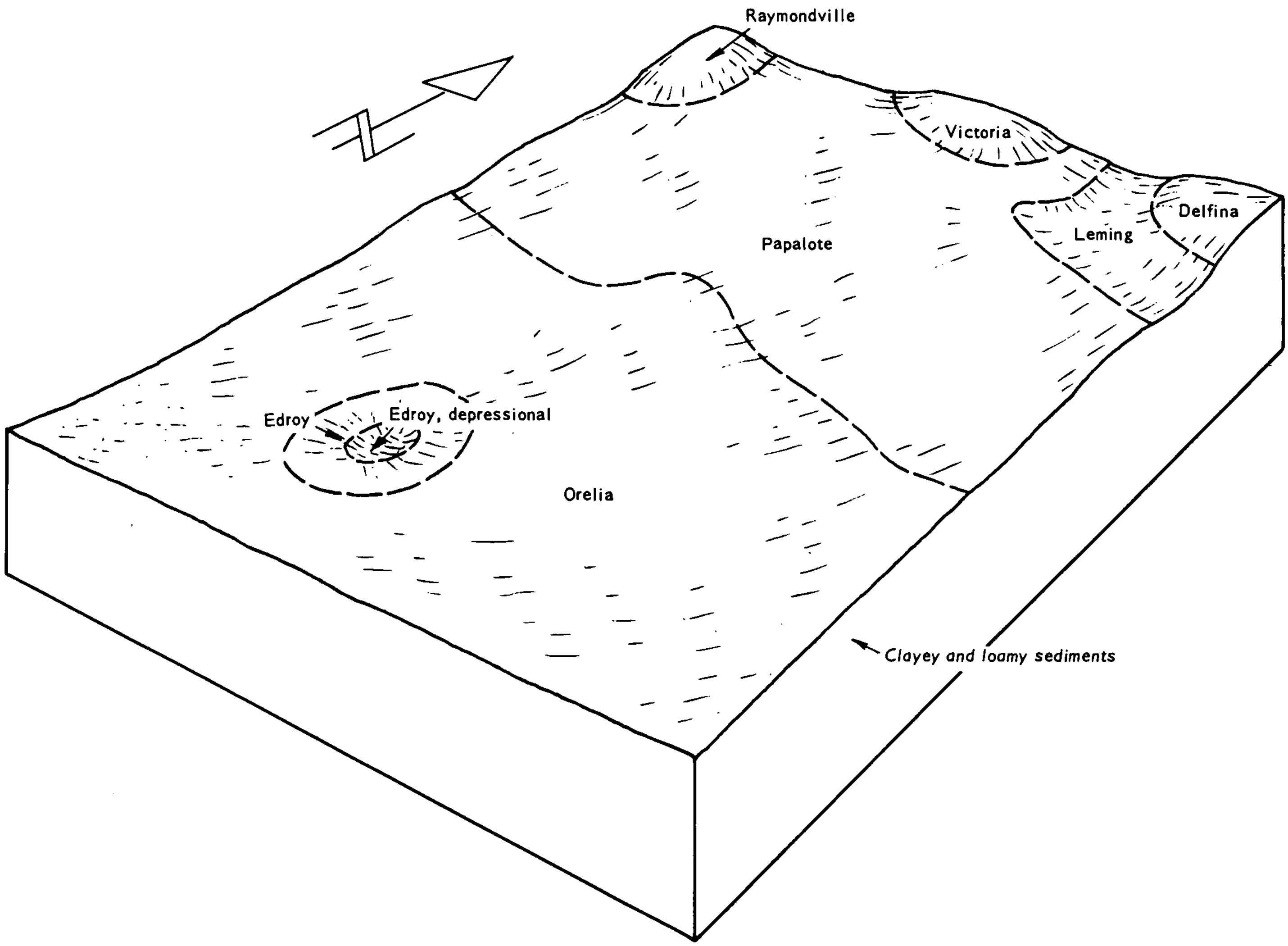


Figure 2.—Typical pattern of soils and underlying material in the Orelia-Papalote unit.

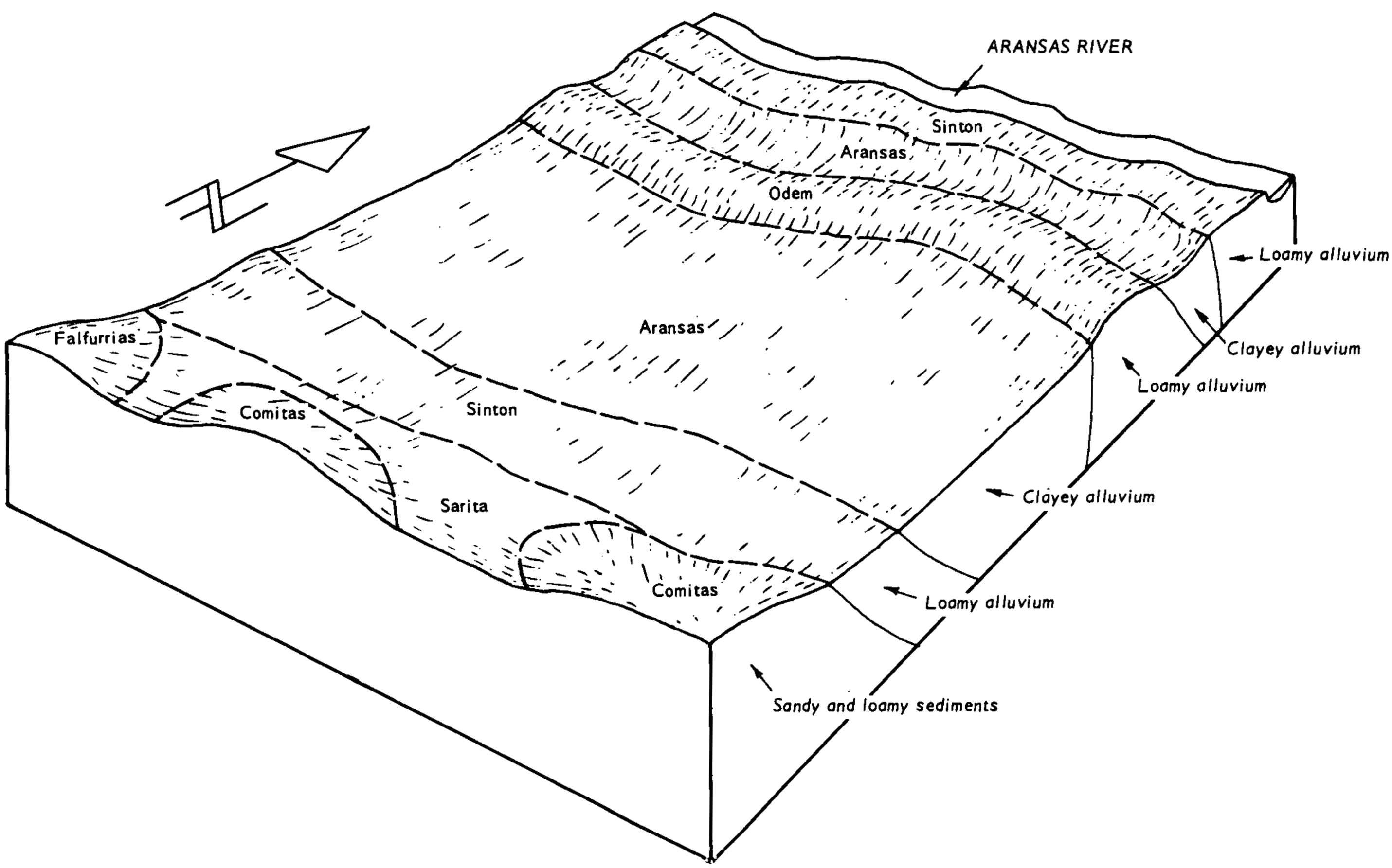


Figure 3.—Typical pattern of soils and underlying material in the Aransas-Sinton-Odem unit.

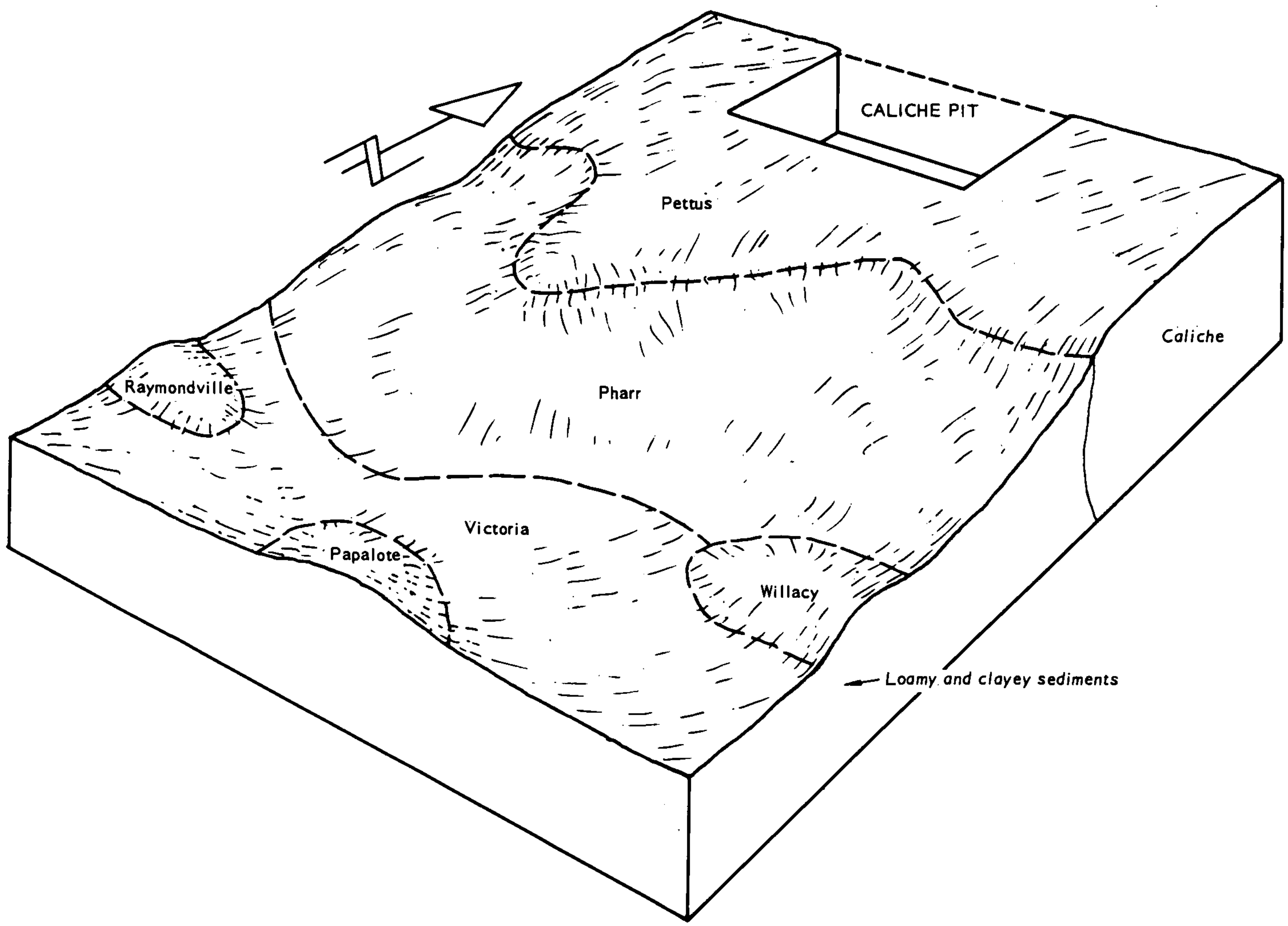


Figure 4.—Typical pattern of soils and underlying material in the Pettus-Pharr unit.

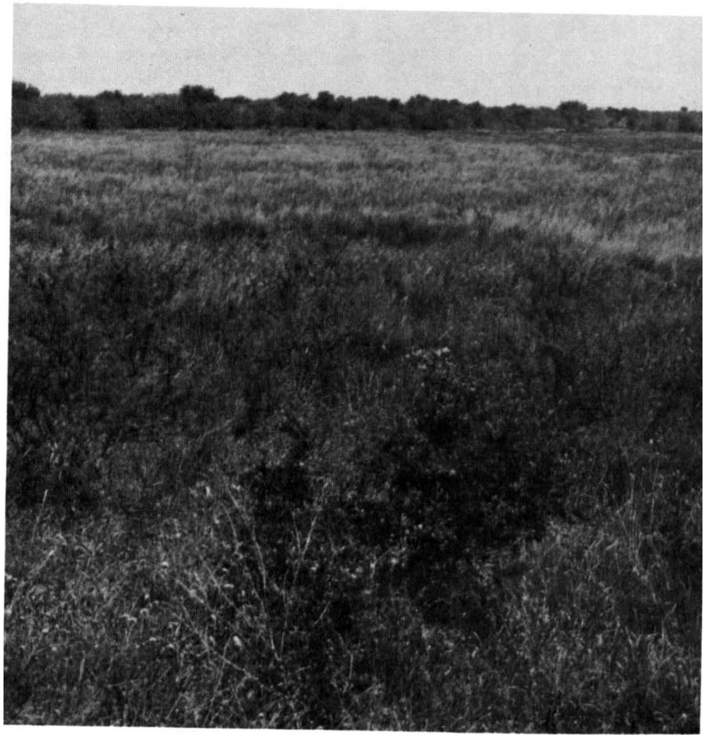


Figure 5.—An area of Aransas clay in the Clayey Bottomland range site.

