SOIL SURVEY OF

Cameron County, Texas

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

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.

Major fieldwork for this soil survey was completed in the period 1963-69. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1970. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Southmost Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Cameron County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification, the yard and garden suitability group, the orchard suitability group, the pasture and hay suitability group, and the range site of each. It also shows the page where each soil is described and the page for the interpretive groups in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units.

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

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and for recreation areas in the section "Engineering Uses of the Soils."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Cameron County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Additional Facts About the County."

Cover: Irrigated cotton and grain sorghum on Laredo silty clay loam, 0 to 1 percent slopes.

Contents

Issued May 1977

SOIL SURVEY OF CAMERON COUNTY, TEXAS

BY DEWAYNE WILLIAMS, CHARLES M. THOMPSON, AND JERRY L. JACOBS, SOIL CONSERVATION SERVICE

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

CAMERON COUNTY is in the extreme southern tip of Texas (fig. 1). It adjoins the State of Tamaulipas, Mexico, across the Rio Grande, which forms the southern boundary of the county. It has a total area of 741,760 acres or 1,159 square miles. Brownsville is the county seat and is the southernmost point in Texas.

This county is in an area of highly intensified and specialized farming in the Lower Rio Grande Valley of Texas. Approximately 287,000 acres of the county are intensively irrigated. Citrus, cool-season vegetables of almost all varieties, cotton, and grain sorghum are the main crops. The main source of irrigation water is Falcon Reservoir. Water control and improvement districts, which are political subdivisions, furnish water to most farms by a complex system of canals and pipelines. About 139,000 acres in the northern part and eastern part of the county are used for dryfarming. A narrow band of saline coastal soils is parallel to the Gulf of Mexico and is used as range.

Cameron County consists of a flat plain that slopes gently to the northeast. The greater part of the area is an alluvial plain or delta of the Rio Grande River. The average elevation is about 45 feet. The elevation varies from sea level to 70 feet. The higher elevation is 1 mile south of Santa Maria.

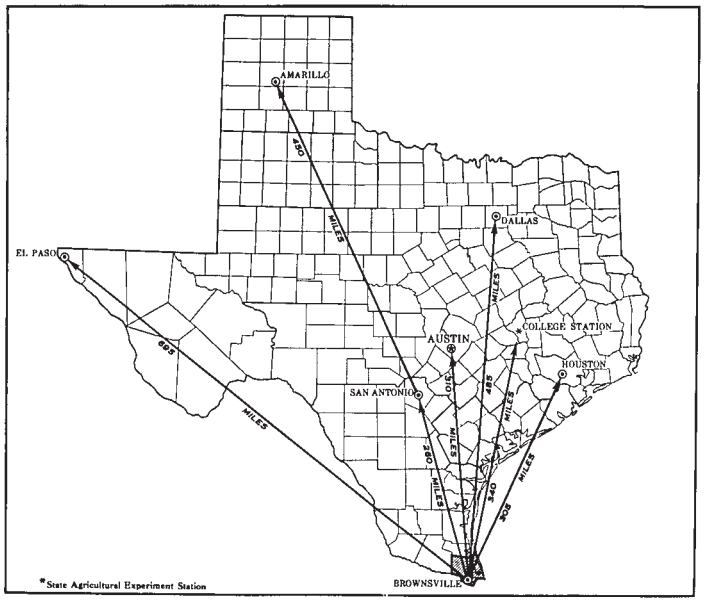

Figure 1.—**Location of Cameron County, in Texas.**

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Cameron County, where they are located, and how they can be used. The soil scientists went into the county knowing they were likely to find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Harlingen and Willacy, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Willacy fine sandy loam, 1 to 3 percent slopes, is one of several phases within the Willacy series.

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

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in

planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Cameron County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Laredo-Olmito complex is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. If there are two or more dominant series represented in the group, the name of the group ordinarily consists of the names of the dominant soils, joined by "and." Racombes soils and Urban land is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severly eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Coastal beach is a land type in Cameron County.

One soil in this survey area is similar to a known series but differs in one major respect. Since the acreage is small it is classified as the known series and the term *variant* added to the name to show that it is different in one characteristic. This soil is Orelia clay loam, clayey subsoil variant, which is not really within the range of the Orelia series. If a large acreage is located in the future surveys, a new name will be proposed.

Ustifluvents, clayey, are soils unlike any known series. They are named in this survey using nomenclature from higher levels in the classification system. The acreage is too small to warrant series names at this time. If similar soils are found as work progresses in other areas, they will be named as series using names from places nearby.

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

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

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Cameron County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or other structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this county have been grouped into five general kinds of landscapes for broad interpretative purposes. Each of the broad groups and their included soil associations are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 8, the words "sandy clay loams" and "clay loams" refer to the texture of the surface layer.

Level to Gently Sloping, Moderately Permeable to Very Slowly Permeable, Saline, Clayey and Loamy Soils of Coastal Areas

This group of soils occupies about 31 percent of the

county. It consists of the Sejita-Lomalta-Barrada association, the Laredo-Lomalta association, and the Willamar association. In this group are the saline, wet soils along the lower Gulf Coast known as the salt flats or coastal flats as well as the Willamar association, an area that is marginal for crops. Most of the acreage of this group is range, and less than 10 percent is cropped.

1. Sejita-Lomalta-Barrada association

Level, poorly drained and very poorly drained clays and silty clay loams

This association occupies a large irregularly shaped area. It consists of areas of saline, loamy and clayey soils at or near sea level and broad areas of barren clay that are inundated by high tides and heavy rains. The flat topography is broken by numerous "clay dunes" at an elevation of 10 to 40 feet above the surrounding soils.

This association makes up about 23 percent of the county. It is about 31 percent Sejita soils, 29 percent Lomalta soils, 24 percent Barrada soils, and 16 percent soils of minor extent.

Sejita soils have a surface layer of light brownish-gray, calcareous silt loam about 2 inches thick. Below this layer is light-gray silty clay loam about 18 inches thick. The underlying material extends to a depth of 40 inches; it is stratified silt loam, silty clay loam, and clay loam. The soils are poorly drained and moderately slowly permeable.

Lomalta soils have a surface layer of light-gray, calcareous clay about 5 inches thick. Below this layer, to a depth of about 53 inches, is light-gray clay. The underlying material is stratified silty clay loam and silt loam. The soils are poorly drained and very slowly permeable.

Barrada soils are dark grayish-brown clay extending from the surface to a depth of about 52 inches and below this is grayish-brown silty clay loam. These soils are very poorly drained and very slowly permeable.

Minor soils of this association are in the Benito, Latina, Point Isabel, and Willamar series and saline soils of the Laredo series.

The soils in this association are used for range and wildlife habitat. In much of this association high water table is at a depth of 1 to 5 feet throughout the year. Barrada soils are barren. This association has a low potential for the production of forage.

2. Laredo-Lomalta association

Gently sloping to level, well-drained to poorly drained silty clay loams and clays

This association is mainly in and adjacent to the Laguna Atascosa National Wildlife Refuge. It consists of nearly level to gently sloping saline Laredo soils at an elevation of about 1 to 5 feet above the slightly depressional Lomalta soils. Most of the Lomalta soil is in old meander channels.

This association makes up about 4 percent of the county. It is about 45 percent Laredo soils, about 27 percent Lomalta soils, and 28 percent soils of minor extent.

Laredo soils have a surface layer of dark grayish-brown, calcareous silty clay loam, about 8 inches thick, over stratified silt loams and silty clay loams. They are well drained and moderately permeable.

Lomalta soils have a surface layer of light-gray, calcareous clay about 5 inches thick. The underlying material is stratified loamy materials. These soils are poorly drained and very slowly permeable.

Minor soils of this association are in the Chargo, Point Isabel, and Sejita series.

The soils in this association are used for range and wildlife habitat. A small acreage is dryfarmed. A seasonal high water table is at a depth of 2 to 6 feet. This association has a medium potential for the production of forage.

3. Willamar association

Nearly level, somewhat poorly drained fine sandy loams and sandy clay loams

This association occupies a nearly level area in which are many slickspots.

This association makes up about 4 percent of the county. It is about 71 percent Willamar soils and 29 percent soils of minor extent.

Willamar soils have a surface layer, 5 inches thick; it is grayish-brown, noncalcareous fine sandy loam in the upper part and gray fine sandy loam in the lower part. The next layer, to a depth of 30 inches, is clay loam that is dark grayish brown in the upper part and light brownish gray in the lower part. The underlying material, to a depth of 60 inches, is very pale brown sandy clay loam. These soils are somewhat poorly drained and very slowly permeable.

Minor soils of this association are in the Lozano, Lyford, Raymondville, Tiocano, and Willacy series.

More than half of this association is used for dryfarming. The remaining acreage is used for range and as wildlife habitat. A seasonal high water table is at a depth of 36 to 72 inches, and the soils are saline. This association has a low potential for the production of a few of the major crops commonly grown in the county.

Nearly Level to Gently Sloping, Moderately Permeable to Slowly Permeable, Loamy and Clayey Soils of Flood Plains and Low Terraces

This group of soils occupies about 23 percent of the county. It consists of the Laredo-Olmito association and the Rio Grande-Matamoros association. In this group are soils along the Rio Grande flood plain and the well drained and moderately well drained, silty soils adjacent to the major or larger resacas within the county. Most of the area is used for irrigated crops.

4. Laredo-Olmito association

Nearly level to gently sloping, well drained and moderately well drained silty clay loams and silty clays

This association is irregularly shaped. It follows generally the pattern of the old resacas (abandoned river channels) on a low terrace of the Rio Grande. Laredo soils occupy the higher, well-drained areas adjacent to the resacas, and Olmito soils occupy the level or slightly concave areas away from but parallel to the resacas.

This association makes up about 19 percent of the county. It is about 65 percent Laredo soils, 20 percent Olmito soils, and about 15 percent soils of minor extent.

Laredo soils have a surface layer of dark grayish-brown, calcareous silty clay loam about 8 inches thick. The next layer, to a depth of 41 inches, is silt loam. It is dark grayish brown in the upper part and light brownish gray in the lower part. The underlying material is stratified silt loam and silty clay loam. These soils are well drained and moderately permeable.

Olmito soils have a surface layer of dark-gray, calcareous silty clay about 16 inches thick. The next layer, to a depth of 34 inches, is silty clay that is grayish brown in the upper part and dark brown in the lower part. The underlying material is mottled silty clay. These soils are moderately well drained and slowly permeable.

Minor soils of this association are in the Cameron, Chargo, Harlingen, and Reynosa series.

The soils in this association are used mainly for irrigated crops. This association has a high potential for the production of most of the major crops commonly grown in the county. Laredo soils are suited to citrus trees.

5. *Rio Grande-Matamoros association*

Nearly level to gently sloping, well drained and moderately well drained silt loams and silty clays

This association occupies a narrow band less than 2 miles wide adjacent to the Rio Grande. The soils are geologically young. Rio Grande soils are in the higher, well-drained areas adjacent to the river or old oxbows. Matamoros soils are in nearly level, slack water areas.

This association makes up about 4 percent of the county. It is about 49 percent Rio Grande soils, 27 percent Matamoros soils, and 24 percent soils of minor extent.

Rio Grande soils have a surface layer of light-gray, calcareous silt loam, about 9 inches thick, over stratified silt loam, silty clay loam, or very fine sandy loam. They are well drained and moderately permeable.

Matamoros soils have a surface layer of light brownish-gray, calcareous silty clay, about 8 inches thick, over stratified silt loam, silty clay loam, clay, or silty clay. They are moderately well drained and slowly permeable.

Minor soils of this association are in the Camargo, Grulla, and Zalla series.

The soils in this association are used mostly for irrigated crops. They are rarely flooded because the Falcon and Amistad Dams have been constructed on the Rio Grande, but there is a hazard of flooding, especially when tropical disturbances bring high-intensity rain into northern Mexico. This association has a high potential for the production of most of the major crops commonly grown in the county.

Nearly Level to Gently Sloping, Moderately Permeable to Slowly Permeable, Loamy Soils of Coastal Terraces

This group of soils occupies about 23 percent of the county. It consists of the Willacy-Racombes association, the Lyford-Raymondville-Lozano association the Hidalgo-Raymondville association, the Willacy-Raymondville association, and the Raymondville association. The soils in this group are loamy, and many are leached of carbonates in the surface layer. They are used mostly for irrigated crops and dryfarming.

6. *Willacy-Racombes association*

Nearly leve to gently sloping, well-drained fine sandy loams and sandy clay loams

This association occupies an irregularly shaped area. Willacy soils are in the higher, more sloping areas and Racombes soils are in the level or slightly concave areas. Most of the Racombes soils form slight drainageways providing an outlet for runoff. The area contains many small, enclosed depressions or potholes that trap excess water. These depressions remain wet several weeks or months of the year.

This association makes up about 7 percent of the county. It is about 40 percent Willacy soils, 35 percent Racombes soils, and 25 percent soils of minor extent.

Willacy soils have a surface layer of dark grayish-brown, noncalcareous fine sandy loam, about 19 inches thick, over friable sandy clay loam. They are well drained and moderately permeable.

Racombes soils have a surface layer of dark-gray, noncalcareous sandy clay loam, about 13 inches thick, over sandy clay loam. They are well drained and moderately permeable.

Minor soils of this association are in the Hidalgo, Raymondville, Rio, and Tiocano series.

The soils in this association are used for irrigated crops and dryfarming. About 10 to 15 percent of the area is affected by a seasonal high water table and slight to moderate salinity. This association has a high potential for the production of most of the major crops commonly grown in the county. It is the leading citrus producing area in the county.

7. *Lyford-Raymondville-Lozano association*

Nearly level, well drained and moderately well drained sandy clay loams, clay loams, and fine sandy loams

This association occupies an irregularly shaped area. It consists of nearly level sandy clay loams, fine sandy loams, and clay loams and a few, long, narrow depressions or old meanders of wet, saline soils.

This association makes up about 4 percent of the county. It is about 38 percent Lyford soils, 15 percent Raymondville soils, 12 percent Lozano soils, and 35 percent soils of minor extent.