Figure 6.—An area typical of the Barrada-Tatton association along the coast.

Figure 7.—An area of the Falfurrias association in the Sand Hill range site.

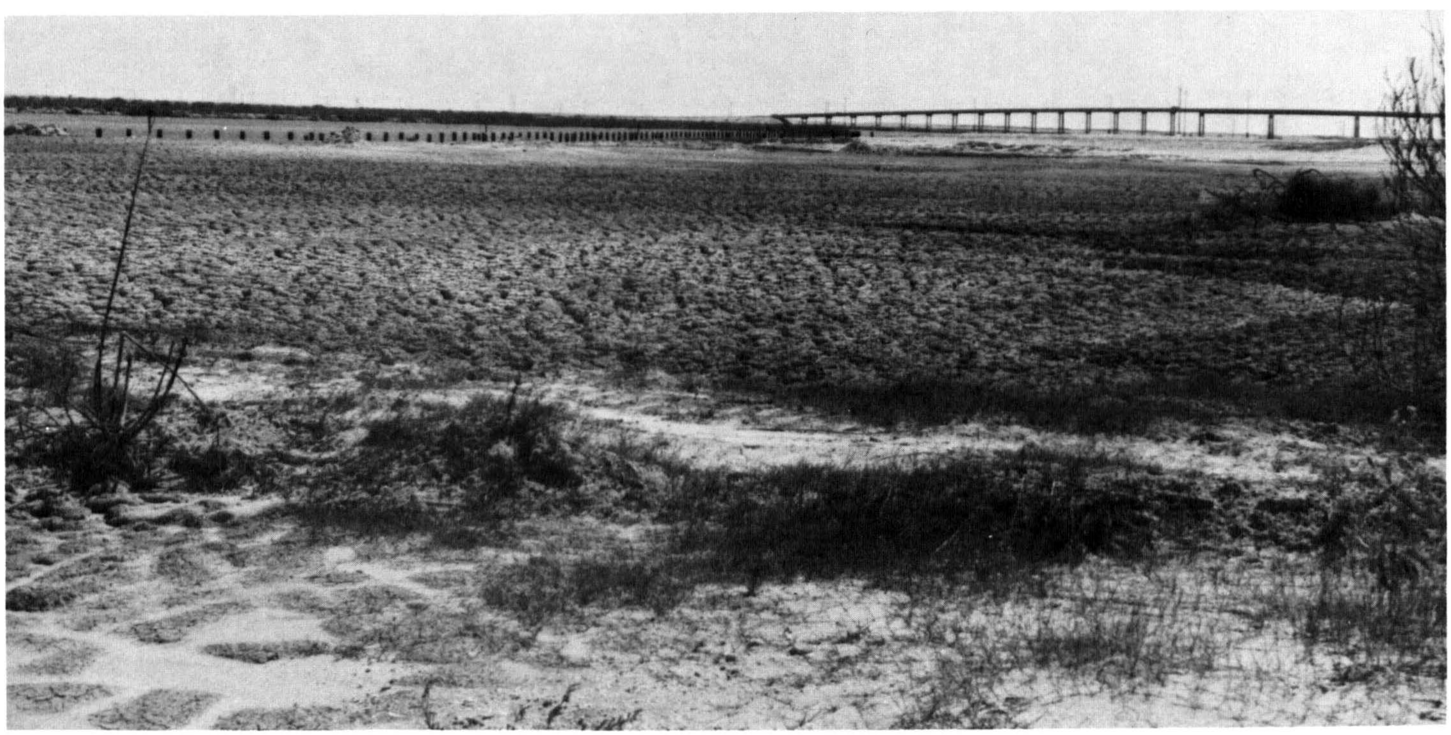


Figure 8.—An area of Ijam soils recently dredged from the bay floor.

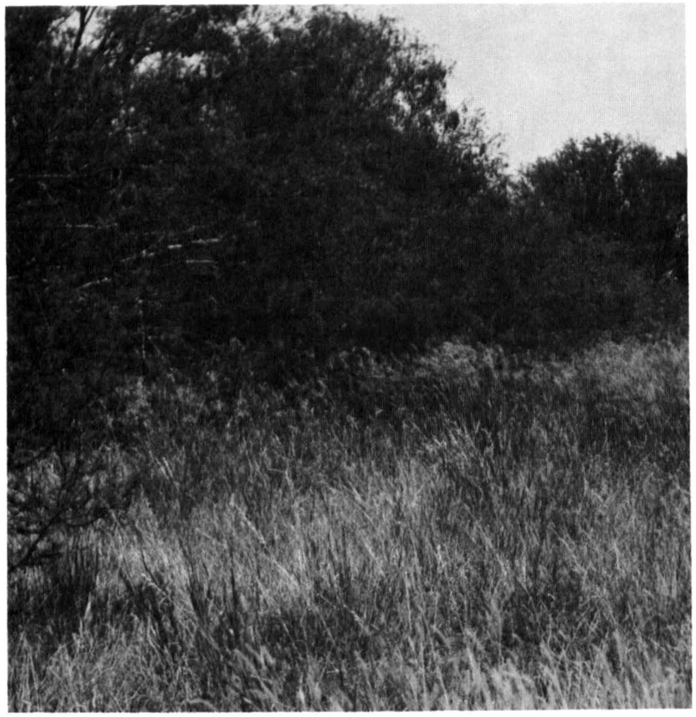


Figure 9.—Pharr fine sandy loam, 1 to 5 percent slopes, in a typical area of Gray Sandy Loam range site.

Figure 10.—An area of Psamments on the barrier islands.

Figure 11.—Sinton Loam in a typical area of Loamy Bottomland range site.

Figure 12.—A typical landscape of Tatton complex.

Figure 13.—Growing cotton on Victoria clay, 0 to 1 percent slopes.

Figure 14.—Land-smoothing an area of Victoria clay, depressional.

Figure 15.—White tailed deer feeding on Raymondville clay loam, 0 to 1 percent slopes. (Photo courtesy Rob and Bessie Welder Wildlife Research Foundation)

Figure 16.—Controlled burning on Victine clay and Narta fine sandy loam. (Photo courtesy U.S. Fish and Widllife Service.)

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

County and month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average	Temperature: Two years in 10 will have-- Maximum temperature higher than--	Temperature: Two years in 10 will have-- Minimum temperature lower than--	Temperature: Average growing degree days[2]	Precipitation[1]: Average	Precipitation[1]: Two years in 10 will have-- Less than--	Precipitation[1]: Two years in 10 will have-- More than--	Precipitation[1]: Average days with 0.10 inch or more
	°F	°F	°F	°F	°F	°F	In	In	In	Days
San Patricio County[3]										
January	67.0	46.0	56.5	70.0	32.0	186	1.6	0.2	2.7	2
February	68.0	46.0	57.0	75.0	35.0	199	1.9	0.7	2.5	2
March	76.0	54.0	65.0	80.0	40.0	459	1.3	0.4	2.7	3
April	84.0	68.0	76.0	90.0	50.0	777	2.4	1.2	3.2	3
May	88.0	72.0	80.0	95.0	60.0	930	2.9	1.1	4.3	3
June	94.0	74.0	84.0	95.0	60.0	1,017	3.5	2.7	6.2	5
July	96.0	78.0	87.0	100.0	65.0	1,144	1.9	1.0	2.3	2
August	97.0	78.0	87.5	100.0	65.0	1,163	1.8	1.4	3.1	3
September	92.0	74.0	83.0	95.0	60.0	984	4.8	4.4	7.0	6
October	84.0	62.0	73.0	90.0	50.0	716	3.5	2.4	5.7	5
November	79.0	60.0	69.5	85.0	40.0	591	1.9	0.9	3.2	3
December	68.0	48.0	58.0	75.0	35.0	242	1.8	1.2	3.5	2
Year	82.7	63.3	73.0	87.5	49.3	8,408	29.3	17.6	46.4	39
Aransas County[4]										
January	65.0	45.0	55.0	70.0	32.0	152	2.2	1.0	2.6	4
February	68.0	49.0	58.5	75.0	35.0	238	2.4	1.5	2.4	4
March	73.0	55.0	64.0	80.0	40.0	425	1.6	1.0	1.6	3
April	79.0	63.0	71.0	90.0	45.0	633	2.4	1.5	3.4	3
May	84.0	69.0	76.5	95.0	60.0	828	3.2	2.1	4.7	4
June	89.0	75.0	82.0	95.0	65.0	960	3.5	2.5	4.6	5
July	92.0	76.0	84.0	95.0	70.0	1,045	2.3	1.5	3.4	2
August	92.0	75.0	83.5	95.0	65.0	1,035	4.5	2.5	6.7	5
September	89.0	72.0	80.5	95.0	60.0	906	5.8	4.9	8.4	6
October	83.0	64.0	73.5	90.0	50.0	716	4.0	2.1	6.5	5
November	74.0	55.0	64.5	85.0	40.0	435	2.1	1.0	3.3	4
December	68.0	48.0	58.0	75.0	35.0	242	2.8	31.9	3.4	4
Year	79.5	62.2	70.9	86.6	49.8	7,615	36.8	23.5	51.0	49

[1]Snow and sleet have not been included in the precipitation data as occurrences are rare--in about 1 or 2 years out of 10. The duration is short, usually less than 36 hours, and the amount of moisture obtained is negligible.

[2]A growing degree day is an index of the amount 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 plant growth is minimal for the principal crops of the area (50° F).

[3]Data recorded for the period 1921-1973 at Sinton, Texas.

[4]Data recorded for the period 1942-1971 at Aransas National Wildlife Refuge.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Freeze	San Patricio County	Aransas County
First in fall	December 14	December 6.
Last in spring	February 13	February 6.
Length of growing season.	303 days	302 days.

TABLE 3.--GROWING SEASON LENGTH

Probability	Daily minimum temperature during growing season					
	San Patricio County			Aransas County		
	Higher than 30° F	Higher than 50° F	Higher than 70° F	Higher than 30° F	Higher than 50° F	Higher than 70° F
	Days	Days	Days	Days	Days	Days
9 years in 10	303	276	153	302	250	122
7 years in 10	319	292	169	325	263	135
5 years in 10	335	308	185	338	276	148
3 years in 10	350	323	200	351	289	161
1 year in 10	365	338	215	365	303	175

TABLE 4.--MAP UNITS AND THEIR POTENTIALS

Map unit	Percent of survey area	Cultivated farm crops	Specialty crops	Range	Urban uses	Recreation
1. Victoria-Raymondville-Orelia	47	High	High	High	Low: wetness, shrink-swell.	Low: too clayey.
2. Galveston-Mustang-Dianola	21	Low: wetness, floods, salinity.	Low: wetness, floods, salinity.	Low: salinity, wetness.	Low: wetness, floods.	Low: wetness, floods, too sandy.
3. Narta-Aransas-Victine	9	Low: wetness, salinity, floods.	Low: wetness, salinity, floods.	High	Low: wetness, shrink-swell, corrosivity, floods.	Low: wetness, floods, too clayey.
4. Orelia-Papalote	8	Medium: wetness.	Medium: wetness.	High	Medium: wetness, shrink-swell, low strength.	Medium: wetness, percs slowly.
5. Aransas-Sinton-Odem	7	Medium: floods.	Medium: floods.	High	Low: floods.	Low: floods.
6. Papalote-Delfina-Leming	6	Medium: soil blowing, percs slowly.	Medium: soil blowing, percs slowly.	High	Medium: low strength, shrink-swell.	High.
7. Pettus-Pharr	2	Low: droughty, depth to rock.	Low: droughty, depth to rock.	Medium: depth to rock.	High	High.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	San Patricio County	Aransas County	Total-- Area	Extent
		Acres	Acres	Acres	Pct
Ac	Aransas clay	12,550	0	12,550	1.7
Af	Aransas clay, frequently flooded	3,920	60	3,980	0.5
As	Aransas clay, saline	15,990	6,750	22,740	3.1
BT	Barrada-Tatton association	10,450	9,890	20,340	2.8
By	Beaches	0	7,100	7,100	1.0
Cs	Comitas loamy fine sand	1,760	0	1,760	0.2
Dn	Delfina loamy fine sand	9,150	30	9,180	1.2
Ds	Dianola soils	0	10,870	10,870	1.5
Dt	Dietrich fine sand	1,870	3,840	5,710	0.8
Ec	Edroy clay	13,950	1,140	15,090	2.1
Ed	Edroy clay, depressional	3,050	300	3,350	0.5
FA	Falfurrias association	210	1,620	1,830	0.2
GA	Galveston association	0	3,100	3,100	0.4
GM	Galveston-Mustang association	9,380	47,230	56,610	7.7
Is	Ijam soils	860	730	1,590	0.2
Ls	Leming loamy fine sand	1,700	2,430	4,130	0.6
MoC	Monteola clay, 3 to 5 percent slopes	2,890	180	3,070	0.4
MoD	Monteola clay, 5 to 8 percent slopes	1,830	80	1,910	0.3
Mu	Mustang fine sand	1,020	17,850	18,870	2.6
Na	Narta fine sandy loam	7,610	19,430	27,040	3.7
Nu	Nueces fine sand	2,650	0	2,650	0.4
Od	Odem fine sandy loam	5,810	0	5,810	0.8
On	Oil-waste land	410	30	440	0.1
Or	Orelia fine sandy loam	12,840	670	13,510	1.8
Os	Orelia sandy clay loam	65,070	1,530	66,600	9.1
PaA	Papalote fine sandy loam, 0 to 1 percent slopes	23,480	4,980	28,460	3.9
PaB	Papalote fine sandy loam, 1 to 3 percent slopes	6,610	30	6,640	0.9
PaC	Papalote fine sandy loam, 3 to 5 percent slopes	1,090	0	1,090	0.1
PeB	Pettus loam, 0 to 3 percent slopes	4,100	0	4,100	0.6
PfC	Pharr fine sandy loam, 1 to 5 percent slopes	3,640	0	3,640	0.5
Ps	Psamments	0	1,690	1,690	0.2
RaA	Raymondville clay loam, 0 to 1 percent slopes	50,252	4,614	54,866	7.5
RaB	Raymondville clay loam, 1 to 3 percent slopes	4,940	1,110	6,050	0.8
Sa	Sarita-Nueces complex	630	0	630	0.1
Sn	Sinton loam	6,700	0	6,700	0.9
Tn	Tatton complex	0	6,720	6,720	0.9
Va	Victine clay	120	10,050	10,170	1.4
VcA	Victoria clay, 0 to 1 percent slopes	130,300	7,750	138,050	18.9
VcB	Victoria clay, 1 to 3 percent slopes	4,590	150	4,740	0.6
Vd	Victoria clay, depressional	10,250	1,230	11,480	1.6
WfA	Willacy fine sandy loam, 0 to 1 percent slopes	1,910	0	1,910	0.3
WfB	Willacy fine sandy loam, 1 to 3 percent slopes	1,280	0	1,280	0.2
WfC	Willacy fine sandy loam, 3 to 5 percent slopes	3,730	0	3,730	0.5
	Water	9,408	110,592	120,000	16.4
	Total	448,000	283,776	731,776	100.0

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[All yields were estimated for a high level of management. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Cotton lint	Grain sorghum	Pasture
	Lb	Bu	AUM*
Ac: Aransas	450	55	5.0
Af: Aransas	---	---	5.0
As: Aransas	---	---	---
BT**:			
Barrada	---	---	---
Tatton	---	---	---
By**. Beaches			
Cs: Comitas	---	45	3.0
Dn: Delfina	---	35	5.0
Ds: Dianola	---	---	---
Dt: Dietrich	---	---	3.0
Ec: Edroy	300	35	4.0
Ed: Edroy	---	---	---
FA**: Falfurrias	---	---	---
GA**: Galveston	---	---	---
GM**:			
Galveston	---	---	---
Mustang	---	---	---
Is: Ijam	---	---	---
Ls: Leming	350	65	2.5
MoC: Monteola	300	40	3.0
MoD: Monteola	---	---	2.5
Mu: Mustang	---	---	---
Na: Narta	---	---	---

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Cotton lint	Grain sorghum	Pasture
	Lb	Bu	AUM*
Nu------------------------ Nueces	200	---	2.5
Od------------------------ Odem	300	55	5.5
On**. Oil-waste land			
Or, Os-------------------- Orelia	200	35	6.0
PaA----------------------- Papalote	250	45	5.5
PaB----------------------- Papalote	200	40	5.0
PaC----------------------- Papalote	150	30	4.5
PeB----------------------- Pettus	---	25	2.0
PfC----------------------- Pharr	---	20	4.0
Ps**---------------------- Psamments	---	---	---
RaA----------------------- Raymondville	425	60	4.0
RaB----------------------- Raymondville	400	55	4.0
Sa------------------------ Sarita	---	---	---
Sn------------------------ Sinton	350	70	6.0
Tn------------------------ Tatton	---	---	---
Va------------------------ Victine	200	30	---
VcA----------------------- Victoria	450	60	4.0
VcB----------------------- Victoria	350	55	4.0
Vd------------------------ Victoria	450	60	3.5
WfA----------------------- Willacy	500	70	4.5
WfB----------------------- Willacy	425	60	4.0
WfC----------------------- Willacy	---	50	3.5

* 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 a period of 30 days.

** See map unit description for the composition and behavior of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas excluded. Dashes mean no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I:					
San Patricio County	---	---	---	---	---
Aransas County	---	---	---	---	---
II:					
San Patricio County	241,532	12,830	16,950	204,032	7,720
Aransas County	19,714	1,140	1,230	17,344	---
III:					
San Patricio County	141,756	33,716	106,280	1,760	---
Aransas County	9,970	2,790	7,180	---	---
IV:					
San Patricio County	573	453	---	120	---
Aransas County	10,050	---	---	10,050	---
V:					
San Patricio County	6,970	---	6,970	---	---
Aransas County	360	---	360	---	---
VI:					
San Patricio County	35,829	7,833	20,386	7,610	---
Aransas County	94,439	33,407	41,602	19,430	---
VII:					
San Patricio County	1,070	210	860	---	---
Aransas County	13,220	1,620	730	10,870	---
VIII:					
San Patricio County	10,450	---	---	10,450	---
Aransas County	18,299	---	---	18,299	---

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Soils not listed do not support rangeland vegetation suited to grazing]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ac, Af: Aransas	Clayey Bottomland	Favorable	8,000	Virginia wildrye	10
		Normal	6,500	Little bluestem	10
		Unfavorable	4,500	Switchgrass	10
				Fourflower trichloris	10
				Indiangrass	10
				Vine-mesquite	10
				Buffalograss	10
				Panicum	5
As: Aransas	Salt Marsh	Favorable	7,000	Gulf cordgrass	70
		Normal	5,000	Little bluestem	5
		Unfavorable	2,000		
Cs: Comitas	Loamy Sand	Favorable	4,500	Little bluestem	20
		Normal	3,500	Crinkleawn	10
		Unfavorable	2,000	Switchgrass	10
				Arizona cottontop	10
				Plains bristlegrass	10
				Tanglehead	5
				Sideoats grama	5
				Hooded windmillgrass	5
				Fall witchgrass	5
				Pink pappusgrass	5
Dn: Delfina	Loamy Sand	Favorable	4,500	Little bluestem	40
		Normal	3,800	Arizona cottontop	10
		Unfavorable	2,000	Plains bristlegrass	10
				Tanglehead	5
				Sideoats grama	5
				Hooded windmillgrass	5
				Pink pappusgrass	5
Ds*: Dianola	Salt Flat	Favorable	1,200	Shoregrass	50
		Normal	850	Gulf cordgrass	5
		Unfavorable	500	Seashore saltgrass	5
Dt: Dietrich	Sandy Coastal Flat	Favorable	5,500	Gulf cordgrass	75
		Normal	4,500	Shoregrass	10
		Unfavorable	3,500	Marshhay cordgrass	5
Ec: Edroy	Claypan Prairie	Favorable	5,000	Twoflower trichloris	20
		Normal	4,000	Plains bristlegrass	10
		Unfavorable	2,500	Buffalograss	8
				Arizona cottontop	7
				Vine-mesquite	7
				Pink pappusgrass	7
				Sideoats grama	7
				Little bluestem	6
Ed: Edroy	Lakebed	Favorable	5,000	Hartweg paspalum	40
		Normal	4,000	Spike lovegrass	10
		Unfavorable	3,000	White tridens	10
				Buffalograss	5
				Knotroot panicum	5
FA*: Falfurrias	Sand Hill	Favorable	4,000	Seacoast bluestem	30
		Normal	3,500	Indiangrass	10
		Unfavorable	1,500	Crinkleawn	10
				Brownseed paspalum	10
				Wright threeawn	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
GA*: Galveston	Coastal Sand	Favorable	4,500	Seacoast bluestem	25
		Normal	3,000	Sea-oats	15
		Unfavorable	2,000	Switchgrass	10
				Brownseed paspalum	10
				Common reed	10
				Gulfdune paspalum	10
GM*:					
Galveston	Coastal Sand	Favorable	4,500	Seacoast bluestem	25
		Normal	3,000	Sea-oats	15
		Unfavorable	2,000	Switchgrass	10
				Brownseed paspalum	10
				Common reed	10
				Gulfdune paspalum	10
Mustang	Low Coastal Sand	Favorable	4,000	Marshhay cordgrass	25
		Normal	3,000	Seashore saltgrass	20
		Unfavorable	2,000	Seacoast bluestem	15
				Gulfdune paspalum	10
				Seashore dropseed	5
				Switchgrass	5
				Shoregrass	5
				Bushy sea-oxeye	5
Is*: Ijam	Salty Prairie	Favorable	7,000	Gulf cordgrass	73
		Normal	5,000	Marshhay cordgrass	5
		Unfavorable	2,000	Common reed	5
Ls: Leming	Sandy	Favorable	4,500	Little bluestem	20
		Normal	4,000	Crinkleawn	10
		Unfavorable	2,000	Switchgrass	10
				Arizona cottontop	10
				Brownseed paspalum	5
				Sideoats grama	5
				Hooded windmillgrass	5
				Knotroot panicum	5
				Plains bristlegrass	5
				Pink pappusgrass	5
MoC, MoD: Monteola	Blackland	Favorable	4,000	Sideoats grama	10
		Normal	3,500	Vine-mesquite	10
		Unfavorable	2,500	Texas cupgrass	10
				Pinhole bluestem	10
				Plains lovegrass	10
				Plains bristlegrass	8
				Buffalograss	8
				Texas needlegrass	7
				Curlymesquite	7
				Twoflower trichloris	5
Mu: Mustang	Low Coastal Sand	Favorable	4,000	Marshhay cordgrass	25
		Normal	3,000	Seashore saltgrass	20
		Unfavorable	2,000	Seacoast bluestem	15
				Gulfdune paspalum	10
				Seashore dropseed	5
				Switchgrass	5
				Shoregrass	5
				Bushy sea-oxeye	5
Na: Narta	Salty Prairie	Favorable	7,000	Gulf cordgrass	70
		Normal	5,000	Seashore saltgrass	5
		Unfavorable	2,000	Hartweg paspalum	5
				Marshhay cordgrass	5
				Switchgrass	5
				Buffalograss	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Nu: Nueces	Sandy	Favorable	5,000	Seacoast bluestem	50
		Normal	4,000	Brownseed paspalum	5
		Unfavorable	2,000	Indiangrass	5
				Switchgrass	5
				Tanglehead	5
				Fringeleaf paspalum	5
				Hooded windmillgrass	5
Od: Odem	Loamy Bottomland	Favorable	7,000	Fourflower trichloris	15
		Normal	6,000	Seacoast bluestem	15
		Unfavorable	4,000	Vine-mesquite	10
				Big sandbur	5
				Switchgrass	5
				Southwestern bristlegrass	5
				Texas needlegrass	5
				Virginia wildrye	5
				White tridens	5
				Sideoats grama	5
				Pink pappusgrass	5
Or, Os: Orelia	Claypan Prairie	Favorable	5,000	Twoflower trichloris	15
		Normal	4,000	Fourflower trichloris	10
		Unfavorable	2,500	Plains bristlegrass	10
				Buffalograss	8
				Arizona cottontop	7
				Pink pappusgrass	7
				Sideoats grama	7
				Vine-mesquite	7
				Pinhole bluestem	7
				Curlymesquite	7
				Hooded windmillgrass	5
				Lovegrass tridens	5
PaA, PaB, PaC: Papalote	Tight Sandy Loam	Favorable	4,800	Little bluestem	20
		Normal	4,000	Fourflower trichloris	10
		Unfavorable	2,000	Hooded windmillgrass	10
				Sideoats grama	7
				Arizona cottontop	5
				Tanglehead	5
				Lovegrass tridens	5
				Plains bristlegrass	5
				Plains lovegrass	5
PeB: Pettus	Shallow Ridge	Favorable	3,200	Arizona cottontop	20
		Normal	2,700	Sideoats grama	10
		Unfavorable	1,500	Little bluestem	10
				Twoflower trichloris	10
				Tanglehead	10
				Pinhole bluestem	5
				Green sprangletop	5
				Slim tridens	5
				Fall witchgrass	5
				Hairy grama	5
				Curlymesquite	5
PfC: Pharr	Gray Sandy Loam	Favorable	4,800	Twoflower trichloris	10
		Normal	4,000	Fourflower trichloris	10
		Unfavorable	2,500	Plains bristlegrass	10
				Hooded windmillgrass	10
				Pink pappusgrass	10
				Green sprangletop	8
				Lovegrass tridens	7
				Arizona cottontop	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight		
			Lb/acre		Pct
RaA, RaB: Raymondville	Clay Loam	Favorable	5,800	Fourflower trichloris	20
		Normal	4,500	Little bluestem	15
		Unfavorable	2,500	Pinhole bluestem	10
				Plains bristlegrass	10
				Pink pappusgrass	10
				Arizona cottontop	5
				Twoflower trichloris	5
				Buffalograss	5
				Curlymesquite	5
				Sideoats grama	5
Sa*:					
Sarita	Sandy	Favorable	5,000	Seacoast bluestem	50
		Normal	4,000	Brownseed paspalum	5
		Unfavorable	2,000	Indiangrass	5
				Switchgrass	5
				Tanglehead	5
				Fringeleaf paspalum	5
				Hooded windmillgrass	5
Nueces	Sandy	Favorable	5,000	Seacoast bluestem	50
		Normal	4,000	Brownseed paspalum	5
		Unfavorable	2,000	Indiangrass	5
				Switchgrass	5
				Tanglehead	5
				Fringeleaf paspalum	5
				Hooded windmillgrass	5
Sn: Sinton	Loamy Bottomland	Favorable	7,000	Fourflower trichloris	15
		Normal	6,000	Little bluestem	15
		Unfavorable	4,000	Vine-mesquite	10
				Switchgrass	5
				Southwestern bristlegrass	5
				Texas needlegrass	5
				Virginia wildrye	5
				White tridens	5
				Sideoats grama	5
				Buffalograss	5
				Pink pappusgrass	5
				Plains bristlegrass	5
Va: Victine	Salty Prairie	Favorable	7,000	Gulf cordgrass	70
		Normal	5,000	Marshhay cordgrass	5
		Unfavorable	2,000	Seashore saltgrass	5
				Hartweg paspalum	5
				Little bluestem	5
VcA, VcB, Vd: Victoria	Blackland	Favorable	5,000	Little bluestem	15
		Normal	4,000	Indiangrass	15
		Unfavorable	2,500	Fourflower trichloris	15
				Sideoats grama	15
				Arizona cottontop	8
				Pinhole bluestem	7
				Pink pappusgrass	5
				Plains bristlegrass	5
				Vine-mesquite	5
				Texas needlegrass	5
WfA, WfB, WfC: Willacy	Sandy Loam	Favorable	5,400	Gray horsebrush	20
		Normal	4,500	Twoflower trichloris	15
		Unfavorable	3,000	Fourflower trichloris	15
				Little bluestem	10
				Hooded windmillgrass	10