Lozano soils are in higher positions on the landscape, and Lyford and Raymondville soils are in the lower landscape positions. The old meander channels are 4 to 10 feet below the surrounding topography, and they lack natural outlets.

Lyford soils have a surface layer of very dark grayish-brown, noncalcareous sandy clay loam, about 11 inches thick, over sandy clay loam. They are moderately well drained and moderately permeable.

Raymondville soils have a surface layer of calcareous clay loam about 25 inches thick. The upper 6 inches is gray, the next 8 inches is dark gray, and the lower 11 inches is gray. The next layer is calcareous, very firm clay. These soils are moderately well drained and slowly permeable.

Lozano soils have a surface layer of dark grayish-brown, noncalcareous fine sandy loam, about 11 inches thick, over blocky sandy clay loam. They are well drained and moderately slowly permeable.

Minor soils of this association are in the Delfina, Hidalgo, Rio, Tiocano, Willacy, and Willamar series.

The soils in this association are used mostly for irrigated crops. A small acreage is dryfarmed. A seasonal high water table is at a depth of 2 to 6 feet in 40 to 50 percent of the acreage of this association. About 30 percent of the association is affected by moderate to severe salinity. This association has a medium potential for the production of most of the major crops commonly grown in the county. A few of the soils are suited to citrus trees.

8. Hidalgo-Raymondville association

Nearly level to gently sloping, well drained and moderately well drained sandy clay loams and clay loams

This association occupies an irregularly shaped area. It consists of nearly level to gently sloping sandy clay loams and nearly level clay loams.

This association makes up about 4 percent of the county. It is about 40 percent Hidalgo soils, 40 percent Raymondville soils, and 20 percent soils of minor extent.

Hidalgo soils have a surface layer of dark grayish-brown, calcareous sandy clay loam, about 12 inches thick, over friable sandy clay loam. They are well drained and moderately permeable.

Raymondville soils have a surface layer of calcareous clay loam about 25 inches thick. The upper 6 inches is gray, the next 8 inches is dark gray, and the lower 11 inches is gray. The next layer is calcareous, very firm clay. These soils are moderately well drained and slowly permeable.

Minor soils of this association are in the Mercedes, Racombes, Tiocano, and Willacy series.

The soils in this association are used for irrigated crops. A seasonal high water table is in 15 to 20 percent of the area. Moderate salinity affects about 10 to 15 percent of the acreage. This association has a high potential for the production of most of the major crops commonly grown in the county. Hidalgo soils are suited to citrus trees.

9. Willacy-Raymondville association

Nearly level to gently sloping, well drained and moderately well drained fine sandy loams and clay loams

This association is mainly in an irregularly shaped area. Willacy soils are in the higher, more sloping areas. Raymondville soils are in the less sloping areas and are on broad, nearly level plains and in narrow, winding drainageways.

This association makes up about 4 percent of the county. It is about 40 percent Willacy soils, 30 percent Raymondville soils, and 30 percent soils of minor extent.

Willacy soils have a surface layer of dark grayish-brown, noncalcareous fine sandy loam, about 19 inches thick, over friable sandy clay loams. They are well drained and moderately permeable.

Raymondville soils have a surface layer of calcareous clay loam about 25 inches thick. The upper 6 inches is gray, the next 8 inches is dark gray, and the lower 11 inches is gray. The next layer is calcareous, very firm clay. The soils are moderately well drained and slowly permeable.

Minor soils of this association are in the Hidalgo, Racombes, Rio, and Tiocano series.

The soils in this association are used mainly for dryfarmed crops. About 10 percent of the acreage is irrigated. Less than 5 percent of the acreage of this association is affected by a seasonal high water table and slight to moderate salinity. This association has a medium potential for the production of many of the crops commonly grown in the county. Willacy soils are suited to citrus trees.

10. Raymondville association

Nearly level, moderately well drained clay loams

This association occupies small irregularly shaped areas. It consists of a nearly level plain broken in places by slight rises.

This association makes up about 4 percent of the county. It is about 82 percent Raymondville soils and 18 percent soils of minor extent.

Raymondville soils have a surface layer of gray, calcareous clay loam about 25 inches thick. The upper 6 inches is gray, the next 8 inches is dark gray, and the lower 11 inches is gray. The next layer is calcareous, very firm clay. The soils are moderately well drained and slowly permeable.

Minor soils of this association are in the Hidalgo, Mercedes, Racombes, and Willacy series.

The soils in this association are used for irrigated and dryfarmed crops. A seasonal high water table is at a depth of 2 to 10 feet in irrigated areas. About 30 to 40 percent of the irrigated areas of the association are affected by slight to moderate salinity. Much of the acreage of the association lacks adequate surface drainage. This association has a medium potential for the production of many of the crops commonly grown in the county.

Level to Gently Sloping, Very Slowly Permeable, Clayey Soils of Low Terraces

This group of soils occupies about 20 percent of the county. It consists of the Harlingen-Benito association, the Harlingen association, and the Mercedes association. In this group are somewhat poorly drained clays that have a high shrink-swell potential. These clayey soils crack and shrink when dry and swell when wet. The shrinking and swelling causes severe problems with foundations and other structures. Most of the area is used for irrigated crops.

11. Harlingen-Benito association

Level and nearly level, moderately well drained to poorly drained clays

This association occupies broad areas of slightly depressed areas that lack adequate surface drainage and are mostly flooded for several days after heavy rains. Benito soils are in slightly lower areas than Harlingen soils.

This association makes up about 8 percent of the county. It is about 45 percent Harlingen soils, 40 percent Benito soils, and 15 percent soils of minor extent.

Harlingen soils have a surface layer of calcareous, grayish-brown clay, about 11 inches thick, over brown and light-brown clay that extends to a depth of several feet. They are moderately well drained and very slowly permeable.

Benito soils have a surface layer of calcareous, gray clay, about 54 inches thick, over loamy calcareous material. They are saline, poorly drained, and very slowly permeable.

Minor soils of this association are in the Camargo, Laredo, Lomalta, and Olmito series.

The soils in this association are used mainly for irrigated crops and improved pasture. A small acreage is dryfarmed. The soils are moderately to severely saline. The water table is generally below a depth of 5 feet. This association has a low potential for the production of a few of the major crops commonly grown in the county. Crop selection is restricted to those in which salt tolerance is medium or high.

12. Harlingen association

Level and nearly level, moderately well drained clays

This association is in broad clayey areas. It is on a level to nearly level plain that is broken only by a few slightly depressional drainageways.

This association makes up about 7 percent of the county. It is about 70 percent Harlingen soils and 30 percent soils of minor extent.

Harlingen soils have a surface layer of calcareous, grayish-brown clay, about 11 inches thick, over brown and light-brown clay that extends to a depth of several feet. They are moderately well drained and very slowly permeable.

Minor soils of this association are in the Benito, Laredo, and Olmito series.

The soils in this association are used mainly for irrigated crops. Most of the soils in this association lack adequate surface drainage and have a slight to moderate hazard of salinity. The water table is generally below a depth of 5 feet. This association has a medium potential for the production of most of the major crops commonly grown in the county.

13. Mercedes association

Level to gently sloping, moderately well drained clays

This association occupies a broad plain. It makes up about 5 percent of the county. It is about 75 percent Mercedes soils and about 25 percent soils of minor extent.

Mercedes soils have a surface layer of calcareous, gray clay, about 29 inches thick, over very firm clay that extends to a depth of several feet. They are moderately well drained and very slowly permeable.

Minor soils of this association are in the Hidalgo and Raymondville series.

The soils in this association are used mainly for irrigated crops, dryfarmed crops, and urban development. A small acreage adjacent to the Arroyo Colorado is idle and in brush. Soils in this association have a slight hazard of salinity, and the water table generally is below a depth of 5 feet. This association has a medium potential for the production of many of the major crops commonly grown in the county.

Nearly Level to Steep, Rapidly Permeable, Sandy Soils of Coastal Areas

This group of soils occupies about 3 percent of the county. It consists only of the Mustang-Coastal dunes association. In this group are the sandy soils on Padre and Boca Chica Islands along the Gulf Coast. This area is used mostly for recreation and for range.

14. Mustang-Coastal dunes association

Nearly level to steep, poorly drained fine sands and sand dunes

This association is in a long narrow band along the Gulf Coast. It is separated from the mainland by the shallow water of Laguna Madre. It consists of active to partly stabilized windblown sands that are as much as 30 feet above sea level and that are on the eastern or Gulf side of the islands. The Mustang soils are in a broad area 2 to 5 feet above mean high tide and extend from the dunes westward to the Laguna Madre.

This association makes up about 3 percent of the county. It is about 56 percent Mustang soils, about 19 percent Coastal dunes, and 25 percent soils of minor extent.

Mustang soils consist of very pale brown fine sands, about 8 inches thick, over fine sands that are several feet thick and that are saturated with saline or brackish water within a depth of 2 feet.

Coastal dunes consist of fine sands several feet thick. The size and shape of the dunes are constantly changing.

Minor soils of this association are small areas of Galveston soils and a narrow band of Coastal beach.

This association is one of the most important associations in the county for present and potential use for recreation. Urban development is increasing along the southern end of Padre Island.

Descriptions of the Soils

This section describes the soil series and mapping units in Cameron County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the

mapping unit. Unless otherwise stated, the colors given in the descriptions are those of a dry soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Urban land, for example, does not belong to a soil series, but nevertheless, is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit in which the mapping unit has been placed; also at the end of the description of some mapping units is the pasture and hay group, orchard group, or range site, or a combination of these. The page for the description of each capability unit, the range site, orchard group, and yard and garden group can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual.[1]

[1] UNITED STATES DEPARTMENT OF AGRICULTURE. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. 1951. [Supplement issued in May 1962]

Barrada Series

The Barrada series consists of deep, very poorly drained, calcareous, saline clays at or near sea level. These soils are on barren, nearly level, tidal flats a few inches to several feet below the surrounding topography near the Gulf Coast.

In a representative profile this soil is light brownish-gray clay from the surface to a depth of about 52 inches, and below this, extending to a depth of 63 inches, it is stratified light-gray silty clay loam.

Permeability is very slow. The available water capacity is very low. These soils are subject to flooding during Gulf storms, high tides, or high-intensity rains. The soil is saturated to the surface for periods of 4 to 6 months and is never dry in any horizon below a depth of 6 to 12 inches in most years.

Barrada soils have no use in farming. They are barren and produce no vegetation. These soils are used for range and as wildlife refuges.

Representative profile of Barrada clay, 12 miles east of Brownsville on State Highway 4, 4.5 miles north on ranch trail, and 0.2 mile east of ranch trail through range:

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

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

Soil	Acres	Percent	Soil	Acres	Percent
Barrada clay	34,860	5.6	Mercedes clay, 1 to 3 percent slopes	1,780	0.3
Benito clay	25,730	4.2	Mercedes clay, loamy substratum, 1 to 5 percent slopes	2,240	.4
Benito-Urban land complex	950	.1	Mercedes-Urban land complex	2,200	.4
Camargo silt loam	2,240	.4	Mustang fine sand	1,210	.2
Camargo silty clay loam	600	.1	Mustang fine sand, saline	7,490	1.2
Cameron silty clay	1,840	.3	Olmito silty clay	29,940	4.8
Cameron silty clay, saline	1,390	.2	Olmito-Urban land complex	1,010	.2
Chargo silty clay	11,020	1.8	Orelia clay loam, clayey subsoil variant	1,100	.2
Coastal beach	1,120	.2	Point Isabel clay loam	13,660	2.2
Coastal dunes	3,430	.6	Point Isabel-Urban land complex	310	(1)
Delfina fine sandy loam	2,400	.4	Racombes sandy clay loam	19,610	3.2
Galveston fine sand, hummocky	2,730	.4	Racombes soils and Urban land	665	.1
Grulla clay	1,530	.2	Raymondville clay loam	49,540	8.0
Harlingen clay	49,730	8.1	Raymondville clay loam, saline	700	.1
Harlingen clay, saline	4,110	.7	Raymondville-Urban land complex	2,800	.4
Harlingen-Urban land complex	2,520	.4	Rio clay loam	1,240	.2
Hidalgo fine sandy loam, 0 to 1 percent slopes	1,330	.2	Rio Grande silt loam	9,440	1.5
Hidalgo fine sandy loam, 1 to 3 percent slopes	570	.1	Rio Grande silty clay loam	1,580	.3
Hidalgo sandy clay loam	22,100	3.6	Rio Grande-Urban land complex	1,120	.2
Hidalgo-Urban land complex	600	.1	Rio Grande-Zalla complex	460	.1
Laredo silty clay loam, 0 to 1 percent slopes	64,420	10.4	Sejita silty clay loam	44,780	7.3
Laredo silty clay loam, 1 to 3 percent slopes	2,470	.4	Sejita-Urban land complex	480	.1
Laredo silty clay loam, saline	12,410	2.0	Tiocano clay	3,630	.6
Laredo-Olmito complex	4,810	.8	Ustifluvents, clayey	9,660	1.6
Laredo-Reynosa complex, 0 to 1 percent slopes	3,210	.5	Willacy fine sandy loam, 0 to 1 percent slopes	28,570	4.6
Laredo-Reynosa complex, 1 to 3 percent slopes	460	.1	Willacy fine sandy loam, 1 to 3 percent slopes	3,200	.5
Laredo-Urban land complex	5,070	.8	Willamar soils	24,140	3.9
Latina sandy clay loam	2,160	.3	Zalla loamy fine sand	1,650	.3
Lomalta clay	47,160	7.6			
Lomalta-Urban land complex	410	.1	Total land area	616,695	100.0
Lozano fine sandy loam	3,490	.6	Water	125,065	
Lyford sandy clay loam	10,950	1.8			
Matamoros silty clay	6,090	1.0	Total area	741,760	
Matamoros-Rio Grande complex	1,630	.3			
Mercedes clay, 0 to 1 percent slopes	16,950	2.7			

[1] Less than 0.05 percent.

C2—4 to 25 inches, light brownish-gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; common, fine and medium, distinct, gray (5Y 4/1) and brownish-yellow (10YR 6/6) mottles; massive; saturated soil when squeezed in hand flows with difficulty between fingers; very sticky; few firm clay balls; saline; calcareous; strongly alkaline; diffuse, smooth boundary.