* See map unit description for the composition and behavior of the map unit.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ac, Af, As: Aransas	Severe: floods, too clayey, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.
BT*:					
Barrada	Severe: floods, wetness, too clayey.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.
Tatton	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
By*. Beaches					
Cs: Comitas	Moderate: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.
Dn: Delfina	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.
Ds*: Dianola	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Dt: Dietrich	Moderate: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, shrink-swell.
Ec, Ed: Edroy	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.
FA*: Falfurrias	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
GA*: Galveston	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
GM*:					
Galveston	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Mustang	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Is*: Ijam	Severe: wetness, too clayey.	Severe: wetness, low strength, shrink-swell.	Severe: wetness, low strength, shrink-swell.	Severe: wetness, low strength, shrink-swell.	Severe: wetness, low strength, shrink-swell.

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
Ls: Leming	Moderate: too clayey, cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.
MoC, MoD: Monteola	Severe: too clayey, cutbanks cave.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Mu: Mustang	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Na: Narta	Severe: wetness.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Nu: Nueces	Moderate: cutbanks cave.	Slight	Moderate: shrink-swell, wetness.	Slight	Moderate: low strength.
Od: Odem	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
On*. Oil-waste land					
Or, Os: Orelia	Moderate: wetness.	Moderate: shrink-swell, low strength, wetness.	Moderate: shrink-swell, low strength, wetness.	Moderate: shrink-swell, corrosive.	Moderate: shrink-swell, low strength, wetness.
PaA, PaB, PaC: Papalote	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: corrosive, shrink-swell.	Moderate: low strength, shrink-swell.
PeB: Pettus	Moderate: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Moderate: low strength.
PfC: Pharr	Slight	Slight	Slight	Slight	Moderate: low strength.
Ps*: Psamments	Severe: cutbanks cave, too sandy.	Severe: low strength.	Severe: low strength.	Severe: low strength.	Severe: low strength.
RaA, RaB: Raymondville	Severe: too clayey, cutbanks cave.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Sa*:					
Sarita	Severe: too sandy, cutbanks cave.	Slight	Moderate: low strength, shrink-swell.	Slight	Moderate: low strength.
Nueces	Moderate: cutbanks cave.	Slight	Moderate: shrink-swell, wetness.	Slight	Moderate: low strength.
Sn: Sinton	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
Tn*: Tatton	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.

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
Va: Victine	Severe: too clayey, cutbanks cave.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
VcA, VcB, Vd: Victoria	Severe: too clayey, cutbanks cave.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
WfA, WfB, WfC: Willacy	Slight	Slight	Slight	Slight	Moderate: low strength.

* See map unit description for the composition and behavior of the map unit.

TABLE 10.--SANITARY FACILITIES

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ac, Af, As: Aransas	Severe: percs slowly, floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: too clayey, wetness.
BT*:					
Barrada	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: area reclaim, wetness, excess salt.
Tatton	Severe: floods, wetness.	Severe: seepage, floods, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Poor: too sandy, excess salt, wetness.
By*. Beaches					
Cs: Comitas	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Dn: Delfina	Moderate: percs slowly.	Slight	Slight	Slight	Fair: too sandy.
Ds*: Dianola	Severe: floods, wetness.	Severe: seepage, floods.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Poor: too sandy, excess salt, wetness.
Dt: Dietrich	Severe: percs slowly, wetness.	Slight	Severe: wetness.	Moderate: wetness.	Poor: too sandy.
Ec, Ed: Edroy	Severe: percs slowly, wetness.	Slight	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, wetness.
FA*: Falfurrias	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
GA*: Galveston	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: too sandy, wetness.
GM*:					
Galveston	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: too sandy, wetness.
Mustang	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: too sandy, wetness.
Is*: Ijam	Severe: percs slowly, wetness.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness.

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
Ls----------------- Leming	Severe: percs slowly.	Slight-----------	Slight-----------	Slight-----------	Fair: too sandy.
MoC, MoD------------ Monteola	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey.
Mu----------------- Mustang	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: too sandy, wetness.
Na----------------- Narta	Severe: percs slowly.	Slight-----------	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: wetness, area reclaim.
Nu----------------- Nueces	Severe: percs slowly.	Severe: seepage.	Slight-----------	Slight-----------	Poor: too sandy.
Od----------------- Odem	Severe: floods.	Severe: floods, seepage.	Severe: floods.	Severe: floods, seepage.	Good.
On*. Oil-waste land					
Or, Os-------------- Orelia	Severe: percs slowly.	Slight-----------	Moderate: wetness.	Moderate: wetness.	Fair: excess sodium.
PaA---------------- Papalote	Severe: percs slowly.	Slight-----------	Slight-----------	Slight-----------	Good.
PaB, PaC------------ Papalote	Severe: percs slowly.	Moderate: slope.	Slight-----------	Slight-----------	Good.
PeB---------------- Pettus	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Poor: thin layer.
PfC---------------- Pharr	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
Ps*---------------- Psamments	Severe: seepage.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage, too sandy.	Poor: seepage, too sandy, area reclaim.
RaA, RaB------------ Raymondville	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Fair: too clayey.
Sa*:					
Sarita--------------	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy.
Nueces-------------	Severe: percs slowly.	Severe: seepage.	Slight-----------	Slight-----------	Poor: too sandy.
Sn----------------- Sinton	Severe: floods.	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Good.
Tn*---------------- Tatton	Severe: floods, wetness.	Severe: seepage, floods, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Poor: too sandy, excess salt, wetness.
Va----------------- Victine	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, area reclaim.

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
VcA, VcB, Vd-------- Victoria	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
WfA, WfB, WfC------- Willacy	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Good.

* See map unit description for the composition and behavior of the map unit.

TABLE 11.--CONSTRUCTION MATERIALS

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ac, Af: Aransas	Poor: shrink-swell, low strength, wetness.	Unsuited	Unsuited	Poor: too clayey, wetness.
As: Aransas	Poor: shrink-swell, low strength, wetness.	Unsuited	Unsuited	Poor: too clayey, wetness, excess salt.
BT*:				
Barrada	Poor: shrink-swell, wetness, low strength.	Unsuited	Unsuited	Poor: excess salt, wetness, too clayey.
Tatton	Poor: wetness.	Poor: excess fines.	Unsuited	Poor: excess salt, too sandy, wetness.
By*. Beaches				
Cs: Comitas	Fair: low strength.	Poor: excess fines.	Unsuited	Poor: too sandy.
Dn: Delfina	Fair: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too sandy.
Ds*: Dianola	Poor: wetness.	Poor: excess fines.	Unsuited	Poor: excess salt, too sandy, wetness.
Dt: Dietrich	Poor: low strength.	Poor: excess fines.	Unsuited	Poor: too sandy.
Ec, Ed: Edroy	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, wetness.
FA*: Falfurrias	Good	Fair: excess fines.	Unsuited	Poor: too sandy.
GA*: Galveston	Poor: wetness.	Fair: excess fines.	Unsuited	Poor: too sandy.
GM*:				
Galveston	Poor: wetness.	Fair: excess fines.	Unsuited	Poor: too sandy.
Mustang	Poor: wetness.	Fair: excess fines.	Unsuited	Poor: too sandy, wetness.
Is*: Ijam	Poor: low strength, shrink-swell, wetness.	Unsuited	Unsuited	Poor: wetness, too clayey, excess salt.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ls: Leming	Fair: low strength.	Poor: excess fines.	Unsuited	Poor: too sandy.
MoC, MoD: Monteola	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey.
Mu: Mustang	Poor: wetness.	Fair: excess fines.	Unsuited	Poor: too sandy, wetness.
Na: Narta	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: excess salt, excess sodium, thin layer.
Nu: Nueces	Fair: low strength.	Poor: excess fines.	Unsuited	Poor: too sandy.
Od: Odem	Good	Poor: excess fines.	Unsuited	Good.
On*. Oil-waste land				
Or, Os: Orelia	Poor: low strength.	Unsuited	Unsuited	Poor: excess salt, excess sodium.
PaA, PaB, PaC: Papalote	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Fair: thin layer.
PeB: Pettus	Fair: low strength.	Unsuited	Unsuited	Fair: excess lime, thin layer.
PfC: Pharr	Fair: low strength.	Unsuited	Unsuited	Good.
Ps*: Psamments	Poor: area reclaim.	Poor: excess fines.	Unsuited	Poor: too sandy, area reclaim.
RaA, RaB: Raymondville	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: too clayey, thin layer.
Sa*:				
Sarita	Fair: low strength.	Fair	Unsuited	Poor: too sandy.
Nueces	Fair: low strength.	Poor: excess fines.	Unsuited	Poor: too sandy.
Sn: Sinton	Fair: low strength.	Unsuited	Unsuited	Good.
Tn*: Tatton	Poor: wetness.	Poor: excess fines.	Unsuited	Poor: excess salt, too sandy, wetness.
Va: Victine	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Poor: too clayey, excess salt.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
VcA, VcB, Vd---------- Victoria	Poor: shrink-swell, low strength.	Unsuited-------------	Unsuited-------------	Poor: too clayey.
WfA, WfB, WfC--------- Willacy	Fair: low strength.	Unsuited-------------	Unsuited-------------	Fair: thin layer.

* See map unit description for the composition and behavior of the map unit.