C3—25 to 52 inches, light brownish-gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; many, coarse, prominent, dark-gray (5Y 4/1) mottles; massive; when squeezed, saturated soil flows with difficulty between fingers, very sticky; few very firm clay balls; few pockets of sand; saline; calcareous; strongly alkaline; diffuse, smooth boundary.

C4—52 to 63 inches, light-gray (10YR 7/2) silty clay loam, grayish brown (10YR 5/2) moist; many, coarse, prominent, gray (10YR 4/1) and yellowish-brown (10YR 5/8) mottles; massive; very firm, sticky and plastic; saline; calcareous; strongly alkaline.

Thickness of the soil over loamy material ranges from 36 to more than 50 inches. The content of clay in the 10- to 40-inch layer ranges from 45 to 60 percent. Reaction is moderately alkaline to strongly alkaline throughout. The soil, when moist, is dark grayish brown, grayish brown, dark gray, or gray and has common to many mottles of gray, dark gray, yellowish brown, and brownish yellow. The C1, C2, and C3 horizons range from clay to silty clay. The C4 horizon is silty clay loam or loam.

Barrada clay (BA).—This soil is in broad, barren areas that are a few inches to several feet below the surrounding topography. The elevation is less than 5 feet, and a few areas are below sea level.

Included with this soil in mapping are areas of Sejita and Lomalta soils which occur as slight, vegetated rises. Also included are a few areas of soils that are similar to Barrada soils but are less clayey.

Permeability is very slow, and runoff is very slow to ponded. During prolonged dry periods, the surface 2- to 4-inch crust breaks down, and the soil particles "fluff" into aggregates that are easily moved by wind. This soil is subject to flooding during Gulf storms, high tides, or high-intensity rainstorms.

This soil is used entirely for wildlife habitat. It is barren and produces no vegetation. Capability unit VIIIs–2, dryland.

Benito Series

The Benito series consists of deep, poorly drained, calcareous, saline soils that are level to slightly depressed. These soils are on old flood plains and deltas.

In a representative profile the surface layer, extending to a depth of about 54 inches, is gray clay. The next layer is light brownish-gray silty clay loam about 9 inches thick. The underlying material, extending to a depth of about 84 inches, is stratified pale-brown silt loam.

Permeability is very slow. The available water capacity is low to very low, depending on the degree of salinity. Runoff is very slow, and water stands on the surface for several weeks after heavy rains.

Most areas of Benito soils are used for improved pasture, but a small acreage is used for dryfarmed and irrigated crops. Because of poor drainage and high degree of salinity, these soils respond slowly to management practices.

Representative profile of Benito clay, in a pasture 4.3 miles northeast on Farm Road 510 from its junction with U.S. Highway 77, east of San Benito, 0.4 mile south on a field road, and 0.1 mile east:

A11—0 to 8 inches, gray (N 5/0) clay, dark gray (N 4/0) moist; weak, fine, granular and subangular blocky structure; very hard, very firm, very sticky and very plastic; saline; calcareous; moderately alkaline; gradual, smooth boundary.

A12—8 to 54 inches, gray (N 5/0) clay, dark gray (N 4/0) moist; many prominent intersecting slickensides and many distinct parallelepipeds parting to moderate, fine, angular blocks; very hard, very firm, very sticky and very plastic; common salt threads; saline; calcareous; moderately alkaline; diffuse, smooth boundary.

AC—54 to 63 inches, light brownish-gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; common, fine, distinct, pale-brown mottles; dark gray (10YR 4/1) moist streaks or burrow fillings; many, distinct, intersecting slickensides and many parallelepipeds; very hard, very firm, very sticky and very plastic; few salt threads; saline; calcareous; moderately alkaline; abrupt, smooth boundary.

IIC—63 to 84 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; common, fine, distinct, brownish-yellow mottles; many, gray (10YR 5/1), moist landcrab burrows; massive; slightly hard, very friable; many weakly cemented concretions and soft lumps of calcium carbonate; saline; calcareous; moderately alkaline.

The solum ranges from 50 to 72 inches in thickness. These soils have cracks 0.4 to 3.0 inches in width at a depth of 20 inches. Intersecting slickensides begin 8 to 20 inches below the surface; parallelepipeds are tilted to about 30° to 60° from the horizontal and part to moderate, fine and medium, angular blocks. Exchangeable sodium increases with increasing depth and may exceed 15 percent. Reaction ranges from moderately alkaline to strongly alkaline.

The A horizon ranges from 45 to 72 inches in thickness and from gray to light gray in color. The 10-to 40-inch layer is 60 to 78 percent clay and 1 to 4 percent sand. The AC horizon ranges from 5 to 15 inches in thickness and from silty clay loam to silty clay or clay in texture. The IIC horizon is silt loam, very fine sandy loam, or silty clay loam.

Benito clay (BE).—This soil is in broad, slightly depressional areas. A few areas of this soil are in long, narrow drainageways. Slopes are less than 0.5 percent, and the surface is concave. Areas are several hundred acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Laredo silty clay loam, saline, that are on slight rises in the nearly level landscape and areas of Harlingen clay, saline, and Chargo silty clay loam. Also included are a few areas of soils that are similar to Benito soils but are underlain by loamy material at a depth of 30 inches or more.

The surface is crusty and cloddy. The soil is poorly drained. It is saline and high in exchangeable sodium. Subsurface tile drains are not practical because this soil has a high content of clay. Capability units VIs–1, dryland, and IVw–1, irrigated; pasture and hay group 7F; Salty range site.

Benito-Urban land complex (BU).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is within Brownsville International Airport. Areas are slightly depressional to nearly level. Benito clay makes up about 60 percent of the complex, and Urban land makes up about 30 percent.

Benito clay consists of about 54 inches of gray, saline, calcareous clay. The next layer is about 9 inches of light brownish-gray, saline, calcareous silty clay loam. The underlying material is stratified, pale-brown silt loam.

Urban land consists mostly of areas where such works and structures as runways, buildings, parking lots, streets, roads, and sidewalks have been constructed. Because of the nearly level topography,

much of the soil has not been altered greatly during construction, but most structures have been built on 1 to 2 feet of fill dirt that helps in drainage of the soil.

Included with these soils in mapping are areas of Harlingen, Olmito, and Laredo soils.

Among the concerns of management for urban development are flooding from runoff, cracking and shifting of structures because of the shrink-swell potential, failure of pipelines and steel because of corrosivity and salinity, and failure of septic-tank filter fields because of permeability. Capability unit and other interpretative groups not assigned.

Camargo Series

The Camargo series consists of deep, well-drained, calcareous silty soils. These soils are on the active flood plain of the Rio Grande. The surface is plane, and slopes are mostly less than 1 percent.

In a representative profile the plow layer is light-gray, calcareous silt loam about 8 inches thick. Below this, extending to a depth of about 63 inches, is light-gray and light brownish-gray, stratified silty clay loam and silt loam.

Permeability is moderate. The available water capacity is very high to high. These soils are rarely flooded. The high lime content causes chlorosis of some plants.

Camargo soils are used entirely for irrigated crops. They respond well to good management.

Representative profile of Camargo silt loam, is a cultivated field, 0.4 mile east of the junction of U.S. Highway 281 and Farm Road 732 and 0.2 mile south on a field road, 3.4 miles southeast on International Boundary and Water Commission (IBWC) levee, 0.8 miles southwest on a field road, and 100 feet east:

Ap—0 to 8 inches, light-gray (10YR 7/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; few mica flakes; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—8 to 14 inches, light-gray (10YR 7/2) silt loam, dark grayish brown (10YR 4/2) moist; few, fine, brownish-yellow mottles along root channels; massive; very evident, thin bedding planes; slightly hard, friable; common very fine pores; few mica flakes; calcareous; moderately alkaline; abrupt, wavy boundary.

C2—14 to 24 inches, light-gray (10YR 7/2) silty clay loam, dark grayish brown (10YR 4/2) moist; few, fine, brownish-yellow mottles along root channels and faces of cleavage planes; massive; large unaltered bedding planes and thin unaltered strata of silt loam; hard, friable; few very fine pores; few mica flakes; calcareous; moderately alkaline; gradual, wavy boundary.

C3—24 to 39 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; massive; large unaltered bedding planes that have smooth dull faces; very hard, firm; few very fine pores; few mica flakes; calcareous; moderately alkaline; gradual, wavy boundary.

C4—39 to 51 inches, light brownish-gray (10YR 6/2) silty clay loam, dark brown (10YR 4/3) moist; few, fine, brownish-yellow mottles along root channels and faces of cleavage planes; massive; large unaltered bedding planes that have smooth, dull faces; very hard, firm; few very fine pores; few mica flakes; calcareous; moderately alkaline; clear, smooth boundary.

C5—51 to 63 inches, light-gray (10YR 7/2) silt loam, dark grayish brown (10YR 4/2) moist; few, fine, brownish-yellow mottles along cleavage planes; massive; thin, unaltered bedding planes; slightly hard, very friable; few mica flakes; calcareous; moderately alkaline.

The texture of the uppermost 40 inches of the soil ranges from silt loam to silty clay loam. The A horizon ranges from grayish brown through light gray in color, from silt loam to silty clay loam in texture, and from 5 to 11 inches in thickness.

The C horizon ranges from grayish brown to light gray, light brownish gray, pale brown, or very pale brown in color. It is silt loam to silty clay loam that has thin strata of more clayey or sandy material. This horizon is 18 to 35 percent clay. Cleavage planes along unaltered bedding planes are weakly to strongly expressed. The sediment below a depth of 40 inches is stratified and ranges from very fine sandy loam to silty clay.

Camargo silt loam (CA).—This nearly level soil is on the flood plain of the Rio Grande. Slopes are less than 1 percent. Areas of this soil are irregularly shaped and range from 10 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Rio Grande and other Camargo soils in narrow streaks or rounded pockets. Also included are a few minor depressions in which Matamoros soils occur.

Permeability is moderate, and runoff is slow. This soil is used for irrigated crops. Because of the contrasting texture throughout the soil, a perched water table is common after heavy irrigation or rainfall. Capability unit I–1, irrigated; pasture and hay group 2A; orchard group C.

Camargo silty clay loam (CC).—This nearly level soil is on the flood plain of the Rio Grande. Slopes are less than 0.5 percent. Areas of this soil are irregularly shaped and range from 5 to 40 acres in size.

The plow layer is light-gray silty clay loam about 11 inches thick. Below the plow layer, to a depth of 40 inches, is pale-brown silty clay loam that contains thin strata of silt loam. The underlying material is pale-brown, stratified very fine sandy loam to silty clay sediments.

Included with this soil in mapping are areas of Rio Grande and other Camargo soils in narrow streaks or rounded pockets. Also included are a few minor depressions in which Matamoros soils occur.

Permeability is moderate, and runoff is slow. This soil is used for irrigated crops. Because of the contrasting texture throughout the soil, a perched water table is common after heavy irrigation or rainfall. Capability unit I–2, irrigated; pasture and hay group 1C; orchard group C.

Cameron Series

The Cameron series consists of deep, moderately well drained, calcareous soils that are nearly level. These soils are on old flood plains and deltas.

In a representative profile (fig. 2) the gray silty clay extends from the surface to a depth of about 23 inches. The underlying material, extending to a depth of about 63 inches, is stratified, light-gray and very pale brown silt loam.

Permeability is moderately slow, and runoff is slow. The available water capacity is very low to high depending on the degree of salinity.

Cameron soils are used mainly for irrigated crops. A small acreage is in pasture or is idle.

Representative profile of Cameron silty clay, in a cultivated field, 4 miles north of Los Fresnos on Farm Road 1847, 0.6 mile east on Farm Road 510, then 900 feet south on field road, and 100 feet west:

Ap—0 to 7 inches, gray (10YR 5/1) silty clay, very dark grayish brown (10YR 3/2) moist; weak, very fine,

Figure 2.—**Profile of Cameron silty clay.**

granular structure; very hard, firm, but crumbly; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—7 to 15 inches, gray (10YR 5/1) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; very hard, very firm, but crumbly; few pores; few snail shell fragments; calcareous; moderately alkaline; clear, smooth boundary.

B2—15 to 23 inches, gray (10YR 6/1) silty clay, dark grayish brown (10YR 4/2) moist, weak, medium, subangular blocky structure; hard, firm, but crumbly; many fine pores; few films and threads of secondary carbonates; calcareous; moderately alkaline; clear, wavy boundary.

IICca—23 to 29 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; hard, friable; 5 percent, by volume, of soft fine calcium carbonate bodies; calcareous; moderately alkaline; gradual, wavy boundary.

IIC—29 to 63 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; calcareous; moderately alkaline.

The depth to a contrasting loamy layer ranges from 22 to 36 inches. These soils have cracks 0.4 to 1.5 inches wide that extend from the surface or lower boundary of the Ap horizon to a depth of 20 inches or more when dry. The upper part of the 10- to 40-inch layer is 40 to about 60 percent clay. The lower part of the 10- to 40-inch layer is loamy, is about 15 to 35 percent clay, and 40 to 55 percent silt.

The A horizon ranges from 10 to 19 inches in thickness and from gray to dark grayish brown in color.

The B horizon ranges from 6 to 12 inches in thickness, from silty clay loam to silty clay or clay in texture, and from gray or light gray to dark grayish brown or grayish brown in color. Structure ranges from weak to moderate subangular and irregular blocky.

The IIC horizon is silt loam with or without thin strata of more sandy or clayey sediment. It ranges from 10 to about 27 percent clay and from light gray or grayish brown to very pale brown or pale brown in color. Secondary carbonates range from a few to about 6 percent by volume of weakly cemeted concretions and soft masses.

Cameron silty clay (CE).—This soil is mainly in small, narrow, elongated areas on old flood plains and deltas. Slopes are less than 0.5 percent, and the surface is plane or slightly concave. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Olmito and Laredo soils and areas of saline Cameron soils. Also included are a few areas of soils that are similar to Cameron soils but have a lighter colored surface layer.

Permeability is moderately slow, and runoff is slow. Almost all of the acreage is in irrigated crops. The suitability of citrus is questionable because the upper part of the soil has a high content of clay. Capability units IIs—1, dryland, and IIs–1, irrigated; pasture and hay group 7C; orchard group F.

Cameron silty clay, saline (CF).—This nearly level soil is on old flood plains and deltas. Slopes are less than 0.5 percent, and the surface is plane or slightly concave.

The gray silty clay extends from the surface to a depth of about 26 inches. The next layer is brown silty clay loam about 6 inches thick. The underlying material, extending to a depth of about 63 inches, is very pale brown stratified silt loam and very fine sandy loam.

Included with this soil in mapping are areas of Chargo and Laredo saline soils. Also included are a few areas of saline Harlingen soils, and Benito soils.

Permeability is moderately slow, and runoff is slow. Most of the acreage is in pasture or is left idle because high salinity prevents the growth of field crops. A seasonal high water table is at a depth of 24 to 60 inches. If adequate outlets are available, tile drain systems can be used to effectively reduce the salinity in this soil. Capability units IVs–3, dryland, and IIIs–4, irrigated; pasture and hay group 7F; orchard group I.

Chargo Series

The Chargo series consists of deep, moderately well drained, calcareous, saline soils that are nearly level. These soils are on old flood plains and deltas.

In a representative profile the surface layer is silty clay about 27 inches thick. It is gray in the upper 5 inches, dark grayish brown in the next 7 inches, and grayish brown in the lower 15 inches. The next layer is brown silty clay about 9 inches thick. The next layer is 5 inches of light brownish-gray silty clay that contains calcium carbonate in the form of a few soft lumps and hard concretions. The underlying material, extending to a depth of about 63 inches, is stratified very pale brown silt loam and light-brown silty clay.

Permeability and runoff are slow. The available

water capacity is very low to medium depending on the degree of salinity. A seasonal high water table is at a depth of 24 to 36 inches.

Chargo soils are idle in most areas because the high salinity prevents the growth of field crops. A small acreage of this soil is irrigated.

Representative profile of Chargo silty clay, in a cultivated field, 1.4 miles south of the intersection of Farm Road 2480 and Farm Road 510 in Bayview, 2 miles northeast on county road, 100 feet north from right-of-way:

Ap—0 to 5 inches, gray (10YR 5/1) silty clay, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure; massive; very hard, very firm, sticky and plastic; few salt threads; saline; calcareous; moderately alkaline; abrupt, smooth boundary.

A11—5 to 12 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; very hard, very firm, sticky and plastic; few fine pores; common salt threads; saline; calcareous; moderately alkaline; gradual, smooth boundary.

A12—12 to 27 inches, grayish-brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, fine and medium, subangular blocky structure; few wedge-shaped peds; very hard, very firm, sticky and plastic; few fine pores; common salt threads; saline; calcareous; moderately alkaline; gradual, wavy boundary.

B2—27 to 36 inches, brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate, fine and medium, subangular blocky structure; few wedge-shaped peds; very hard, very firm, sticky and plastic; few dark streaks in old partly filled cracks; common salt threads and nests; saline; calcareous; moderately alkaline; gradual, wavy boundary.

B3ca—36 to 41 inches, light brownish-gray (10YR 6/2) silty clay, dark brown (10YR 4/3) moist; weak, fine, blocky structure; very hard, very firm, sticky and plastic; 3 percent, by volume, soft lumps and concretions of calcium carbonate; few slickensides that do not intersect; saline; calcareous; moderately alkaline; clear, wavy boundary.

IIC—41 to 47 inches, very pale brown (10YR 7/3) silt loam; few, fine distinct, brownish-yellow mottles, brown (10YR 5/3) moist; massive; hard, friable; saline; calcareous; moderately alkaline; clear, wavy boundary.

IIICca—47 to 63 inches, light-brown (7.5YR 6/4) silty clay, brown (7.5YR 5/4) moist; massive; very hard, very firm, sticky and plastic; 3 percent, by volume, soft lumps and strongly cemented concretions of calcium carbonate; saline; calcareous; moderately alkaline.

The solum ranges from 30 to 50 inches in thickness. Depth to contrasting strata of silt loam or very fine sandy loam ranges from 40 to 80 inches. These soils have cracks from 0.4 to 1 inch wide that extend to a depth of 20 inches or more. The 10- to 40-inch layer ranges from silty clay loam to silty clay and is 35 to 55 percent clay and 40 to 55 percent silt.

The A horizon ranges from 18 to 35 inches in thickness and from very dark gray or gray to grayish brown or dark grayish brown in color.

The B horizon ranges from dark grayish brown or brown to light brownish gray in color. It is weak to moderate subangular blocky and blocky. It has a few slickensides that do not intersect. The B2 horizon ranges from 8 to 31 inches in thickness and from silty clay loam to silty clay or clay in texture. The B3ca horizon ranges from silty clay loam to silty clay in varying shades of brown. In most places there is a weakly expressed ca horizon that ranges from 4 to 12 inches in thickness.

The C horizon ranges from silty clay to clay and has stratified layers of silt loam, silty clay loam, and very fine sandy loam.

Chargo silty clay (CH).—This nearly level soil is on old flood plains and deltas. Slopes are less than 0.5 percent, and the surface is plane or slightly concave. Areas of this soil range from 10 to about 100 acres in size.

Included with this soil in mapping are areas of Benito and the saline Harlingen soils. Also included are a few areas of the saline Laredo soils on a few slight rises.

Permeability and runoff are slow. Most areas of this soil are idle because high salinity prevents the growth of field crops. A small acreage is irrigated. The surface layer is hard and crusty when dry. A seasonal high water table is within 18 to 36 inches of the surface. If adequate outlets are available, tile drain systems can be used to effectively reduce the salinity in this soil. Capability units IVs–3, dryland, and IIIs–4, irrigated; pasture and hay group 7F; orchard group I; Salty range site.

Coastal Beach

Coastal beach (CO) consists of shores that have been washed and rewashed by waves. It is partly or completely covered by water at high tide. The soil material is light-gray to very pale brown fine sand that contains many fragments of seashells. The sand washed from the Gulf of Mexico to the eastern shore of Padre and Brazos Islands. It lies in a narrow band, 20 to 200 feet wide, that adjoins the Coastal dunes. From the eastern base of these dunes to the edge of the water, the slope of the beach ranges from 1 to 3 percent. The beach surface is generally smooth. The water from high tides forms rills in some places but normally the rills are smoothed by the gentle sea.

In this county, Coastal beach and Coastal dunes extend side by side from the mouth of the Rio Grande River for a distance of more than 30 miles along the shore of the Gulf of Mexico. This combination of beach and sand dunes attracts thousands of tourists and others seeking recreation. The county has maintained park facilities on South Padre Island since a causeway was built to the island. Capability unit VIIIs–2.

Coastal Dunes

Coastal dunes (CU) consists of sand dunes that are partly stable and partly active. They are characterized by a succession of dune hills and ridges and a few valleys and swales. Slopes are mostly 1 to 30 percent. Coastal dunes are near the eastern shore of Padre and Brazos Islands and are adjacent to Coastal beach.

The soil material is light-gray to very pale brown, loose fine sand several feet thick. Most of the sand grains are clear, but a few are yellow and black. The soil shows evidence of layering or bedding planes. In a few areas the dark-colored sand grains are sorted and occur in thin strata. The tops of the dunes are 15 to 30 feet above mean high tide and have a base that is 125 to 250 feet wide.

Coastal dunes are steep, more choppy, and less stable than Galveston soils. They are not subject to flooding at high tide as are Mustang soils.

Coastal dunes and Coastal beach attract thousands of tourists and others seeking recreation. Capability unit VIIIs–1.

Delfina Series

The Delfina series consists of deep, well-drained, noncalcareous soils. These soils are on nearly level to gently sloping uplands.

In a representative profile the surface layer is dark grayish-brown, noncalcareous fine sandy loam about 15 inches thick. The next layer is firm, mottled sandy clay loam about 19 inches thick. The upper part is grayish brown, and the lower part is brown. The next layer is about 26 iinches thick; it is strong-brown sandy clay loam that is mottled and that contains a few weakly cemented and strongly cemented calcium carbonate concretions. The underlying material, extending to a depth of about 72 inches, is brownish-yellow sandy clay loam.

Permeability is moderately slow, and runoff is medium. The available water capacity is medium to high.

Delfina soils are used for irrigated crops and dryfarmed crops.

Representative profile of Delfina fine sandy loam, in a cultivated field, 1.7 miles east of State Highway 345 on Farm Road 106, then 2 miles north and 0.4 mile west on County Road, 50 feet north from right-of-way:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular and subangular blocky structure; hard, friable; neutral; abrupt, smooth boundary.

A1—7 to 15 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular and subangular blocky structure; slightly hard, very friable; neutral; clear, wavy boundary.

B21t—15 to 21 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; common, fine, distinct mottles of strong brown (7.5YR 5/6) moist; moderate, medium, angular and subangular blocky structure; very hard, firm; few fine pores; common clay films and organic-matter coatings on vertical and horizontal ped surfaces; organic coatings and stains are black (10YR 2/1) moist; few, weakly cemented, black iron-manganese concretions of pinhead size; mildly alkaline; gradual, smooth boundary.

B22t—21 to 34 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; many, fine and medium, distinct, yellowish-red (5YR 4/6) and strong-brown (7.5YR 5/6) mottles; moderate, medium, angular and subangular blocky structure; very hard, firm; few fine pores; common clay films and coatings of dark gray (10YR 4/1) moist, on vertical and horizontal ped surfaces; few weakly cemented calcium carbonate concretions about 1/2 centimeter in diameter; mildly alkaline; gradual, smooth boundary.

B3ca—34 to 60 inches, strong-brown (7.5YR 5/6) sandy clay loam, dark brown (7.5YR 4/4) moist; few strong-brown mottles; weak, fine and medium, subangular blocky structure; very hard, firm; few root channels containing organic stains; few clay films; few discontinuous organic coatings and sand grains on ped faces; few soft and few cemented concretions of iron manganese; few dark streaks of dark grayish brown (10YR 4/2) moist, along faces of some blocks; common films and threads of calcium carbonate; many weakly cemented and few strongly cemented calcium carbonate concretions; calcareous; moderately alkaline; gradual, wavy boundary.

C—60 to 72 inches, brownish-yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; massive; hard, friable; few fine pores; few weakly and strongly cemented calcium carbonate concretions; calcareous; moderately alkaline.

The solum ranges from 50 to 72 inches in thickness. Secondary carbonates in the form of films, threads, or soft masses are at a depth of 28 to 35 inches.

The A horizon ranges from 7 to 19 inches in thickness and from dark grayish brown to grayish brown in color. Reaction is neutral to mildly alkaline.

The B2t horizon ranges from 13 to 22 inches in thickness, from dark brown to brown or grayish brown in color, and from sandy clay loam to clay loam in texture. The content of clay is 25 to 35 percent. Structure ranges from moderate to strong compound prismatic and blocky. Mottling ranges from distinct to prominent in shades of brown, yellow, and red. Black and dark-gray coatings are on the ped faces. Reaction is neutral to mildly alkaline. The B3 horizon ranges from 20 to 30 inches in thickness. It is sandy clay loam to loam and is less clayey than the B2t horizon. The B3 horizon is brown, strong brown, or light brown. Calcium carbonate, in the form of weakly cemented and strongly cemented concretions that range from common to many, is at a depth of 34 to 50 inches.

The C horizon ranges from light brownish gray or brownish yellow in color and from sandy loam to sandy clay loam in texture. Concretions of calcium carbonate range from few to common and from weakly cemented to strongly cemented.

Delfina fine sandy loam (DE).—This nearly level to gently sloping soil is on uplands. Slopes are less than 2 percent, and the surface is slightly convex. Areas of this soil are mostly round in shape and range from 10 to 60 acres in size.

Included with this soil in mapping are areas of Lozano and Willacy soils on the tops of slight knolls. Also included are a few minor depressions in which Lyford soils occur.

Permeability is moderately slow, and runoff is medium. This soil is used for irrigated and dryfarmed crops. The surface is hard and massive when dry. The hazard of soil blowing is slight. Capability units IIw–1, dryland, and IIw–1, irrigated; pasture and hay group 8C; orchard group A.

Galveston Series

The Galveston series consists of deep, somewhat excessively drained, loose sandy soils. These soils are in hummocky areas on Padre and Boca Chica Islands. They are more than 5 feet above sea level.

In a representative profile the surface layer and underlying material, to a depth of 63 inches, are very pale brown fine sand. Below this depth, the fine sand is generally saturated.

Permeability is rapid. The available water capacity is low.

Most areas of Galveston soils are used for recreation and wildlife habitat. A few areas on the southern end of Padre Island are used for urban development.

Representative profile of Galveston fine sand, hummocky, 16 miles north along the beach from the end of the highway at Andy Bowie Park on South Padre Island, 400 feet west of the outer edge of the dunes:

A1—0 to 5 inches, very pale brown (10YR 7/4) fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; moderately alkaline; abrupt, smooth boundary.

C—5 to 63 inches, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; moderately alkaline.

Depth to loamy materials is more than 72 inches. The soil is mildly alkaline to moderately alkaline throughout. The A horizon ranges from 2 to 8 inches in thickness and from grayish brown to very pale brown in color. The C horizon ranges from light brownish gray to white and very pale brown in color and from fine sand to sand in texture. The content of silt and clay ranges from 3 to 10 percent.

Galveston fine sand, hummocky (GA).—This soil is in hummocky areas adjacent to and on the leeward side of the Coastal dunes on Padre Island and Brazos

Island. Areas of this soil are irregularly shaped and range from less than 10 acres to 400 acres in size. Slopes are mainly 0 to 6 percent and are convex.

Included with this soil in mapping are areas of Mustang soils in small depressions, and a few small active dunes or "blowouts." Also included are a few areas that are calcareous because of sand-size shell fragments.

Permeability is rapid, and runoff is very slow. The hazard of soil blowing on this soil is severe. Areas of this soil are used for recreation, wildlife habitat, and urban development. Capability unit IVe–1, dryland; Coastal Sand range site.