TABLE 12.--WATER MANAGEMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not evaluated]

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
Ac, Af: Aransas	Slight	Moderate: compressible, low strength.	Percs slowly, floods, wetness.	Slow intake, floods, wetness.	Percs slowly, floods, wetness.	Percs slowly, wetness.
As: Aransas	Slight	Moderate: compressible, low strength.	Percs slowly, excess salt, floods.	Excess salt, floods, slow intake.	Percs slowly, floods, wetness.	Excess salt, percs slowly, wetness.
BT*:						
Barrada	Severe: excess salt, wetness, cutbanks cave.	Severe: unstable fill, hard to pack.	Excess salt, floods, wetness.	Excess salt, percs slowly.	Not needed	Not needed.
Tatton	Severe: seepage.	Severe: seepage, piping, excess salt.	Excess salt, floods, wetness.	Excess salt, floods.	Not needed	Excess salt, wetness.
By*. Beaches						
Cs: Comitas	Severe: seepage.	Moderate: piping.	Not needed	Fast intake, droughty.	Too sandy	Droughty, erodes easily.
Dn: Delfina	Moderate: seepage.	Slight	Favorable	Favorable	Favorable	Favorable.
Ds*: Dianola	Severe: seepage.	Severe: seepage, piping.	Excess salt, cutbanks cave, wetness.	Excess salt, seepage.	Not needed	Excess salt, wetness.
Dt: Dietrich	Slight	Moderate: unstable fill.	Percs slowly, wetness.	Percs slowly, wetness, excess salt.	Not needed	Percs slowly, wetness.
Ec, Ed: Edroy	Moderate: seepage, thin layer.	Moderate: compressible.	Floods, percs slowly.	Percs slowly, floods, wetness.	Percs slowly, wetness.	Percs slowly, wetness.
FA*: Falfurrias	Severe: seepage.	Severe: seepage, unstable fill, piping.	Not needed	Droughty, fast intake.	Too sandy	Not needed.
GA*: Galveston	Severe: seepage.	Severe: unstable fill, seepage.	Cutbanks cave, wetness, floods.	Floods, wetness, fast intake.	Wetness, piping.	Wetness, fast intake.
GM*:						
Galveston	Severe: seepage.	Severe: unstable fill, seepage.	Cutbanks cave, wetness, floods.	Floods, wetness, fast intake.	Wetness, piping.	Wetness, fast intake.
Mustang	Severe: seepage.	Severe: unstable fill, seepage.	Floods, cutbanks cave, wetness.	Floods, wetness.	Too sandy, wetness.	Wetness.
Is*: Ijam	Slight	Moderate: unstable fill, low strength.	Wetness, percs slowly, excess salt.	Wetness, percs slowly, excess salt.	Percs slowly, wetness.	Wetness, percs slowly, excess salt.
Ls: Leming	Slight	Moderate: piping.	Percs slowly	Droughty, erodes easily.	Too sandy	Droughty, too sandy.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
MoC, MoD Monteola	Slight	Moderate: compressible.	Percs slowly	Percs slowly	Percs slowly	Percs slowly.
Mu Mustang	Severe: seepage.	Severe: unstable fill, seepage.	Floods, cutbanks cave, wetness.	Floods, wetness.	Too sandy, wetness.	Wetness.
Na Narta	Slight	Moderate: compressible.	Excess salt, percs slowly.	Excess salt, excess sodium, slow intake.	Not needed	Excess salt, excess sodium, percs slowly.
Nu Nueces	Moderate: seepage.	Moderate: unstable fill, piping, erodes easily.	Not needed	Too sandy, fast intake.	Erodes easily, piping.	Erodes easily.
Od Odem	Severe: seepage.	Moderate: unstable fill, piping.	Not needed	Fast intake, seepage.	Not needed	Favorable.
On*. Oil-waste land						
Or, Os Orelia	Slight	Moderate: compressible.	Percs slowly, excess sodium, excess salt.	Slow intake, droughty, excess sodium.	Percs slowly, wetness.	Droughty, excess salt, excess sodium.
PaA, PaB, PaC Papalote	Moderate: seepage.	Slight	Percs slowly	Favorable	Favorable	Favorable.
PeB Pettus	Severe: seepage.	Moderate: thin layer, seepage.	Not needed	Excess lime, seepage, rooting depth.	Cemented pan, droughty.	Droughty, rooting depth.
PfC Pharr	Moderate: seepage.	Moderate: compressible.	Favorable	Favorable	Favorable	Favorable.
Ps* Psamments	Severe: seepage.	Severe: unstable fill, hard to pack, seepage.	Not needed	Soil blowing, seepage.	Soil blowing, too sandy.	Not needed.
RaA, RaB Raymondville	Slight	Moderate: compressible.	Percs slowly, cutbanks cave.	Percs slowly	Percs slowly	Favorable.
Sa*: Sarita	Severe: seepage.	Severe: seepage, unstable fill.	Not needed	Fast intake, droughty.	Too sandy	Droughty.
Nueces	Moderate: seepage.	Moderate: unstable fill, piping, erodes easily.	Not needed	Too sandy, fast intake.	Erodes easily, piping.	Erodes easily.
Sn Sinton	Severe: seepage.	Moderate: compressible, piping.	Floods	Floods	Favorable	Favorable.
Tn* Tatton	Severe: seepage.	Severe: seepage, piping, excess salt.	Excess salt, floods, wetness.	Excess salt, floods.	Not needed	Excess salt, wetness.
Va Victine	Slight	Moderate: compressible, unstable fill.	Percs slowly, cutbanks cave, excess salt.	Slow intake, excess salt.	Percs slowly	Percs slowly, excess salt.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
VcA, VcB, Vd------ Victoria	Slight---------	Moderate: compressible, unstable fill.	Percs slowly, cutbanks cave.	Slow intake----	Percs slowly---	Percs slowly.
WfA, WfB, WfC----- Willacy	Moderate: seepage.	Slight---------	Favorable------	Favorable------	Favorable------	Favorable.

* See map unit description for the composition and behavior of the map unit.

TABLE 13.--SUITABILITY OF SOILS FOR LANDSCAPE AND GARDEN PLANTS

[No flowers and groundcover, vines, shrubs, trees, or vegetables and fruits are recommended for the soils not listed because of flooding, salinity, or wetness]

Soil name and map symbol	Flowers and groundcover	Vines	Shrubs	Trees	Vegetables and fruits
Cs: Comitas	Beach wormwood, hibiscus, cape-weed, memorial rose, St. Johnswort, drawf bamboo, thrift.	Scarlet clematis, greenbrier, mustang grape, winter grape, American wisteria.	Latana, bayberry, waxmyrtle, southern blackhaw, Mexican plum, sweetbay, silk bay, boxwood.	Live oak, southern magnolia, Drummond waxmallow, eucalyptus, winged elm.	Spinach, eggplant, strawberry, swiss chard, potato, beet, lettuce, watermelon.
Dn: Delfina	Canna, gladiolus, geranium, hibiscus, broom, cape-weed, memorial rose, thrift.	Scarlet clematis, greenbrier, mustang grape, winter grape, American wisteria, crossvine, dewberry.	Lantana, wild plum, Mexican plum, American holly, retama, gum elastic, boxwood, wild olive.	Live oak, winged elm, eucalyptus, mimosa, huisache, mesquite, mulberry, hackberry.	Beet, broccoli, brussels sprouts, cantaloup, carrot, orange, grapefruit.
Dt: Dietrich	Beach wormwood, cape-weed, dwarf bamboo, memorial rose, St. Johnswort, canna.	Trumpetcreeper, winter grape, moonflower, honeysuckle, trumpetvine, mustang grape.	Waxmyrtle, wild plum, dwarf palmetto, tamarick, boxwood, oleander, retama.	Huisache, mesquite, mimosa, wild olive, chinaberry.	Cabbage, cantaloup, collard, common bean, okra, onion, squash, strawberry, dewberry.
FA[1]: Falfurrias	Beach wormwood, cape-weed, coralbean, dwarf bamboo, St. Johnswort, memorial rose, yarrow.	Scarlet clematis, winter grape, greenbrier, mustang grape, trumpetcreeper, American wisteria, fleeceflower.	Dwarf pawpaw, lantana, bayberry, waxmyrtle, sweetbay, redbay, gum elastic, catclaw acacia, oleander.	Live oak, Drummond waxmallow, palm, eucalyptus, southern magnolia.	Spinach, Swiss chard, eggplant, lettuce, tomato, strawberry, watermelon.
GA[1], GM[1]: Galveston	Beach wormwood, cape-weed, coralbean, dwarf bamboo, beautyberry, thrift, yarrow.	Trumpetcreeper, greenbrier, mustang grape, winter grape, scarlet clematis, trumpet-vine.	Redbud, lantana, sweetbay, redbay, waxmyrtle, boxwood, wild plum, oleander.	Live oak, Drummond waxmallow, palm, southern magnolia, eucalyptus.	Spinach, celery, eggplant, tomato, watermelon, cucumber, pepper, squash.
Ls: Leming	Canna, hibiscus, capeweed, memorial rose, St. Johnswort, thrift, dwarf bamboo.	Trumpetcreeper, greenbrier, winter grape, mustang grape, honeysuckle, fleeceflower, moonflower.	Crapemyrtle, redbud, gardenia, wild plum, southern blackhaw, yaupon, American holly, catclaw acacia.	Huisache, mesquite, mulberry, chinaberry, pecan, mimosa, ash, wild olive.	Beet, carrot, cucumber, kale, lettuce, strawberry, watermelon, tomato.

See footnote at end of table.

TABLE 13.--SUITABILITY OF SOILS FOR LANDSCAPE AND GARDEN PLANTS--Continued

Soil name and map symbol	Flowers and groundcover	Vines	Shrubs	Trees	Vegetables and fruits
MoC, MoD------------- Monteola	Amaryllis, Aztec marigold, daylily, iris, beebalm, cosmos.	Peppervine, moonflower, honeysuckle, English ivy, morningglory, Carolina jessamine, Virginia creeper, trumpet-vine.	Agarita, bottlebrush, butterflybush, smoketree, burningbush, yaupon, privet.	Mesquite, mimosa, American linden, osageorange, catalpa, hackberry, anaqua, chinaberry.	Corn, okra, parsley, artichoke, collard, common bean, fig, tomato.
Nu------------------ Nueces	Chrysanthemum, gladiolus, daffodil, geranium, canna, shasta daisy, petunia, hollyhock.	Moonflower, morningglory, honeysuckle, American wisteria, mustang grape, fleeceflower, dewberry, Carolina jessamine.	Lantana, privet, Mexican plum, wild plum, fringetree, dwarf palmetto, retama, boxwood.	Mulberry, pale verde, magnolia, Drummond waxmallow, eucalyptus, mimosa, hackberry, bitter orange.	Spinach, lettuce, pepper, onion, strawberry, watermelon, tomato.
Or, Os--------------- Orelia	Beebalm, daylily, bugleweed, lily turf, creeping lippia, moss sandwort, ground-ivy, plantain lily.	Trumpetcreeper, peppervine, moonflower, Japanese honeysuckle, English ivy, morningglory.	Shadblow, western soapberry, oleander, bottlebrush, buttonbush, crapemyrtle, tamarisk, shrimpbush.	Huisache, mesquite, mimosa, sycamore, willow, ash, pecan, chinaberry.	Corn, lima bean, okra, parsley, artichoke, tomato, fig, onion.
PaA, PaB, PaC-------- Papalote	Chrysanthemum, amaryllis, petunia, daylily, gladiolus, pansy, verbena, sweet pea.	Honeysuckle, peppervine, blackberry, dewberry, trumpet-vine, English ivy, wisteria, morningglory.	Bottlebrush, butterflybush, redbud, smoketree, persimmon, castor-bean, yaupon.	Hackberry, mesquite, boxelder, mimosa, huisache, live oak, cottonwood, palo verde.	Turnip, beet, carrot, broccoli, cabbage, bean, onion, pumpkin, orange, grapefruit.
PeB------------------ Pettus	Crocus, canna, daylily, petunia, sweet pea, cosmos, zinnia, verbena.	Dewberry, blackberry, peppervine, moonflower, honeysuckle, English ivy, wisteria, morningglory.	Bottlebrush, smoketree, cenizo, mescalbean, retama, catclaw acacia, butana, agarita.	Huisache, mimosa, mesquite, palo verde, live oak, chinaberry.	Cantaloup, celery, corn, cucumber, garlic, lettuce, mustard, pea.
PfC------------------ Pharr	Beebalm, daylily, hibiscus, canna, gladiolus, geranium, pansy, poppy.	Peppervine, moonflower, winter grape, wisteria, honeysuckle, trumpet-vine, dewberry, Virginia creeper.	Lantana, wild plum, Mexican plum, retama, catclaw acacia, boxwood, dwarf palmetto, gum elastic.	Mimosa, mesquite, huisache, eucalyptus, live oak, osageorange, mulberry, boxelder.	Bean, cucumber, pea, corn, eggplant, spinach, orange, grapefruit, strawberry.

See footnote at end of table.