Grulla Series

The Grulla series consists of deep, somewhat poorly drained, calcareous soils that are level. These soils are in partly filled resacas on the active flood plain of the Rio Grande.

In a representative profile, the plow layer is grayish-brown, calcareous clay about 7 inches thick. Below this and extending to a depth of about 62 inches is light brownish-gray clay that contains weak stratification, loamy sediment, and remnants of a buried former surface layer.

Permeability is very slow. The available water capacity is high to medium. Unless the soils are artificially drained, water remains on the surface for several weeks after heavy rains.

Grulla soils are used almost entirely for irrigated crops. A few areas are idle.

Representative profile of Grulla clay, in a cultivated field, 0.4 mile east on U.S. Highway 281 from its junction with Farm Road 2556, then 1.6 miles south on County Road to IBWC levee, 0.6 mile west and 0.7 mile north on levee, 100 feet west of levee:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak, angular blocky structure; the upper 1/2 inch is one unit of value higher and consists of recent waterlain sediment of clay texture; extremely hard, very firm; few earthworm casts; few roots; calcareous; moderately alkaline; clear, smooth boundary.

C1—7 to 30 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; many, coarse, faint mottles of dark grayish brown (10YR 4/2) moist, and many distinct coarse mottles of reddish brown (5YR 4/4) moist, on the outside of some clay fragments; the reddish mottles decrease in number and size with increasing depth but do not penetrate the fragments; the fragments are variable in size but are mainly about 2 inches across the axes, the interfaces are dull and not shiny; distinct horizontal cleavage planes; very hard, very firm, sticky and plastic; very few pores in the clay fragments; few remnants of leaves on the interfaces; calcareous; moderately alkaline; abrupt, smooth boundary.

Ab—30 to 36 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; few; fine; yellowish-brown mottles; weak, angular blocky structure; very hard, very firm, sticky and plastic; calcareous: moderately alkaline; clear, smooth boundary.

C2—36 to 62 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; many, fine, distinct, mottles of yellowish brown along the interfaces of the fragments; massive; bedding planes are evident; very hard, very firm, sticky and plastic; calcareous, moderately alkaline.

The soils, if dry, have cracks 1 to 10 centimeters wide that reach to a depth of at least 20 inches.

The Ap horizon or surface layer generally contains some recent sediment; ranging from clay to silty clay or clay loam that is 30 to 70 percent clay. It ranges from grayish brown or light gray to grayish brown or pale brown.

The C horizon is 45 to 60 percent clay, except for a 1- to 2-inch layer of loamy sediment. Colors are about the same as in the Ap horizon, but yellowish and brownish mottles range from none to few.

Grulla clay (GR).—This soil is in resacas that have been cut off from the Rio Grande by major floods. Areas of the soil are in level, long oxbows on the active flood plain. The soils are 1 to 5 feet below the surrounding landscape and have no natural drainage outlet. Slopes are less than 0.5 percent, and the surface is plane to concave. Areas of the soil rarely exceed 40 acres in size.

Included with this soil in mapping are Matamoros and Rio Grande soils that occur along the edges and upper ends of the areas of this soil. Also included are a few areas of soils that are similar to Grulla soils, but they are dark gray.

Permeability is very slow, and runoff is ponded. Excess water is a limitation to use. Some areas remain wet several weeks each year. This soil is used almost entirely for irrigated crops. A few areas are idle. Capability unit IVw–2, irrigated; pasture and hay group 1A.

Harlingen Series

The Harlingen series consists of deep, moderately well drained, calcareous soils that are level to nearly level. These soils are on old flood plains and deltas.

In a representative profile the surface layer is about 11 inches of grayish-brown clay and 12 inches of brown clay. The next layer is brown clay about 12 inches thick. The next lower layer is light-brown clay 24 inches thick. Beneath this to a depth of 71 inches is brown clay.

Permeability is very slow, and runoff is slow. The available water capacity is very low to high, depending on the degree of salinity.

Most areas of Harlingen soils are used for irrigated crops. A small acreage is used for dryfarmed crops and improved pasture. A few areas are idle.

Representative profile of Harlingen clay, in a cultivated field, 3.3 miles southwest on Farm Road 509 from its junction with U.S. Highway 83, then 600 feet northwest:

Ap—0 to 11 inches, grayish-brown (10YR 5/2) clay, dark brown (7.5YR 5/2) moist; weak, fine, granular and subangular blocky structure; very hard, very firm, very sticky and plastic; calcareous; moderately alkaline; clear, smooth boundary.

A1—11 to 23 inches, brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; moderate, medium, blocky structure; very hard, very firm, very sticky and plastic; calcareous; moderately alkaline; diffuse, wavy boundary.

AC1—23 to 35 inches, brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; moderate, medium angular blocky structure; many intersecting slickensides; parallelepipeds that have long axis tilted 30° to 45° from the horizontal; very hard, firm, very sticky and very plastic; shiny pressure faces on peds; few salt threads; calcareous; moderately alkaline; diffuse, wavy boundary.

AC2—35 to 59 inches, light-brown (7.5YR 6/3) clay, dark brown (7.5YR 4/3) moist; common prominent intersecting slickensides, and parallelepipeds; very hard, very firm, very sticky and plastic; few salt threads; few strongly cemented and weakly cemented concretions and films and threads of calcium carbonate; saline; calcareous; moderately alkaline; diffuse, wavy boundary.

AC3—59 to 71 inches, brown (7.5YR 5/3) clay, dark brown (7.5YR 4/3) moist; few prominent intersecting slickensides, and parallelepipeds; very hard, very firm, very sticky and plastic; common films and threads of salt; few lumps of soft calcium carbonate; saline; calcareous; moderately alkaline.

The solum ranges from 30 to 50 inches in thickness. Intersecting slickensides begin at a depth of 20 to 30 inches. The axes of parallelepipeds are tilted 10° to about 45° from horizontal. Exchangeable sodium increases with increasing depth; and ranges from about 6 percent of the soil mass in the upper part of the solum to about 25 percent in the AC3 horizon.

The A horizon is grayish brown, brown, pinkish gray, or light brownish gray and is 16 to 28 inches thick. The A horizon is clay or silty clay. Texture at a depth of 10 to 40 inches is 60 to 76 percent clay. The AC horizon is brown to light brown or pale brown and has strata of loamy sediment below a depth of 50 inches in places. Native areas have gilgai microrelief with micropits about 2 to 5 inches lower than the microknolls. Distance between microknolls ranges from about 5 to 10 feet.

Harlingen clay (HA).—This level soil generally occupies broad areas several hundred acres in size, but a few areas are small and irregularly shaped. Slopes are less than 0.5 percent, and the surface is plane. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Olmito and Laredo soils, and Harlingen clay, saline. Also included are a few areas of soils that are similar to Harlingen soils, but they are underlain by loamy material at a depth of 36 inches or more. Other inclusions are a few other areas of soils that are similar to Harlingen soils, but they are slightly less clayey.

Permeability is very slow, and runoff is slow. Most areas lack adequate surface drainage. This soil cracks or shrinks when dry and swells when wet. Most areas of this soil are in irrigated crops. A small acreage is used for dryfarmed crops, and a few areas are in improved pasture. Capability units IIIs–1, dryland, and IIIs–1, irrigated; pasture and hay group 7A.

Harlingen clay, saline (HC).—This is a level soil. The areas are smooth and 10 to 200 acres in size, and most are long and narrow. Slopes are less than 0.5 percent, and the surface is plane.

The surface layer is grayish-brown clay about 8 inches thick. Beneath this, and extending to a depth of about 63 inches, is pale-brown clay. The underlying material is stratified silty and clayey sediment.

Included with this soil in mapping are areas of Benito, Chargo, and Harlingen soils. Also included are a few areas of soils similar to Harlingen clay, saline, but they are underlain by loamy material at a depth of 36 inches or more.

The surface layer is crusty and cloddy. Permeability is very slow, and runoff is slow. This soil cracks and shrinks when dry and swells when wet. The salinity of this soil is moderate to very high. Subsurface tile drains are not practical because the soil has a high content of clay. This soil is used mostly for irrigated pasture. A small acreage is used for irrigated crops, and a few areas are idle. Capability units IVs–1, dryland, and IVs–1, irrigated; pasture and hay group 7F.

Harlingen-Urban land complex (HE).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is in San Benito. Slopes range from 0 to 1 percent. Harlingen clay makes up about 60 percent of the complex, Urban land makes up 30 percent, and other soils the remaining 10 percent.

Harlingen clay consists of about 11 inches of grayish-brown, calcareous clay. Beneath this, extending to a depth of about 71 inches, is brown, calcareous clay. The underlying material is silty and clayey sediment.

Urban land consists mostly of areas where such works and structures as streets, sidewalks, buildings, driveways, and patios have been constructed. Most of the structures are single-unit dwellings. Because of the flat topography, much of the soil has not been disturbed greatly during construction, but most structures have been built on 6 inches to 1 foot of fill dirt, a practice that helps drainage.

Included with these soils in mapping are areas of Olmito, Cameron, and Laredo soils.

Among the concerns of management for urban development are flooding from runoff, cracking and shifting of structures because of the shrink-swell potential, failure of pipelines and steel because of corrosivity and salinity, and failure of septic-tank filter fields because of permeability. Capability unit and other interpretative groups not assigned.

Hidalgo Series

The Hidalgo series consists of deep, well-drained, calcareous soils that are nearly level to gently sloping. These soils are on deltas or coastal terraces.

In a representative profile the surface layer is dark grayish-brown, calcareous sandy clay loam about 12 inches thick. The next layer is brown sandy clay loam about 10 inches thick. The next layer is pale-brown sandy clay loam about 15 inches thick. The underlying material, extending to a depth of about 63 inches, is very pale brown sandy clay loam.

Permeability is moderate, and runoff is slow. The available water capacity is medium to high.

Hidalgo soils are used for irrigated crops, dryfarmed crops, and pasture.

Representative profile of Hidalgo sandy clay loam, in a cultivated field, 1.1 miles north on Farm Road 1420 from its junction with Farm Road 508, 1.1 miles west on field road and 100 feet north:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky and granular structure; slightly hard, friable; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—7 to 12 inches, dark grayish-brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure; slightly hard, friable; many fine and very fine pores; few broken snail shells; calcareous; moderately alkaline; clear, wavy boundary.

B21—12 to 22 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate, fine and very fine, subangular blocky structure; hard, friable; common fine pores; common films and threads of calcium carbonate; common snail shell fragments; calcareous; moderately alkaline; diffuse, wavy boundary.

B22—22 to 37 inches, pale-brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate, fine and very fine, subangular blocky structure; hard, friable; common fine pores; common films and threads of calcium carbonate; few snail shell fragments; calcareous; moderately alkaline; clear, wavy boundary.

Cca—37 to 63 inches, very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; few, faint, brown-

ish-yellow mottles; massive; hard, friable; common fine pores; 3 to 5 percent, by volume, is soft lumps of calcium carbonate, percentage of calcium carbonate remains relatively constant with increasing depth; calcareous; moderately alkaline.

The solum ranges from 30 to 50 inches in thickness. Secondary carbonates in the form of films, threads, and soft lumps are within 28 inches of the surface.

The A horizon ranges from 11 to 20 inches in thickness. It ranges from fine sandy loam to sandy clay loam in texture and from grayish brown or brown to dark grayish brown in color.

The B horizon ranges from 15 to 31 inches in thickness, from sandy clay loam to clay loam in texture, and from 23 to 32 percent in clay content. It ranges from light brownish gray or grayish brown to brown or pale brown in color. Secondary carbonates range from few to common and occur as films, threads, and small soft splotches. The volume of secondary carbonates increases with increasing depth.

The C horizon ranges from pale brown to very pale brown in color and from sandy clay loam to clay loam in texture. The percentage, by volume, of carbonates, to a depth of 12 feet or more, remains relatively constant with increasing depth.

Hidalgo fine sandy loam, 0 to 1 percent slopes (HGA).—This soil is on small coastal terraces. Most areas occur as rounded knolls. Slopes are about 0.5 percent, and the surface is plane to slightly convex. Areas of this soil are rarely more than about 25 acres in size.

The surface layer is dark grayish-brown fine sandy loam about 15 inches thick. The next layer is pale-brown sandy clay loam about 24 inches thick. The underlying material, extending to a depth of about 60 inches, is very pale brown sandy clay loam.

Included with this soil in mapping are areas of Hidalgo sandy clay loam in slight depressions. Also included are small areas of Willacy soils and Hidalgo fine sandy loam, 1 to 3 percent slopes.

Permeability is moderate, and runoff is slow. A few areas of this soil have been altered considerably by land leveling for irrigation. Some areas have a thick surface layer because of filling operations, and some have a thin surface layer because of cutting operations. All of the surface layer has been removed from a few areas. Capability units IIc–1, dryland, and I–3, irrigated; pasture and hay group 8C; orchard group C.

Hidalgo fine sandy loam, 1 to 3 percent slopes (HGB).—This soil is on small coastal terraces. Most areas are adjacent to the Arroyo Colorado or old lakebeds, or they surround small enclosed depressions, or potholes. Slopes are about 2 percent, and the surface is convex.

The surface layer is dark grayish-brown fine sandy loam about 11 inches thick. The next layer is grayish-brown sandy clay loam about 9 inches thick. Below this is pale-brown sandy clay loam about 23 inches thick. The underlying material, extending to a depth of about 60 inches, is very pale brown sandy clay loam.

Included with this soil in mapping are areas of Hidalgo fine sandy loam, 0 to 1 percent slopes, and Willacy soils. Also included are a few areas of soils that are similar to Hidalgo soils, but they are less clayey. A few areas near the Arroyo Colorado are included that have a sandy clay loam surface layer.

Permeability is moderate, and runoff is slow. A few areas of this soil have been altered by land leveling for irrigation. Some areas have a thick surface layer because of filling operations, and many areas have a thin surface layer because of cutting operations. All of the surface layer has been removed from a few areas. Soil blowing is a slight hazard. Erosion by water is a moderate hazard. Capability units IIe–1, dryland, and IIe–1, irrigated; pasture and hay group 8C; orchard group D.