TABLE 13.--SUITABILITY OF SOILS FOR LANDSCAPE AND GARDEN PLANTS--Continued

Soil name and map symbol	Flowers and groundcover	Vines	Shrubs	Trees	Vegetables and fruits
RaA, RaB: Raymondville	Chrysanthemum, aster, carnation, cosmos, poppy, petunia, pansy, sweet pea, rose.	Trumpetcreeper, peppervine, English ivy, honeysuckle, moonflower, Carolina jessamine, blackberry, dewberry.	Agarita, herculesclub, yaupon, pyracantha, oleander, western soapberry, buckeye, crapemyrtle, privet.	Pecan, catalpa, chinaberry, anaqua, sycamore, cottonwood, mesquite, cedar, elm.	Corn, bean, pea, onion, cabbage, asparagus, okra, fig, peach, plum.
Sa[1]: Sarita	Beach wormwood, cape-weed, dwarf bamboo, memorial rose, St. Johnswort, thrift, coralbean.	Scarlet clematis, greenbrier, winter grape, mustang grape, wisteria, trumpet-vine, fleeceflower.	Waxmyrtle, gum elastic, southern blackhaw, lantana, Mexican plum, wild plum, retama, dwarf pawpaw.	Mesquite, eucalyptus, southern magnolia, mulberry, Drummond waxmallow.	Spinach, strawberry, watermelon, pepper, carrot, cucumber, eggplant.
VcA, VcB, Vd: Victoria	Beebalm daylily, iris, narcissus, lily turf, ground ivy, wintercreeper, plantain lily.	Peppervine, moonflower, honeysuckle, Virginia creeper, trumpet-vine, English ivy, morningglory, trumpetcreeper.	Shadblow, buttonbush, fringetree, shrimpbush, oleander, pyracantha, tamarisk, crapemyrtle.	Huisache, mesquite, pecan, hackberry, chinaberry, ash, cottonwood, mimosa.	Artichoke, celery, collard, bean, corn, okra, onion, tomato.
WfA, WfB, WfC: Willacy	Amaryllis, canna, gladiolus, geranium, petunia, sweet pea, verbena, poppy.	Blackberry, dewberry, winter grape, fleeceflower, wisteria, morningglory, honeysuckle, English ivy.	Lantana, wild plum, Mexican plum, gum elastic, catclaw acacia, retama, persimmon, buttonbush.	Mulberry, catalpa, hackberry, huisache, mesquite, bitter orange, eucalyptus, ash.	Asparagus, carrot, beet, lettuce, bean, onion, strawberry, orange, grapefruit.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior characteristics of the map unit.

TABLE 14.--RECREATIONAL DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ac, Af, As------------ Aransas	Severe: floods, wetness, too clayey.	Severe: wetness, too clayey.	Severe: floods, wetness, too clayey.	Severe: wetness, too clayey.
BT*:				
Barrada--------------	Severe: floods, wetness, too clayey.	Severe: floods, wetness, too clayey.	Severe: floods, wetness, too clayey.	Severe: floods, wetness, too clayey.
Tatton---------------	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.
By*. Beaches				
Cs-------------------- Comitas	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Dn-------------------- Delfina	Moderate: percs slowly, too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Ds*------------------- Dianola	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.
Dt-------------------- Dietrich	Moderate: wetness, percs slowly, too sandy.	Moderate: wetness, too sandy.	Severe: too sandy.	Severe: too sandy.
Ec, Ed---------------- Edroy	Severe: wetness, floods, too clayey.	Severe: wetness, floods, too clayey.	Severe: wetness, floods, too clayey.	Severe: wetness, floods, too clayey.
FA*------------------- Falfurrias	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
GA*------------------- Galveston	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
GM*:				
Galveston------------	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Mustang--------------	Severe: wetness, floods, too sandy.	Severe: wetness, too sandy.	Severe: wetness, floods, too sandy.	Severe: wetness, too sandy.
Is*------------------- Ijam	Severe: wetness, percs slowly, too clayey.	Severe: wetness, too clayey.	Severe: wetness, percs slowly, too clayey.	Severe: wetness, too clayey.
Ls-------------------- Leming	Moderate: too sandy, percs slowly.	Moderate: too sandy.	Moderate: too sandy, percs slowly.	Moderate: too sandy.

See footnote at end of table.

TABLE 14.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
MoC-------- Monteola	Severe: percs slowly, too clayey.	Severe: too clayey.	Severe: percs slowly, too clayey.	Severe: too clayey.
MoD-------- Monteola	Severe: percs slowly, too clayey.	Severe: too clayey.	Severe: percs slowly, too clayey, slope.	Severe: too clayey.
Mu-------- Mustang	Severe: wetness, floods, too sandy.	Severe: wetness, too sandy.	Severe: wetness, floods, too sandy.	Severe: wetness, too sandy.
Na-------- Narta	Severe: percs slowly, wetness.	Moderate: wetness.	Severe: percs slowly, wetness.	Moderate: wetness.
Nu-------- Nueces	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Od-------- Odem	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
On*. Oil-waste land				
Or, Os-------- Orelia	Severe: percs slowly.	Moderate: wetness, dusty.	Severe: percs slowly.	Moderate: wetness, dusty.
PaA-------- Papalote	Moderate: percs slowly.	Slight--------	Slight--------	Slight.
PaB, PaC-------- Papalote	Moderate: percs slowly.	Slight--------	Moderate: slope.	Slight.
PeB-------- Pettus	Slight--------	Slight--------	Slight--------	Slight.
PfC-------- Pharr	Slight--------	Slight--------	Moderate: slope.	Slight.
Ps*-------- Psamments	Severe: soil blowing, too sandy.	Severe: soil blowing, too sandy.	Severe: soil blowing, too sandy.	Severe: soil blowing, too sandy.
RaA, RaB-------- Raymondville	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: percs slowly, too clayey.	Moderate: too clayey.
Sa*:				
Sarita--------	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Nueces--------	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Sn-------- Sinton	Severe: floods.	Slight--------	Moderate: floods.	Slight.
Tn*-------- Tatton	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.
Va-------- Victine	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.

See footnote at end of table.

TABLE 14.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
VcA, VcB, Vd---------- Victoria	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.
WfA------------------- Willacy	Slight---------------	Slight---------------	Slight---------------	Slight.
WfB, WfC-------------- Willacy	Slight---------------	Slight---------------	Moderate: slope.	Slight.

* See map unit description for the composition and behavior of the map unit.

TABLE 15.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates 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
Ac----------------- Aransas	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair.
Af----------------- Aransas	Very poor	Poor	Fair	Fair	Poor	Good	Poor	Fair	Fair.
As----------------- Aransas	Very poor	Poor	Poor	Fair	Poor	Good	Poor	Fair	Poor.
BT*:									
Barrada-----------	Very poor	Very poor	Very poor	Very poor	Poor	Good	Very poor	Fair	Very poor.
Tatton------------	Very poor	Very poor	Very poor	Very poor	Fair	Fair	Very poor	Fair	Very poor.
By*. Beaches									
Cs----------------- Comitas	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Dn----------------- Delfina	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Ds*---------------- Dianola	Very poor	Very poor	Very poor	Very poor	Good	Good	Very poor	Good	Very poor.
Dt----------------- Dietrich	Fair	Fair	Fair	Good	Poor	Fair	Fair	Fair	Fair.
Ec----------------- Edroy	Fair	Fair	Poor	Poor	Poor	Good	Fair	Fair	Poor.
Ed----------------- Edroy	Very poor	Poor	Poor	Poor	Poor	Good	Poor	Fair	Poor.
FA*---------------- Falfurrias	Very poor	Very poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
GA*---------------- Galveston	Poor	Fair	Fair	Fair	Very poor	Fair	Fair	Poor	Fair.
GM*:									
Galveston---------	Poor	Fair	Fair	Fair	Very poor	Fair	Fair	Poor	Fair.
Mustang-----------	Poor	Poor	Fair	Fair	Fair	Good	Poor	Fair	Fair.
Is*---------------- Ijam	Very poor	Very poor	Poor	---	Good	Good	Very poor	Good	---
Ls----------------- Leming	Fair	Good	Good	Good	Poor	Poor	Good	Poor	Good.
MoC---------------- Monteola	Fair	Good	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
MoD---------------- Monteola	Poor	Fair	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor.
Mu----------------- Mustang	Poor	Poor	Fair	Fair	Fair	Good	Poor	Fair	Fair.

See footnote at end of table.

TABLE 15.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Na------------------ Narta	Poor	Poor	Very poor	Very poor	Fair	Fair	Poor	Fair	Very poor.
Nu------------------ Nueces	Fair	Poor	Good	Good	Poor	Poor	Fair	Poor	Good.
Od------------------ Odem	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
On*. Oil-waste land									
Or, Os-------------- Orelia	Fair	Fair	Good	Good	Fair	Fair	Fair	Fair	Good.
PaA, PaB, PaC------- Papalote	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
PeB----------------- Pettus	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
PfC. Pharr--------------	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Ps*----------------- Psamments	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
RaA, RaB------------ Raymondville	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
Sa*: Sarita-------------	Fair	Fair	Fair	Good	Poor	Very poor	Fair	Very poor	Fair.
Nueces-------------	Fair	Poor	Good	Good	Poor	Poor	Fair	Poor	Good.
Sn------------------ Sinton	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Tn*----------------- Tatton	Very poor	Very poor	Very poor	Very poor	Fair	Fair	Very poor	Fair	Very poor.
Va------------------ Victine	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor.
VcA, VcB, Vd-------- Victoria	Good	Good	Poor	Fair	Poor	Fair	Fair	Poor	Poor.
WfA, WfB------------ Willacy	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
WfC----------------- Willacy	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.

* See map unit description for the composition and behavior of the map unit.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

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	
Ac, Af, As--------- Aransas	0-66	Clay------------	CH	A-7-6	100	95-100	95-100	75-95	51-75	30-50
BT*:										
Barrada-----------	0-36	Clay------------	CH	A-7-6	90-100	85-100	80-100	80-100	51-66	27-39
	36-60	Silty clay loam, clay, sandy clay loam.	CL, CH	A-6, A-7-6	90-100	85-100	80-100	70-95	30-52	11-28
Tatton------------	0-5	Loamy sand------	SM	A-2-4, A-4	85-100	80-100	80-98	20-50	<25	NP-3
	5-60	Loamy fine sand, loamy sand.	SM	A-2-4, A-4	85-100	80-100	80-98	13-40	<25	NP-3
By*. Beaches										
Cs---------------- Comitas	0-28	Loamy fine sand	SM, SM-SC	A-2-4	95-100	95-100	85-100	15-25	<25	NP-4
	28-80	Fine sandy loam, sandy clay loam.	SM, SC, SM-SC	A-2-4, A-2-6, A-4, A-6	95-100	90-100	80-95	30-50	<34	NP-14
Dn---------------- Delfina	0-14	Loamy fine sand	SM, SM-SC	A-2-4, A-4	100	100	85-100	20-45	<25	NP-7
	14-40	Sandy clay loam, clay loam.	SC, CL	A-6, A-7	100	100	90-100	40-55	34-44	14-22
	40-60	Sandy clay loam, fine sandy loam.	SC	A-6	90-100	75-95	70-90	36-50	30-40	11-20
Ds*--------------- Dianola	0-6	Loamy fine sand	SM	A-2-4, A-4	85-100	80-100	80-98	20-50	<25	NP-3
	6-60	Stratified loamy fine sand to fine sand.	SM	A-2-4, A-4	85-100	80-100	80-98	13-40	<25	NP-3
Dt---------------- Dietrich	0-12	Fine sand-------	SM, SM-SC	A-2-4	100	100	90-100	15-35	<25	NP-7
	12-45	Clay.loam, sandy clay loam, loam.	SC, CL, CH	A-6, A-7-6	100	100	90-100	40-75	40-53	25-35
	45-72	Loam, sandy clay loam.	SC, CL, CH	A-6, A-7-6	95-100	90-100	85-100	36-70	40-55	25-40
Ec, Ed------------ Edroy	0-18	Clay------------	CH	A-7-6	100	100	90-100	75-95	51-60	27-35
	18-42	Clay loam, clay, sandy clay.	CL, CH	A-7-6	100	95-100	90-100	70-90	41-55	20-30
	42-60	Sandy clay loam, clay loam, loam.	SC, CL	A-7-6, A-6	100	95-100	80-95	40-55	30-42	11-20
FA*--------------- Falfurrias	0-80	Fine sand-------	SP-SM, SM	A-2-4, A-3	100	100	75-100	5-25	<25	NP-3
GA*--------------- Galveston	0-4	Fine sand-------	SW-SM, SP-SM, SM	A-3, A-2-4	100	95-100	65-90	5-20	<25	NP-3
	4-72	Fine sand, sand	SW-SM, SP-SM	A-3, A-2-4	100	90-100	65-90	5-10	---	NP
GM*:										
Galveston---------	0-4	Fine sand-------	SW-SM, SP-SM, SM	A-3, A-2-4	100	95-100	65-90	5-20	<25	NP-3
	4-72	Fine sand, sand	SW-SM, SP-SM	A-3, A-2-4	100	90-100	65-90	5-10	---	NP
Mustang-----------	0-5	Fine sand-------	SW-SM	A-2-4, A-3	85-100	80-100	60-80	5-12	---	NP
	5-60	Fine sand, sand	SW-SM	A-2-4, A-3	85-100	80-100	60-80	5-12	---	NP