Hidalgo sandy clay loam (HO).—This nearly level soil is on rather broad coastal terraces. Slopes are less than 0.5 percent, and the surface is plane. Areas of this soil are irregularly shaped and generally are several hundred acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Raymondville and Racombes soils and Hidalgo fine sandy loam, 0 to 1 percent slopes. Also included are areas of a soil that is similar to Hidalgo sandy clay loam, but it has a clay loam surface layer. A few areas that have a weakly calcareous surface layer are also included.

Permeability is moderate, and runoff is slow. This soil is used for irrigated and dryfarmed crops, pasture, and citrus. Capability units IIc–2, dryland, and I–4, irrigated; pasture and hay group 7C; orchard group C.

Hidalgo-Urban land complex (HU).—This unit is in the built-up areas of cities and towns. Hidalgo sandy clay loam makes up about 60 percent of the complex, and Urban land makes up about 25 percent. Slopes range from 0 to 1 percent.

The Hidalgo soil has a surface layer of dark grayish-brown, calcareous sandy clay loam about 12 inches thick. The next layer is pale-brown sandy clay loam about 25 inches thick. The underlying material, extending to a depth of about 63 inches, is very pale brown sandy clay loam.

Urban land consists mostly of such works and structures as streets, sidewalks, buildings, driveways, and patios. Most of the structures are single-unit dwellings. Other than preparing sites for construction or cutting streets to grade, little alteration of the Hidalgo soil has taken place.

Included in mapping are areas of Raymondville, Racombes, and Willacy soils.

Nearly all areas of this complex support good stands of large mesquite, hackberry, ash, or ebony trees. Among the limitations to urban development are corrosive failure of pipelines and steel and chlorosis of some plants as a result of the high alkalinity and high lime content of the soil material. Capability unit and other interpretative groups not assigned.

Laredo Series

The Laredo series consists of deep, well-drained, calcareous soils that are nearly level to gently sloping. These soils are on old flood plains and deltas.

In a representative profile the surface layer is dark grayish brown, calcareous, and about 18 inches thick. It is silty clay loam in the upper part and silt loam in the lower part. The next layer is light brownish-gray silt loam about 23 inches thick. The underlying material, extending to a depth of 72 inches, is stratified layers of light brownish-gray and light-gray silt loam, silty clay loam, and very fine sandy loam.

Permeability is moderate, and runoff is slow. The available water capacity is very high to very low, depending on the degree of salinity.

Laredo soils are used for irrigated crops, dryfarmed crops, and pasture.

Representative profile of Laredo silty clay loam, 0 to 1 percent slopes, in a cultivated field, 0.9 mile south on Farm Road 1479 from its junction with Farm Road 675 in Rangerville, then 200 feet west:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure and moderate, very fine, granular structure; hard, friable; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—8 to 18 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish-brown (10YR 3/2) moist; moderate, very fine, granular structure and fine, subangular blocky structure; hard, friable; few fine pores; common earthworm casts; calcareous; moderately alkaline; clear, wavy boundary.

B2—18 to 41 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, fine and medium, subangular blocky structure; slightly hard, friable; many fine pores; few insect tunnels and root channels filled with slightly darker colored material from A horizon; few films and threads of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

Cca—41 to 49 inches, light brownish-gray (10YR 6/2) silty clay loam and thin strata of silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; many fine pores; contains 4 percent, by volume, soft lumps and concretions of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

C—49 to 72 inches, light-gray (10YR 7/2) silt loam and thin strata of silty clay loam and very fine sandy loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; calcareous; moderately alkaline.

The solum ranges from 34 to 56 inches in thickness. Secondary carbonates in the form of films and threads range from few to common. The A horizon ranges from dark grayish brown or grayish brown to brown in color, from silt loam to silty clay loam in texture, and from 12 to 20 inches in thickness. The B horizon ranges from grayish brown or light brownish gray to pale brown in color and from weak to moderate subangular blocky in structure. Texture of the 10- to 40-inch layer ranges from silt loam to silty clay loam, and the content of clay is 18 to 35 percent. The amount of sand coarser than very fine sand ranges from 1 to 8 percent. Thin strata of silt loam, silty clay loam, and very fine sandy loam are within a depth of 34 to 50 inches. The ca horizon is weakly to moderately expressed and is 4 to 10 inches thick.

Laredo silty clay loam, 0 to 1 percent slopes (LAA).—This soil is on broad, old flood plains and deltas, generally adjacent to resacas. Slopes are about 0.5 percent, and the surface is plane or slightly convex. Areas of this soil vary widely in size and shape, but most are several hundred acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Olmito and Cameron soils in slight depressions and a few, long, narrow areas of Laredo silty clay loam, 1 to 3 percent slopes. Also included are small areas that have varying degrees of salinity, and a few areas of soils that are similar to Laredo soils but are lighter colored in the surface layer.

Permeability is moderate, and runoff is slow. A few areas of this soil have been altered for irrigation by land leveling. Some areas have a thick surface layer because of filling operations, and some have a thin surface layer because of cutting operations. All of the surface layer has been removed from a few areas.

This soil is used for irrigated and dryfarmed crops, pasture, and citrus trees (fig. 3). Capability units IIc–

Figure 3.—**Irrigated cabbage and citrus on Laredo silty clay loam, 0 to 1 percent slopes.**

2, dryland, and I–4, irrigated; pasture and hay group 7C; orchard group C.

Laredo silty clay loam, 1 to 3 percent slopes (LAB).—This soil is in long, narrow areas adjacent to resacas. Slopes are dominantly about 2 percent, and the surface is convex. Areas of this soil range in size from 5 to about 50 acres.

The surface layer is dark grayish-brown, calcareous silty clay loam about 13 inches thick. The next layer is grayish-brown silt loam about 28 inches thick. The underlying material, extending to a depth of about 60 inches, is stratified layers of silt loam and silty clay loam.

Included with this soil in mapping are areas of Laredo silty clay loam, 0 to 1 percent slopes, and areas of Reynosa soils. Also included are a few areas that have slopes of more than 3 percent and small areas that have varying degrees of salinity.

Permeability is moderate, and runoff is slow. A few areas of this soil have been altered for irrigation by land leveling. Some areas have a thin surface layer because of cutting operations, and a few areas have a thick surface layer because of filling operations. All of the surface layer has been removed from a few areas.

Because of the location and size of the areas, this soil generally is left idle. A few areas are used for irrigated crops and pasture. Capability units IIe–2, dryland, and IIe–3, irrigated; pasture and hay group 7C; orchard group D.

Laredo silty clay loam, saline (LC).—This soil is on old flood plains and deltas, generally adjacent to old meanders. Slopes are less than 2 percent, and the surface is plane or slightly convex. Areas of this soil vary widely in size and shape, but most are irregularly shaped and range from about 10 to 400 acres in size.

The surface layer is grayish-brown, calcareous silty clay loam about 12 inches thick. The next layer is grayish-brown silt loam about 31 inches thick. The underlying material, extending to a depth of about 60 inches, is stratified layers of silt loam and silty clay loam.

Included with this soil in mapping are areas of Chargo and Reynosa soils.

Permeability is moderate, and runoff is slow. Most areas of this soil are in pasture or range, but a few areas are irrigated. Where adequate outlets are available, tile drainage systems can be used effectively to reduce the salinity of the soil. Capability units IIIs–2, dryland, and IIs–4, irrigated; pasture and hay group 7G, orchard group I; Coastal Ridge range site.

Laredo-Olmito complex (LD).—The soils of this mapping unit occur in such intricate patterns that it is not feasible to map them separately. Laredo silty clay loam makes up about 55 percent of the complex, and Olmito silty clay makes up 35 percent. These soils are on the inside bends of some old resacas in alternating bands parallel to the resacas. Slopes are less than 1 percent. The Laredo soil has a plane or slightly convex surface. The Olmito soil is in slight depressions and has a weakly concave surface. Areas of these soils are irregular in shape and range from 10 to about 80 acres in size.

The Laredo soil has a surface layer of grayish-brown, calcareous silty clay loam about 17 inches thick. The next layer is pale-brown silt loam 25 inches thick. The underlying material, extending to a depth of about 63 inches, is stratified layers of silt loam and silty clay loam.

The Olmito soil has a surface layer of dark-gray, calcareous silty clay about 23 inches thick. The next layer is brown silty clay 18 inches thick. The underlying material, reaching to a depth of about 63 inches, is pale-brown silty clay.

Included with these soils in mapping are areas of Cameron and Reynosa soils.

Permeability is moderate in the Laredo soil and slow in the Olmito soil. Runoff is slow on both soils. The soils of this complex are used for irrigated crops. The Laredo soil is suited to citrus trees, but the Olmito soil is not. Therefore, uniform growth and production of citrus are difficult. Capability units IIs–3, dryland, and IIs–3, irrigated; pasture and hay group 7C; orchard group F.

Laredo-Reynosa complex, 0 to 1 percent slopes (LEA).—The soils of this complex occur in such intricate patterns that it is not feasible to map them separately. Laredo silty clay loam makes up about 50 percent of the complex, and Reynosa silt loam makes up 35 percent. These soils are adjacent to some of the older or larger resacas, in nearly alternating, narrow streaks or bands parallel to the resacas. Both soils have plane to slightly convex surfaces. Areas of these soils are generally elongated and range from about 10 to 50 acres in size.

The Laredo soil has a surface layer of grayish-brown, calcareous silty clay loam about 15 inches thick. The next layer is light brownish-gray silt loam 22 inches thick. The underlying material, to a depth of about 63 inches, is stratified layers of silt loam and silty clay loam.

The Reynosa soil has the profile described as representative of the Reynosa series.

Included with these soils in mapping are areas of Olmito and Cameron soils. Also included are areas of soils that are similar to Laredo and Reynosa soils but are less clayey between depths of 10 and 40 inches.

Permeability is moderate, and runoff is slow. The Reynosa soil crusts badly if it is left bare. A few areas have been leveled for irrigation. Some areas have a thin surface layer as a result of cutting operations, and a few areas have a thick surface layer as a result of filling operations. Almost all the acreage of these soils is used for irrigated crops. Capability units IIc–2, dryland, and I–4, irrigated; pasture and hay group 7C; orchard group C.

Laredo-Reynosa complex, 1 to 3 percent slopes (LEB).—The soils of this mapping unit are adjacent to older or larger resacas in narrow, alternating streaks or bands parallel to the resacas. Laredo silty clay loam makes up about 50 percent of the complex, and Reynosa silt loam makes up 40 percent. Slopes are dominantly about 2 percent, and the surface is convex. Areas of these soils are long and narrow; they are 100 to 300 feet wide and range from 8 to 30 acres in size.

The Laredo soil has a surface layer of grayish-brown, calcareous silty clay loam about 13 inches thick. The next layer is light brownish-gray silt loam 28 inches thick. The underlying material, extending

to a depth of about 63 inches, is stratified layers of silt loam, silty clay loam, and very fine sandy loam.

The Reynosa soil has a surface layer of grayish-brown, calcareous silt loam about 11 inches thick. The next layer is light brownish-gray silt loam 23 inches thick. The underlying material, extending to a depth of about 63 inches, is stratified layers of silt loam, very fine sandy loam, and silty clay loam.

Included with these soils in mapping are soils that are similar to Laredo and Reynosa soils but are less clayey between depths of 10 and 40 inches.

Permeability is moderate, and runoff is slow. The Reynosa soil crusts badly if it is left bare. A few areas have been altered for irrigation by land leveling. Some areas have a thin surface layer because of cutting operations, and a few areas have a thick surface layer because of filling operations. All of the surface layer has been removed from a few areas. Almost all the acreage of these soils is used for irrigated crops. Capability units IIe–2, dryland, and IIe–3, irrigated; pasture and hay group 7C; orchard group D

Laredo-Urban land complex (LG).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is in Brownsville. Laredo silty clay loam makes up about 50 percent of the complex, and Urban land makes up 35 percent. Slopes range from 0 to 3 percent.

The Laredo soil has a surface layer of dark grayish-brown, calcareous silty clay loam about 18 inches thick. The next layer is light brownish-gray silt loam about 23 inches thick. The underlying material, reaching to a depth of about 72 inches, is stratified layers of silt loam and silty clay loam.

Urban land consists mostly of such works and structures as streets, sidewalks, buildings, driveways, and patios. Most of the structures are single-unit dwellings. About 10 percent of this mapping unit consists of multiple-unit dwellings, businesses, shopping centers, schools, and churches that have paved parking lots. Other than preparing the sites for construction or cutting streets to grade, little alteration has taken place on the Laredo soil. Little of the filling has been done with materials brought in from other areas.

Included with these soils in mapping are areas of Cameron and Olmito soils and soils that are similar to the Laredo soil but are less clayey between depths of 10 and 40 inches.

Nearly all areas of this complex support good stands of large mesquite, hackberry, ash, or ebony trees. In the fringe areas of Brownsville and San Benito, this mapping unit is desirable for urban development because of the natural beauty of the meandering resacas. Limitations to urban development include corrosive failure of pipelines and steel and chlorosis of some plants because of the high alkalinity and high lime content of the soil material. Capability unit and other interpretive groups not assigned.

Latina Series

The Latina series consists of deep, somewhat poorly drained, noncalcareous, saline soils that are nearly level. These soils are on deltas and coastal terraces.

In a representative profile the surface layer is dark-gray, noncalcareous sandy clay loam about 4 inches thick. The next layer is dark-gray, dense noncalcareous sandy clay loam about 5 inches thick. The next layer is light brownish-gray, calcareous sandy clay loam about 21 inches thick. The underlying material, extending to a depth of 63 inches, is grayish-brown sandy clay loam.

Permeability is slow, and runoff is very slow. The available water capacity is very low.

Latina soils are used for range and as wildlife habitat.

Representative profile of Latina sandy clay loam, in the Laguna Atascosa Wildlife Refuge, 4 miles east on General Brandt Highway from its intersection with Farm Road 1847, 1.1 miles north on west Lake Road, and 100 feet west:

A1—0 to 4 inches, dark-gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; massive; very hard, friable; saline; mildly alkaline; clear, wavy boundary.