See footnote at end of table.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
Is*----------------- Ijam	0-6	Clay------------	CH, CL	A-7	98-100	90-100	90-99	70-95	45-80	25-55
	6-60	Clay------------	CH	A-7	100	90-100	90-100	80-98	60-80	35-60
Ls----------------- Leming	0-28	Loamy fine sand	SM-SC, SM	A-2-4	95-100	95-100	50-75	20-35	<30	NP-7
	28-54	Sandy clay, clay, clay loam.	CL, SC, CH	A-7-6	95-100	95-100	80-95	45-60	41-55	20-30
	54-72	Sandy clay loam, sandy clay, clay loam.	CL, SC	A-6, A-7-6	95-100	90-100	80-95	40-60	30-45	11-25
MoC, MoD----------- Monteola	0-16	Clay------------	CH	A-7-6	80-100	80-100	80-100	75-90	51-60	30-38
	16-72	Clay------------	CH	A-7-6	90-100	80-100	75-100	75-90	56-76	33-50
Mu----------------- Mustang	0-5	Fine sand-------	SW-SM	A-2-4, A-3	85-100	80-100	60-80	5-12	---	NP
	5-60	Fine sand, sand	SW-SM	A-2-4, A-3	85-100	80-100	60-80	5-12	---	NP
Na----------------- Narta	0-8	Fine sandy loam	SC, CL, SM-SC, ML-CL	A-4, A-6	100	100	100	36-70	<30	NP-17
	8-26	Silty clay, clay, silty clay loam.	CH, CL	A-7-6	98-100	95-100	90-100	60-80	48-60	35-45
	26-60	Clay loam, sandy clay loam, clay.	CH, CL	A-7-6	95-100	90-100	90-100	51-80	43-55	30-40
Nu----------------- Nueces	0-36	Fine sand-------	SP-SM, SM, SM-SC	A-2-4	100	95-100	90-100	10-35	<25	NP-6
	36-72	Sandy clay loam, sandy loam.	SC	A-2-6, A-6	100	95-100	90-100	20-50	27-40	11-20
Od----------------- Odem	0-60	Fine sandy loam	SM-SC, SM	A-2-4	100	100	90-100	20-30	<25	NP-7
On*. Oil-waste land										
Or----------------- Orelia	0-5	Fine sandy loam	SC, CL, SM-SC, CL-ML	A-4, A-6, A-2	98-100	95-100	80-100	33-60	22-35	6-19
	5-25	Sandy clay loam, clay loam.	CL, SC	A-7, A-6	98-100	90-100	80-100	47-75	35-50	20-30
	25-60	Sandy clay loam	CL	A-6, A-7	95-100	85-100	80-100	51-75	35-46	20-30
Os----------------- Orelia	0-6	Sandy clay loam	SC, CL, SM-SC, CL-ML	A-4, A-6, A-2	98-100	95-100	80-100	33-60	22-35	6-19
	6-28	Sandy clay loam, clay loam.	CL, SC	A-7, A-6	98-100	90-100	80-100	47-75	35-50	20-30
	28-60	Sandy clay loam	CL	A-6, A-7	95-100	85-100	80-100	51-75	35-46	20-30
PaA, PaB, PaC------ Papalote	0-14	Fine sandy loam	SM, SM-SC, SC	A-2-4, A-4	95-100	95-100	90-100	25-50	<25	NP-8
	14-36	Sandy clay, clay, clay loam.	CL, SC, CH	A-7-6	95-100	90-100	85-100	45-70	41-60	21-36
	36-60	Sandy clay loam, clay loam, sandy clay.	CL, SC	A-6, A-7	95-100	80-100	75-100	40-70	38-48	18-31
PeB---------------- Pettus	0-18	Loam------------	CL, SC	A-6, A-7	80-100	75-95	55-75	40-65	30-43	11-21
	18-24	Variable, cemented.	---	---	---	---	---	---	---	---
	24-65	Stratified gravelly sandy clay loam to gravelly loam.	SC, GC	A-2-4, A-2-6, A-4, A-6	50-90	45-85	40-60	25-50	25-35	8-15

See footnote at end of table.

TABLE 16.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
PfC---------------- Pharr	0-18	Fine sandy loam	SM-SC, SC	A-4, A-6	100	100	100	36-50	21-30	5-13
	18-72	Sandy clay loam, clay loam.	SC, CL	A-6	95-100	80-100	80-100	36-55	30-40	11-21
Ps*---------------- Psamments	0-80	Fine sand-------	SP-SM, SW-SM	A-2-4, A-3	95-100	95-100	85-100	5-12	---	NP
RaA, RaB----------- Raymondville	0-14	Clay loam-------	CL	A-6, A-7-6	100	100	95-100	51-85	37-50	18-30
	14-38	Clay, clay loam	CL, CH	A-6, A-7-6	100	95-100	95-100	75-95	38-55	19-35
	38-60	Clay, clay loam	CL, CH	A-6, A-7-6	100	85-100	80-100	75-95	40-53	20-35
Sa*:										
Sarita------------	0-48	Fine sand-------	SM-SC, SP-SM, SM	A-2-4	100	100	65-100	9-35	<25	NP-7
	48-80	Sandy clay loam, fine sandy loam.	SC	A-2-6, A-6	100	100	80-100	30-50	28-40	11-22
Nueces------------	0-36	Fine sand-------	SP-SM, SM, SM-SC	A-2-4	100	95-100	90-100	10-35	<25	NP-6
	36-72	Sandy clay loam, sandy loam.	SC	A-2-6, A-6	100	95-100	90-100	20-50	27-40	11-20
Sn----------------- Sinton	0-44	Loam------------	CL	A-4, A-6	100	95-100	85-100	51-80	27-40	9-20
	44-72	Stratified loamy fine sand to sandy clay loam.	SM, SC, ML, CL	A-2-4, A-2-6, A-4, A-6	100	90-100	50-100	20-52	<30	NP-14
Tn*---------------- Tatton	0-5	Loamy sand------	SM	A-2-4, A-4	85-100	80-100	80-98	20-50	<25	NP-3
	5-60	Loamy fine sand, loamy sand.	SM	A-2-4, A-4	85-100	80-100	80-98	13-40	<25	NP-3
Va----------------- Victine	0-12	Clay------------	CH	A-7-6	100	95-100	90-100	65-95	58-75	35-49
	12-40	Clay, silty clay	CH	A-7-6	95-100	95-100	85-100	65-95	58-75	35-49
	40-72	Clay, silty clay	CH	A-7-6	100	90-100	85-100	65-90	57-75	35-49
VcA, VcB, Vd------- Victoria	0-14	Clay------------	CH	A-7-6	100	95-100	90-100	70-90	58-75	35-49
	14-58	Clay, silty clay	CH	A-7-6	100	95-100	90-100	70-90	58-75	35-49
	58-72	Clay, silty clay	CH	A-7-6	100	95-100	90-100	70-90	58-75	35-49
WfA, WfB, WfC------ Willacy	0-16	Fine sandy loam	SC, SM-SC	A-2-4, A-4	100	100	95-100	30-45	20-30	5-10
	16-72	Sandy clay loam, fine sandy loam.	SC, CL	A-4, A-6	95-100	90-100	90-100	36-65	28-40	9-20

* See map unit description for the composition and behavior of the map unit.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means greater than. The erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors	
							K	T
	In	In/hr	In/in	pH	Mmhos/cm			
Ac, Af----------- Aransas	0-66	<0.06	0.12-0.18	7.9-8.4	<4	High---------	0.32	5
As--------------- Aransas	0-66	<0.06	0.01-0.12	7.9-9.0	4-16	High---------	0.32	5
BT*:								
Barrada---------	0-36 36-60	<0.06 <0.06	0.00-0.01 0.00-0.01	>8.5 >8.5	>16 >16	Very high---- High---------	0.43 0.43	5
Tatton----------	0-5 5-60	6.0-20 6.0-20	0.-0.02 0.-0.02	7.9-9.0 7.9-9.0	>16 >16	Very low----- Very low-----	0.17 0.15	2
By*. Beaches								
Cs--------------- Comitas	0-28 28-80	2.0-6.0 2.0-6.0	0.05-0.10 0.11-0.17	6.1-7.3 6.1-8.4	<2 <2	Low---------- Low----------	0.17 0.24	5
Dn--------------- Delfina	0-14 14-40 40-60	2.0-6.0 0.2-0.6 0.6-2.0	0.07-0.11 0.10-0.20 0.10-0.17	6.6-7.8 6.6-8.4 7.4-8.4	<2 <4 <4	Low---------- Moderate----- Moderate-----	0.24 0.32 0.32	5
Ds*-------------- Dianola	0-6 6-60	6.0-20 6.0-20	0.00-0.02 0.00-0.02	7.9-9.0 7.9-9.0	>16 >16	Very low----- Very low-----	0.15 0.15	5
Dt--------------- Dietrich	0-12 12-45 45-72	2.0-6.0 0.06-0.2 0.2-0.6	0.05-0.10 0.08-0.15 0.05-0.15	6.1-7.3 7.4-8.4 7.9-8.4	<2 <8 2-8	Low---------- Moderate----- Moderate-----	0.20 0.32 0.32	5
Ec, Ed----------- Edroy	0-18 18-42 42-60	<0.06 0.06-0.2 0.06-0.2	0.10-0.17 0.09-0.17 0.08-0.16	6.1-7.3 7.9-8.4 7.9-8.4	<8 <8 <8	Very high---- High--------- Moderate-----	0.32 0.32 0.37	5
FA*-------------- Falfurrias	0-80	6.0-20	0.02-0.08	6.6-8.4	<2	Very low-----	0.15	5
GA*-------------- Galveston	0-4 4-72	6.0-20 6.0-20	0.05-0.10 0.05-0.10	5.6-8.4 5.6-8.4	<4 <4	Low---------- Low----------	0.15 0.15	5
GM*:								
Galveston-------	0-4 4-72	6.0-20 6.0-20	0.05-0.10 0.05-0.10	5.6-8.4 5.6-8.4	<4 <4	Low---------- Low----------	0.15 0.15	5
Mustang---------	0-5 5-60	6.0-20 6.0-20	0.01-0.07 0.01-0.06	6.6-8.4 6.6-8.4	<4 <4	Low---------- Low----------	0.15 0.15	5
Is*-------------- Ijam	0-6 6-60	<0.06 <0.06	0.10-0.12 0.10-0.12	6.6-9.0 6.6-9.0	4-16 4-16	High--------- High---------	0.32 0.32	5
Ls--------------- Leming	0-28 28-54 54-72	2.0-6.0 0.06-0.2 0.6-2.0	0.05-0.10 0.15-0.20 0.14-0.18	6.1-7.3 6.1-8.4 6.6-8.4	<2 <2 <2	Very low----- Moderate----- Moderate-----	0.20 0.32 0.32	5
MoC, MoD--------- Monteola	0-16 16-72	<0.06 <0.06	0.10-0.20 0.10-0.17	7.9-9.0 7.9-9.0	<4 <4	Very high---- Very high----	0.32 0.37	5
Mu--------------- Mustang	0-5 5-60	6.0-20 6.0-20	0.01-0.07 0.01-0.06	6.6-8.4 6.6-8.4	<4 <4	Low---------- Low----------	0.15 0.15	5
Na--------------- Narta	0-8 8-26 26-60	0.6-2.0 <0.06 <0.06	0.05-0.11 0.00-0.02 0.00-0.02	6.6-8.4 7.4-9.0 7.9-9.0	<4 >16 >16	Low---------- High--------- High---------	0.49 0.43 0.43	5