B2—4 to 9 inches, dark-gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; moderate, coarse, prismatic structure parting to moderate, fine and medium, blocky; very hard, friable; common fine roots; few fine pores; thin clay films on ped surfaces; black organic stains on ped faces; saline; mildly alkaline; clear, wavy boundary.

B2sa—9 to 16 inches, light brownish-gray (10YR 6/2) sandy clay loam; few, faint, yellowish-brown mottles that are light brownish gray (2.5Y 6/2) moist; moderate, fine and medium, blocky structure; very hard, friable; few fine pores; few clay films on ped surfaces that are slightly darker colored; common salt threads; saline; calcareous; moderately alkaline; gradual, wavy boundary.

B3casa—16 to 30 inches, light brownish-gray (10YR 6/2) sandy clay loam; few, faint, yellowish-brown mottles, same color moist; weak, coarse, blocky structure; very hard, friable; few fine pores; common salt threads and nests; 3 to 5 percent, by volume, soft masses of calcium carbonate; saline; calcareous; moderately alkaline; gradual, wavy boundary.

Csa—30 to 63 inches, grayish-brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; common, medium, distinct, strong-brown and reddish-brown mottles; massive; hard, friable; many soft masses and few concretions of calcium carbonate; saline; calcareous; moderately alkaline.

The solum ranges from 20 to 36 inches in thickness. Organic-matter content ranges from 1 to about 2.5 percent in the A horizon and upper part of the B horizon. Electrical conductivity within the root zone is more than 20 millimhos.

The A horizon is 3 to 9 inches thick. When moist it is dark gray, very dark gray, or very dark grayish brown.

The B horizon is 16 to 36 inches thick. It ranges from sandy clay loam to clay loam, and the clay content ranges from 25 to 35 percent. When moist this horizon ranges from very dark gray to very dark grayish brown in the upper part and gray to light brownish gray in the lower part.

The C horizon is calcareous stratified materials containing 3 to 5 percent soft lumps and concretions of calcium carbonate. It is dark grayish brown, grayish brown, or light brownish gray.

Latina sandy clay loam (LK).—This nearly level soil is somewhat poorly drained and is on coastal terraces. Slopes are less than 0.5 percent, and the surface is plane. Areas of this soil are rounded to somewhat elongated and are about 15 to 150 acres in size.

Included with this soil in mapping are small depressions in which Lomalta and Sejita soils occur. Also included are areas of Willamar soils at a slightly higher elevation.

Permeability is slow, and runoff is very slow. This soil is used for range and as wildlife habitat. Soil

salinity and a saline high water table are the major limitations to the use of this soil. Capability unit VIs–2, dryland; pasture and hay group 7F; Sandy Coastal Flat range site.

Lomalta Series

The Lomalta series consists of deep, poorly drained, calcareous, saline clays that are level to slightly depressional. These soils are in semimarsh areas adjacent to the Gulf of Mexico only a few feet above tide water.

In a representative profile the light-gray clay extends from the surface to a depth of about 53 inches. The next layer is light brownish-gray silty clay loam about 4 inches thick. Beneath this, extending to a depth of about 72 inches, is stratified very pale brown silt loam.

Permeability is very slow, and the available water capacity is very low. Runoff is very slow to ponded, and water ponds on the surface for several days or weeks after heavy rains.

Lomalta soils are used for range and as wildlife habitat.

Representative profile of Lomalta clay, in range, 1.6 miles south on Farm Road 1847 from its junction with State Highway 100 in Los Fresnos and then 780 feet east:

A1—0 to 5 inches, light-gray (5Y 6/1) clay, dark gray (5Y 4/1) moist; moderate, fine and medium, angular and subangular blocky structure; very hard, very firm, very sticky and very plastic; 1/4-inch surface crust of light gray (N 6/0) moist; numerous roots; saline; calcareous; moderately alkaline; gradual, smooth boundary.

B2g—5 to 19 inches, light-gray (5Y 6/1) clay, gray (5Y 5/1) moist; weak, coarse, prismatic structure and moderate, medium, blocky; extremely hard, extremely firm, very sticky and very plastic; few fine roots; few fine pores; few films, threads, and crystals of salt; saline; calcareous; moderately alkaline; gradual, smooth boundary.

C1—19 to 31 inches, light-gray (10YR 6/1) clay, gray (10YR 5/1) moist; many small intersecting slickensides and parallelepipeds; extremely hard, extremely firm, very sticky and very plastic; few roots; few fine pores; few slightly darker colored streaks along old root channels and cracks; common films and threads of salts; saline; calcareous; moderately alkaline; gradual, smooth boundary.

C2—31 to 53 inches, light-gray (10YR 6/1) clay, gray (10YR 5/1) moist; many prominent intersecting slickensides and parallelepipeds; extremely hard, extremely firm, very sticky and very plastic; few roots; 5 percent, by volume, soft masses and crystals of salts; saline; calcareous; moderately alkaline; gradual, smooth boundary.

IIC3—53 to 57 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; few, distinct, brownish-yellow (10YR 6/6) mottles and 20 percent, by volume, light-gray (N 6/0) streaks (gray streaks are old land-crab burrows); weak, blocky structure; hard, firm, sticky and plastic; few roots; few shiny pressure faces; common soft masses and crystals of salts; saline; calcareous; moderately alkaline; gradual, smooth boundary.

IIC4—57 to 72 inches, very pale brown (10YR 7/3) silt loam, light yellowish brown (10YR 6/4) moist; massive; land-crab holes filled with gray (N 6/0); calcareous; moderately alkaline.

The solum ranges from 50 to 70 inches in thickness. The soil, when dry, has cracks 0.5 to 4 inches wide that reach to a depth of 30 inches or more. Intersecting slickensides begin at a depth of 20 to 30 inches. Content of exchangeable sodium is more than 15 percent in all horizons.

The A, B, and C horizons are gray or light gray. The B horizon ranges from weak medium to coarse prismatic in structure. The 10- to 40-inch layer is 60 to 75 percent clay. The IIC horizon is grayish brown, light brownish gray, light yellowish brown, or very pale brown and has few to common mottles and streaks of gray or brown. The IIC horizon is silty clay loam or silt loam.

Lomalta clay (LM).—This level to slightly depressional soil is generally in broad areas several hundred acres in size, but a few areas occur as long, narrow drainageways. Slopes are less than 0.5 percent, and the surface is plane to concave. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Sejita, Willamar, and Benito soils. Also included are areas of soils that are in narrow drainageways and that are similar to Lomalta soils, but they are slightly darker colored.

Permeability is very slow, and runoff is very slow to ponded. This soil, which is saline, is high in exchangeable sodium. Subsurface tile drains are not practical because the soil has a high content of clay. Areas of this soil are used for range and as wildlife habitat. Capability unit VIIs–1, dryland; pasture and hay group 7F; Salty range site.

Lomalta-Urban land complex (LO).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is in the industrial areas of Port Brownsville. Slopes are less than 0.5 percent. Lomalta clay makes up about 40 percent of the complex, and Urban land makes up 40 percent.

Lomalta clay consists of about 53 inches of gray, saline, calcareous clay. The next layer is light brownish-gray silty clay loam about 4 inches thick. The underlying material is stratified very pale brown silty clay loam.

Urban land consists mostly of industrial sites connected with port operations. Among these are buildings, roads, railways, and oil storage tanks. Most structures are built on 1 to 3 feet of fill dirt, a practice that helps drainage. Most of the surfaces of this complex have been altered by the addition of oil and other waste connected with port operations.

Included in mapping are areas of Sejita and Willamar soils and Ustifluvents, clayey.

Among the concerns of management for urban development are flooding from runoff, cracking and shifting of structures because of the shrink-swell potential, failure of pipelines, concrete, and steel because of corrosivity and salinity, and failure of septic-tank filter fields because of permeability. Capability unit and other interpretative groups not assigned.

Lozano Series

The Lozano series consists of deep, well-drained, noncalcareous soils that are nearly level. These soils are on deltas or coastal terraces.

In a representative profile the surface layer is dark grayish-brown, noncalcareous fine sandy loam about 11 inches thick. The next layer is sandy clay loam about 24 inches thick; it is dark grayish brown in the upper part and brown in the lower part. Beneath this, to a depth of about 63 inches, is calcareous sandy clay loam; it is light brown in the upper part and very pale brown in the lower part.

Permeability is moderately slow, and runoff is slow. The available water capacity is medium to high.

Lozano soils are used for irrigated crops, dryfarmed crops, range, and as wildlife habitat.

Representative profile of Lozano fine sandy loam, in a cultivated field, 0.7 mile east on Farm Road 106 from its junction with State Highway 345, then 1 mile north and 0.1 mile east on county road, 100 feet south:

Ap—0 to 11 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable; few fine roots; neutral; abrupt, smooth boundary.

B21t—11 to 22 inches, dark grayish-brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; few, fine, faint, yellowish-brown mottles; moderate, coarse, prismatic structure parting to moderate, fine and medium, blocky; very hard, friable; few fine roots; few fine pores; clay films and very dark gray (10YR 3/1) coatings on peds; neutral; gradual, wavy boundary.

B22t—22 to 35 inches, brown (10YR 5/3) sandy clay loam, dark grayish brown (10YR 4/2) moist; few, fine, distinct, very dark gray and yellowish-brown mottles; moderate, coarse, prismatic structure parting to moderate, medium and coarse, blocky; very hard, friable; common fine pores; patchy clay films on peds; few weakly cemented calcium carbonate concretions, and common films of calcium carbonate; neutral; gradual, wavy boundary.

B3ca—35 to 47 inches, light-brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; few, fine, faint, brownish-yellow mottles; weak, coarse, blocky structure; very hard, friable; common fine pores; few thin clay films; many films, threads, and soft masses of calcium carbonate and a few weakly cemented calcium carbonate concretions; calcareous; moderately alkaline; clear, wavy boundary.

C1ca—47 to 54 inches, very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; few, fine, grayish-brown and yellowish-brown mottles; massive; very hard, friable; few pores; about 3 percent, by volume, weakly cemented and strongly cemented calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C2ca—54 to 63 inches, very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; few, fine, faint, brownish-yellow mottles; massive; very hard, friable; few fine pores; a few strongly cemented calcium carbonate concretions; calcareous; moderately alkaline.

The solum ranges from 37 to 50 inches in thickness. Depth to secondary lime ranges from 17 to 34 inches. The A horizon and B21 horizon is grayish brown, dark grayish brown, or dark gray. Mottles in the B21 horizon range from few to common and faint to distinct in shades of yellow, gray, and brown. The A horizon and B21 horizon are neutral or mildly alkaline. The B22 horizon and B3 horizon are brown, light brown, or light yellowish brown and has few to common, faint to distinct mottles in shades of gray, brown, and yellow. The B21 horizon and B22 horizon is sandy clay loam or clay loam that is 25 to 35 percent clay. The B3 horizon is sandy clay loam or sandy loam. The C horizon is pale-brown, very pale brown, or pink sandy clay loam or sandy loam. Accumulation of calcium carbonate in the C horizon ranges from a few weakly cemented concretions to about 5 percent by volume.

Lozano fine sandy loam (LR).—This nearly level soil is on coastal terraces. Slopes are about 0.5 percent, and the surface is plane to slightly convex. Areas of this soil are irregularly shaped and range from 10 to about 200 acres in size.

Included with this soil in mapping are areas of Lyford, Delfina, and Willacy soils. Also included are a few small irregularly shaped saline areas.

Permeability is moderately slow, and runoff is slow. The hazard of soil blowing is slight. A seasonal high water table is a limitation in this soil. Subsurface tile drains can be effectively used to lower the water table.

Areas of this soil are used for irrigated crops, dryfarmed crops, range, and as wildlife habitat. Capability units IIw–1, dryland, and IIw–1, irrigated; pasture and hay group 8C; orchard group F; Sandy Loam range site.

Lyford Series

The Lyford series consists of deep, moderately well drained, noncalcareous soils that are nearly level. These soils are on deltas or coastal terraces.

In a representative profile the surface layer is very dark grayish-brown noncalcareous sandy clay loam about 11 inches thick. The next layer is sandy clay loam about 14 inches thick; it is dark grayish brown in the upper part and light brownish gray in the lower part. Beneath this, to a depth of about 63 inches, is sandy clay loam that is light brownish gray in the upper part and pale brown in the lower part.

Permeability is moderate, and runoff is slow. The available water capacity is medium to high.

Lyford soils are used for irrigated crops, dryfarmed crops, and range.

Representative profile of Lyford sandy clay loam, 1.7 miles east on Farm Road 106 from its junction with State Highway 345, then 0.3 mile north and 0.1 mile west on county road, 100 feet north in a cultivated field:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy clay loam, very dark brown (10YR 2/2) moist; weak, fine, granular and subangular blocky structure; very hard, friable; few fine pores; neutral; abrupt, smooth boundary.

A1—8 to 11 inches, very dark grayish-brown (10YR 3/2) sandy clay loam, very dark brown (10YR 2/2) moist; weak, fine subangular blocky structure; hard, friable; few fine pores; neutral; clear, smooth boundary.

B21t—11 to 17 inches, dark grayish-brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; few, fine, distinct, yellowish-brown mottles; moderate, fine and medium, blocky structure; very hard, friable; few fine pores; patchy clay films on peds; neutral; gradual, smooth boundary.

B22t—17 to 25 inches, light brownish-gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; common, fine, faint, yellowish-brown mottles; moderate, fine and medium, blocky structure; very hard, friable; few fine pores; patchy clay films on peds; neutral; clear, smooth boundary.

B3—25 to 34 inches, light brownish-gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; weak, subangular blocky structure; hard, friable; many films and threads of secondary carbonates; few calcium carbonate concretions; calcareous; moderately alkaline; clear, smooth boundary.

Cca—34 to 63 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive; hard, friable; 5 percent, by volume, soft lumps of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 28 to 50 inches in thickness. Secondary carbonates are at a depth of 20 to 34 inches. The A horizon and B21t horizon are dark grayish brown, dark gray, or very dark grayish brown. The B21t horizon has few to common, faint to distinct mottles of gray and yellowish brown.