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T
	In	In/hr	In/in	pH	Mmhos/cm			
Nu----------------	0-36	2.0-6.0	0.05-0.10	6.1-7.3	<2	Low-----------	0.17	5
Nueces	36-72	0.2-0.6	0.12-0.17	6.6-8.4	<2	Moderate-----	0.24	
Od----------------	0-60	2.0-6.0	0.10-0.16	6.6-8.4	<2	Low-----------	0.24	5
Odem								
On*.								
Oil-waste land								
Or----------------	0-5	0.2-0.6	0.10-0.16	6.6-7.8	<4	Low-----------	0.28	5
Orelia	5-25	0.06-0.2	0.10-0.17	7.4-8.4	<8	Moderate-----	0.32	
	25-60	<0.06	0.09-0.17	7.9-8.4	<12	Moderate-----	0.32	
Os----------------	0-6	0.2-0.6	0.10-0.16	6.6-7.8	<4	Low-----------	0.28	5
Orelia	6-28	0.06-0.2	0.10-0.17	7.4-8.4	<8	Moderate-----	0.32	
	28-60	<0.06	0.09-0.17	7.9-8.4	<12	Moderate-----	0.32	
PaA, PaB, PaC-----	0-14	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low-----------	0.32	5
Papalote	14-36	0.06-0.2	0.13-0.18	6.1-8.4	<2	Moderate-----	0.32	
	36-60	0.06-0.2	0.12-0.17	7.9-8.4	<2	Moderate-----	0.32	
PeB---------------	0-18	0.6-2.0	0.10-0.15	7.9-8.4	<2	Low-----------	0.24	2
Pettus	18-24	0.6-2.0	0.02-0.05	7.9-8.4	<2	Very low-----	---	
	24-65	0.6-6.0	0.08-0.12	7.9-8.4	<2	Low-----------	0.24	
PfC---------------	0-18	0.6-2.0	0.09-0.17	7.9-8.4	0-4	Low-----------	0.24	5
Pharr	18-72	0.6-2.0	0.09-0.17	7.9-8.4	0-4	Low-----------	0.32	
Ps*---------------	0-80	>20	0.02-0.10	7.4-9.0	8-16	Low-----------	0.10	5
Psamments								
RaA, RaB----------	0-14	0.2-0.6	0.12-0.18	7.9-8.4	<4	High----------	0.32	5
Raymondville	14-38	0.06-0.2	0.10-0.18	7.9-8.4	<4	High----------	0.32	
	38-60	0.06-0.2	0.10-0.18	7.9-8.4	<4	High----------	0.32	
Sa*:								
Sarita-----------	0-48	6.0-20	0.05-0.10	6.1-7.3	<2	Low-----------	0.17	5
	48-80	2.0-6.0	0.13-0.19	6.1-8.4	<2	Moderate-----	0.24	
Nueces-----------	0-36	2.0-6.0	0.05-0.10	6.1-7.3	<2	Low-----------	0.17	5
	36-72	0.2-0.6	0.12-0.17	6.6-8.4	<2	Moderate-----	0.24	
Sn----------------	0-44	0.6-2.0	0.15-0.20	7.9-8.4	<2	Low-----------	0.28	5
Sinton	44-72	2.0-6.0	0.07-0.15	7.9-8.4	<2	Low-----------	0.20	
Tn*---------------	0-5	6.0-20	0.-0.02	7.9-9.0	>16	Very low-----	0.17	2
Tatton	5-60	6.0-20	0.-0.02	7.9-9.0	>16	Very low-----	0.15	
Va----------------	0-12	<0.06	0.09-0.15	7.9-9.0	<4	Very high----	0.32	5
Victine	12-40	<0.06	0.02-0.11	7.9-9.0	4-16	Very high----	0.32	
	40-72	<0.06	0.01-0.10	7.9-9.0	>8	Very high----	0.32	
VcA, VcB, Vd------	0-14	<0.06	0.18-0.21	7.9-8.4	<4	Very high----	0.32	5
Victoria	14-58	<0.06	0.13-0.20	7.9-9.0	<8	Very high----	0.32	
	58-72	<0.06	0.02-0.15	7.9-9.0	4-16	Very high----	0.32	
WfA, WfB, WfC-----	0-16	2.0-6.0	0.14-0.18	7.4-7.8	<4	Low-----------	0.24	5
Willacy	16-72	0.6-2.0	0.14-0.18	7.4-8.4	<4	Low-----------	0.32	

* See map unit description for the composition and behavior of the map unit.

TABLE 18.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Uncoated steel	Concrete
					Ft				
Ac, Af, As: Aransas	D	Common	Brief to very long.	Sep-May	0-5.0	Apparent	Sep-Jun	High	Low.
BT*:									
Barrada	D	Frequent	Very long	Jan-Dec	0.5-3.0	Apparent	Jan-Dec	High	Moderate.
Tatton	D	Frequent	Very brief to very long.	Jan-Dec	1-0.5	Apparent	Jan-Dec	High	High.
By*. Beaches									
Cs: Comitas	A	None	---	---	>6.0	---	---	Low	Low.
Dn: Delfina	B	None	---	---	2.5-5.0	Apparent	Sep-May	High	Low.
Ds*: Dianola	D	Common	Brief to long.	Jul-Jan	1.5-3.5	Apparent	Jan-Dec	High	High.
Dt: Dietrich	C	None	---	---	3.0-5.0	Perched	Sep-May	High	Moderate.
Ec, Ed: Edroy	D	Common	Brief to long.	Sep-May	0-4.0	Apparent	Sep-May	High	Low.
FA*: Falfurrias	A	None	---	---	>6.0	---	---	Low	Low.
GA*: Galveston	A	Occasional	Very brief	Jun-Oct	3.0-6.0	Apparent	Jan-Dec	High	Low.
GM*:									
Galveston	A	Occasional	Very brief	Jun-Oct	3.0-6.0	Apparent	Jan-Dec	High	Low.
Mustang	A/D	Rare to common.	Brief to long.	Aug-Nov	0-0.5	Apparent	Jan-Dec	High	Low.
Is*: Ijam	D	Rare	Very brief	Apr-Oct	0-3.0	Apparent	Sep-May	High	High.
Ls: Leming	C	None	---	---	>6.0	---	---	High	Low.
MoC, MoD: Monteola	D	None	---	---	>6.0	---	---	High	Low.
Mu: Mustang	A/D	Rare to common.	Brief to long.	Aug-Nov	0-0.5	Apparent	Jan-Dec	High	Low.
Na: Narta	D	None	---	---	0-0.5	Perched	Sep-May	High	Moderate.
Nu: Nueces	C	None	---	---	>6.0	---	---	Moderate	Low.
Od: Odem	A	Common	Brief	Sep-May	>6.0	---	---	Moderate	Low.

See footnote at end of table.

TABLE 18.--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				
On*. Oil-waste land									
Or, Os------------ Orelia	D	None--------	---	---	0.5-1.0	Perched	Sep-May	High-----	Low.
PaA, PaB, PaC----- Papalote	C	None--------	---	---	>6.0	---	---	High-----	Low.
PeB--------------- Pettus	'C	None--------	---	---	>6.0	---	---	Moderate	Low.
PfC--------------- Pharr	B	None--------	---	---	>6.0	---	---	High-----	Low.
Ps*--------------- Psamments	A	Rare--------	---	---	>6.0	---	---	High-----	Low.
RaA, RaB---------- Raymondville	D	None--------	---	---	>6.0	---	---	High-----	Low.
Sa*:									
Sarita-----------	A	None--------	---	---	>6.0	---	---	Moderate	Low.
Nueces-----------	C	None--------	---	---	>6.0	---	---	Moderate	Low.
Sn---------------- Sinton	B	Common------	Brief-----	Sep-May	>6.0	---	---	Moderate	Low.
Tn*--------------- Tatton	D	Frequent----	Very brief to very long.	Jan-Dec	0.5-1.5	Apparent	Jan-Dec	High-----	High.
Va---------------- Victine	D	None--------	---	---	>6.0	---	---	High-----	Low.
VcA, VcB, Vd------ Victoria	D	None--------	---	---	>6.0	---	---	High-----	Low.
WfA, WfB, WfC----- Willacy	B	None--------	---	---	5.0-6.0	Perched	Sep-Mar	Moderate	Low.

* See map unit description for the composition and behavior of the map unit.

TABLE 19.--ENGINEERING TEST DATA

[Tests performed by Texas Highway Department, Materials and Testing Division, Camp Hubbard]

Soil name and location	Depth	Shrinkage			Mechanical analysis[1]									Liquid limit	Plasticity index	Classification[2]	
					Percentage passing sieve--						Percentage smaller than--						
		Limit	Ratio	Lineal	3/8 in	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 60 (0.25 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm			AASHTO[3]	Unified[4]
	In	Pct		Pct													
Dietrich fine sand: 0.75 mile north and 100 feet west of intersection of Farm Roads 3036 and 1781.	0-12	22	1.71	0.0	---	---	---	100	99	20	12	4	3	22	2	A-2-4(0)	SM
	12-45	18	1.73	12.8	---	---	---	100	99	43	38	31	29	48	33	A-7-6(5)	SC
	45-72	20	1.67	13.0	---	---	---	100	99	37	32	27	26	52	36	A-7-6(4)	SC
Narta fine sandy loam: 5.7 miles north and 1.1 miles west of Copano Bay Causeway on Texas Highway 35.	0-8	19	1.17	4.7	---	---	---	---	100	48	35	15	12	28	10	A-4(3)	SC
	8-36	15	1.88	18.4	100	99	99	98	98	67	61	46	40	59	43	A-7-6(17)	CH
	36-60	11	2.03	17.2	---	---	100	99	99	75	67	51	37	48	36	A-7-6(18)	CL
Papalote fine sandy loam: 1 mile north and 0.2 mile east of intersection of Farm Roads 881 and 136.	0-14	19	1.69	1.8	---	---	---	---	100	47	30	9	8	22	3	A-4(2)	SM
	14-36	14	1.88	15.8	---	---	100	99	99	69	57	37	35	51	36	A-7-6(17)	CH
	36-60	15	1.85	12.8	100	98	97	97	97	66	52	31	30	43	29	A-7-6(14)	CL
Sinton loam: 1.25 miles northeast of Chiva Windmill on Welder Wildlife Refuge.	0-30	17	1.79	10.4	---	---	---	---	100	64	55	27	25	39	23	A-6(11)	CL
	30-42	19	1.74	4.4	---	---	---	---	100	52	39	18	15	27	9	A-4(3)	CL
	42-60	19	1.71	2.9	---	---	---	---	100	40	31	14	13	24	5	A-4(1)	SM-SC
Victine clay (micro-knoll): 4 miles west and 0.5 mile north of Aransas National Wildlife Refuge Headquarters building.	0-40	13	1.94	19.6	---	100	99	98	98	69	63	46	42	60	43	A-7-6(18)	CH
	40-60	10	2.04	21.0	100	99	96	89	88	69	64	51	43	61	44	A-7-6(18)	CH
	60-72	12	2.03	19.6	---	100	97	85	83	69	61	47	40	57	41	A-7-6(18)	CH

[1]Mechanical analysis according to the AASHTO Designation T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

[2]Unified and AASHTO classifications made by SCS personnel.

[3]Based on AASHTO Designation M 145-49.

[4]Based on the Unified soil classification system.

TABLE 20.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Aransas	Fine, montmorillonitic (calcareous), hyperthermic Vertic Haplaquolls
Barrada	Fine, mixed (calcareous), hyperthermic Typic Hydraquents
Comitas	Loamy, mixed, hyperthermic Arenic Aridic Haplustalfs
Delfina	Fine-loamy, mixed, hyperthermic Aquic Haplustalfs
Dianola	Siliceous, hyperthermic Typic Psammaquents
Dietrich	Fine-loamy, mixed, hyperthermic Typic Natraqualfs
Edroy	Fine, mixed, hyperthermic Vertic Haplaquolls
Falfurrias	Mixed, hyperthermic Typic Ustipsamments
*Galveston	Mixed, hyperthermic Typic Udipsamments
Ijam	Fine, montmorillonitic, nonacid, thermic Vertic Fluvaquents
Leming	Clayey, mixed, hyperthermic Aquic Arenic Paleustalfs
Monteola	Fine, montmorillonitic, hyperthermic Typic Pellusterts
*Mustang	Mixed, hyperthermic Typic Psammaquents
Narta	Fine, montmorillonitic, hyperthermic Typic Natraqualfs
Nueces	Loamy, mixed, hyperthermic Aquic Arenic Paleustalfs
Odem	Coarse-loamy, mixed, hyperthermic Cumulic Haplustolls
Orelia	Fine-loamy, mixed, hyperthermic Typic Ochraqualfs
Papalote	Fine, mixed, hyperthermic Aquic Paleustalfs
Pettus	Loamy, mixed, hyperthermic, shallow Typic Calciustolls
Pharr	Fine-loamy, mixed, hyperthermic Typic Argiustolls
Psamments	Siliceous (and mixed), hyperthermic Psamments
Raymondville	Fine, mixed, hyperthermic Vertic Calciustolls
Sarita	Loamy, mixed, hyperthermic Grossarenic Paleustalfs
Sinton	Fine-loamy, mixed, hyperthermic Cumulic Haplustolls
Tatton	Siliceous, hyperthermic Typic Psammaquents
Victine	Fine, montmorillonitic, hyperthermic Udic Pellusterts
Victoria	Fine, montmorillonitic, hyperthermic Udic Pellusterts
Willacy	Fine-loamy, mixed, hyperthermic Udic Argiustolls

TABLE 21.--GEOLOGY OF SAN PATRICIO AND ARANSAS COUNTIES

General soil map unit	Formation, deposit, or facies	Age
Aransas-Sinton-Odem	Flood plain (alluvial) deposits.	Holocene.
Offshore parts and minor mainland parts of Galveston-Mustang-Dianola.	Coastal deposits	Holocene.
Most of Papalote-Delfina-Leming	Deweyville Formation.	Early Holocene or Late Pleistocene.
Narta-Aransas-Victine	Beaumont Formation lagoonal facies.	Pleistocene.
Most of Victoria-Raymondville-Orelia and parts of Orelia-Papalote.	Beaumont Formation fluvio-deltaic facies.	Pleistocene.
Most of mainland parts of Galveston-Mustang-Dianola.	Beaumont Formation barrier island facies.	Pleistocene.
Parts of Orelia-Papalote and Victoria-Raymondville-Orelia.	Montgomery Formation.	
Pettus-Pharr and parts of Victoria-Raymondville-Orelia.	Goliad Formation.	Pliocene.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1979-270-491/5

NRCS Accessibility Statement

This document is not accessible by screen-reader software. 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 1-800-457-3642 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.