The A horizon is 8 to 15 inches thick; it is sandy clay loam or loam and is neutral to mildly alkaline. The Bt horizon is 20 to 32 inches thick. It is sandy clay loam or clay loam that is 25 to 35 percent clay, and it contains about 4 to 10 percent (absolute) more clay than the A horizon. This horizon is neutral to moderately alkaline. The B2t horizon and B3

horizon are dark grayish brown, light brownish gray, brown, or light gray. The C horizon is pale brown, very pale brown, or light gray. Accumulation of calcium carbonate in the form of soft lumps and strongly cemented concretions ranges from 1 to about 5 percent, by volume.

Lyford sandy clay loam (LY).—This nearly level soil is on coastal terraces. Slopes are less than 0.5 percent, and the surface is plane to slightly concave. Areas of this soil vary widely in size and shape, but some are several hundred acres in size, and others are in small, rounded, slight depressions or long, narrow drainageways.

Included with this soil in mapping are areas of Lozano, Hidalgo, and Raymondville soils. Also included are a few irregularly shaped areas that are high in content of sodium.

Permeability is moderate, and runoff is slow. A seasonal high water table is a limitation in this soil. Subsurface tile drains can be effectively used to lower the water table.

Areas of this soil are used for irrigated crops, dryfarmed crops, pasture, range, and as wildlife habitat. Capability units IIw–2, dryland, and IIw–2, irrigated; pasture and hay group 7C; orchard group F; Clay Loam range site.

Matamoros Series

The Matamoros series consists of deep, moderately well drained, calcareous soils that are nearly level. These soils are on the active flood plain of the Rio Grande.

In a representative profile the plow layer is light brownish-gray, calcareous silty clay about 8 inches thick. The next layer is light brownish-gray clay about 16 inches thick. The next layer is brown silt loam about 3 inches thick. The next lower layer is grayish-brown silty clay about 4 inches thick. Beneath this to a depth of 50 inches is light brownish-gray silty clay.

Permeability is slow. The available water capacity is medium to high.

Matamoros soils are used for irrigated crops and pasture.

Representative profile of Matamoros silty clay in a cultivated field, 0.1 mile east on U.S. Highway 281, from its junction with Farm Road 2520, then 0.2 mile south on a field road and 50 feet east:

Ap—0 to 8 inches, light brownish-gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) moist; massive; very hard, firm, sticky; many roots; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—8 to 24 inches, light brownish-gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; massive; clay consists of fragments about 2 inches across the axes; the interfaces of the fragments are dull and not shiny; few fine pores; distinct cleavage planes; very hard, very firm, sticky; many roots; calcareous; moderately alkaline; abrupt, smooth boundary.

C2—24 to 27 inches, brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; few, fine, faint, very dark brown mottles; few lenses of silty clay; massive; bedding planes evident; remnants of leaves, in various stages of decomposition, are along the fractures of the lenses of silty clay; hard, friable, slightly sticky in the matrix of silt loam; few fine roots; calcareous; moderately alkaline; abrupt, smooth boundary.

A1b—27 to 31 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; weak, blocky structure; hard, firm, sticky; few black charcoal spots about 1 to 2 centimeters in diameter; calcareous; moderately alkaline; abrupt, smooth boundary.

C3—31 to 50 inches, light brownish-gray (10YR 6/2) silty clay, grayish brown (10YR 5/2) moist; massive; silty clay consists of angular fragments having dull faces and no definite pattern of cleavage or size, ranging from about 1/2 to 3 inches across the axes; very hard, very firm, sticky; few, fine, distinct, dark-brown mottles made up of decomposed organic materials, on some of the interfaces; calcareous; moderately alkaline.

The uppermost 40 inches ranges from silty clay loam to silty clay in average texture. The A horizon ranges from grayish brown to light brownish gray in color, from silty clay loam to silty clay in texture, and from 5 to 12 inches in thickness. The C horizon, to a depth of about 40 inches, ranges from grayish brown or light brownish gray to brown or pale brown in color. It is silty clay loam to silty clay that has thin strata of loamy sediment. The C horizon is 35 to 50 percent clay. Cleavage planes along unaltered bedding planes are weakly expressed to strongly expressed. The sediment, below a depth of 40 inches, ranges from silt loam to clay and is also stratified.

Matamoros silty clay (MA).—This nearly level soil is on the flood plain of the Rio Grande. Slopes are less than 0.5 percent. Areas of this soil are irregularly shaped and range from 10 to about 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Rio Grande and Camargo soils that occur as narrow streaks or rounded pockets. Also included are a few areas of soils that are similar to Matamoros soils, but they are underlain by loamy material at a depth of 25 to 40 inches.

Permeability is slow, and runoff is slow. This soil is used for irrigated crops and pasture. Capability unit IIs–1, irrigated; pasture and hay group 1C; orchard group I.

Matamoros-Rio Grande complex (MC).—The soils of this complex occur in such intricate patterns that it is not feasible to map them separately. Matamoros silty clay makes up about 30 percent of the complex, and Rio Grande silt loam makes up 30 percent. These soils are on the inside bends of the river or remnants of resacas, in alternating bands parallel to the river or resacas. Both soils are nearly level. The Matamoros soil has a weakly concave surface, and the Rio Grande soil has a plane or slightly convex surface. Areas of this unit are irregularly shaped and range from 40 to about 100 acres in size.

The Matamoros soil has a surface layer of grayish-brown, calcareous silty clay about 12 inches thick. The underlying material, extending to a depth of about 50 inches, is grayish-brown silty clay stratified with loamy material.

The Rio Grande soil has a surface layer of grayish-brown, calcareous silt loam about 10 inches thick. The underlying material, extending to a depth of about 50 inches, is grayish-brown and pale-brown, stratified silt loam and very fine sandy loam.

Included with these soils in mapping are areas of Rio Grande silty clay loam and Camargo soils.

Permeability is slow in the Matamoros soil and moderate in the Rio Grande soil. Runoff is slow on both soils. These soils are used for irrigated crops. Capability unit IIs–3, irrigated; pasture and hay group 1C; orchard group I.

Mercedes Series

The Mercedes series consists of deep, moderately well drained, calcareous clays that are nearly level to gently sloping. These soils are on old flood plains and deltas.

In a representative profile the surface layer is gray, calcareous clay about 29 inches thick. The next layer is light brownish-gray about 18 inches thick. Beneath this, to a depth of about 74 inches, is clay that is pale brown in the upper part and very pale brown in the lower part.

Permeability is very slow, and runoff is slow. The available water capacity is low to high depending on the degree of salinity.

Mercedes soils are used for irrigated crops, dryfarmed crops, and pasture. A few areas are idle.

Representative profile of Mercedes clay, 0 to 1 percent slopes in a cultivated field, 1.6 miles north on Farm Road 1595 from its junction with Farm Road 106, then 150 feet west:

Ap—0 to 10 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate, fine, granular and subangular blocky structure; hard, firm, very sticky and very plastic; common fine shell fragments; calcareous moderately alkaline; abrupt, smooth boundary.

A11—10 to 18 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate, fine, angular blocky structure; hard, firm, very sticky and very plastic; few roots; few soft ferromanganese bodies of dark yellowish brown; many fine shell fragments; calcareous; moderately alkaline; gradual, wavy boundary.

A12—18 to 29 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate, fine blocky structure that forms parallelepipeds; many intersecting slickensides; very hard, very firm, very sticky and very plastic; many fine shell fragments; few fine roots; calcareous; moderately alkaline; diffuse, wavy boundary.

AC1—29 to 47 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; a few gray streaks along apparently filled cracks as much as 2 inches across; moderate fine blocky structure that forms parallelepipeds; many distinct slickensides 14 inches across that have axes tilted about 45° from the horizontal; very hard, very firm, very sticky and very plastic; calcareous; moderately alkaline; diffuse, wavy boundary.

AC2—47 to 63 inches, pale-brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate fine, blocky structure that forms parallelepipeds; few streaks of clay grayish-brown (10YR 5/2) moist are in old filled cracks; few shell fragments; common slickensides; very hard, very firm, very sticky and very plastic; calcareous; moderately alkaline; diffuse, wavy boundary.

C—63 to 74 inches, very pale brown (10YR 7/3) clay, pale brown (10YR 6/3) moist; massive; very hard, very firm, very sticky and plastic; calcareous; moderately alkaline.

The solum ranges from 42 to 72 inches in thickness. Intersecting slickensides begin at a depth of 10 to 30 inches. Exchangeable sodium is more than 15 percent within 30 inches of the surface.

The A horizon is gray or light gray, and it is 13 to 22 inches thick. The 10 to 40-inch layer is clay that is 45 to 60 percent clay and 9 to 21 percent sand. The AC horizon is pale brown, grayish brown, or light brownish gray.

The C horizon is grayish brown, light brownish gray, brown, pale brown, or very pale brown. Accumulations of calcium carbonate, gypsum, and other salts in the form of soft masses and concretions range from few to common. In places there is a IIC horizon of silt loam or very fine sandy loam below a depth of about 55 inches.

Mercedes clay, 0 to 1 percent slopes (MEA).—This level soil is in broad areas several hundred acres in size. A few areas are in long, narrow drainageways. Slopes are mostly less than 0.5 percent, and the surface is plane or weakly concave. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Hidalgo soils on small, rounded knolls. Also included are areas of Raymondville soils.

Permeability is very slow, and runoff is slow. Some areas lack adequate surface drainage. This soil cracks or shrinks when dry and swells when wet. Areas of this soil are used for irrigated crops, dryfarmed crops, and pasture. Capability units IIIs–1, dryland, and IIIs–1, irrigated; pasture and hay group 7A.

Mercedes clay, 1 to 3 percent slopes (MEB).—This soil is in irregularly shaped areas. Slopes are dominantly about 2 percent, and the surface is convex. Areas of this soil range from about 40 to 250 acres in size.

The surface layer is gray, calcareous clay about 22 inches thick. The next layer is light brownish-gray clay about 14 inches thick. The underlying material, extending to a depth of about 63 inches, is grayish-brown clay.

Included with this soil in mapping are areas of Raymondville soils and Mercedes clay, 0 to 1 percent slopes. Also included are areas of Hidalgo soils at the top of slope breaks and a few eroded areas.

Permeability is very slow, and runoff is slow. This soil cracks or shrinks when dry and swells when wet. Areas of this soil are used for irrigated crops, dryfarmed crops, and pasture. Capability units IIIe–1, dryland, and IIIe–1, irrigated; pasture and hay group 7A.

Mercedes clay, loamy substratum, 1 to 5 percent slopes (MGC).—This soil is in a narrow band adjacent to the Arroyo Colorado. Areas are irregularly shaped and are less than 300 feet wide on both sides of the Arroyo. Slopes are convex and range from 1 to 5 percent, and the surface is undulating. This mapping unit has many gullies that begin at the Arroyo and bisect the smooth plane of Mercedes soils. Gullies are mostly V-shaped and are 3 to 10 feet deep.

The surface layer is gray, calcareous clay about 19 inches thick. The next layer is grayish-brown clay about 12 inches thick. Beneath this, and extending to a depth of about 60 inches, is pale-brown clay. The underlying material is stratified loamy sediment.

Included with this soil in mapping are areas of Harlingen soils, Mercedes clay, 0 to 1 percent slopes, and a few rounded areas of Hidalgo soils. Also included are areas of a soil locally called "arroyo sand," which is a stratified mixture of sandy loam, medium sand, and sandy clay loam. These areas of "arroyo sand" are mostly adjacent to the Arroyo Channel. Recent flooding has deposited fine sand a few inches to 3 feet deep in some areas, generally on the inside bends of the channel.

Permeability is very slow, and runoff is rapid. Most areas of this soil are idle. A few areas are in pasture. Capability unit IVe–2, dryland; pasture and hay group 7A.

Mercedes-Urban land complex (MM).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is in Harlingen. Mercedes clay makes up about 55 percent of the complex, and Urban land makes up 35 percent. Slopes range from 0 to 3 percent.

Mercedes clay has a surface layer of gray clay about 22 inches thick. The next layer is light brownish-gray clay about 18 inches thick. The underlying material, extending to a depth of about 60 inches, is clay that is pale brown in the lower part.

About 50 percent of the Urban land consists of areas where such works and structures as streets, sidewalks, buildings, driveways, and patios have been constructed. The remaining 50 percent consists of areas of industrial development and the Harlingen Municipal Airport. Because of the flat topography, much of the soil has not been disturbed greatly during construction, but most of the structures have been built on 6 inches to 1 foot of fill dirt, a practice that helps the drainage.

Included with these soils in mapping are areas of Raymondville and Hidalgo soils.

Among the concerns of management for urban development are flooding from runoff, cracking and shifting of structures because of the shrink-swell potential, failure of pipelines and steel because of corrosivity and salinity, and failure of septic-tank filter fields because of permeability. Capability unit and other interpretative groups not assigned.

Mustang Series

The Mustang series consists of deep, poorly drained, loose sands. These soils are nearly level to gently sloping. They are on Padre Island and Brazos Island.

In a representative profile the surface layer is very pale brown fine sand about 8 inches thick. The underlying material, extending to a depth of 50 inches, is very pale brown fine sand.

Permeability is rapid above the water table. Depth to the water table is 6 to 40 inches. Available water capacity is very low.

Most areas of Mustang soils are used for recreation and wildlife habitat.

Representative profile of Mustang fine sand, 13 miles north along the beach from the end of the highway at Andy Bowie Park and South Padre Island and 1,500 feet west of the outer edge of the dunes:

A—0 to 8 inches, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; many fine roots; mildly alkaline; gradual, smooth boundary.

C1—8 to 18 inches, very pale brown (10YR 7/3) fine sand, grayish brown (10YR 5/2) moist; single grained; loose; many fine roots; mildly alkaline; gradual, smooth boundary.

C2—18 to 24 inches, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; many fine, distinct, brownish-yellow mottles; few shell fragments; mildly alkaline; diffuse boundary.

C3—24 to 50 inches, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained.

Reaction of the soil is mildly alkaline to moderately alkaline. The A horizon ranges from grayish brown to pale brown and very pale brown in color and from 3 to 8 inches in thickness. The C horizon ranges from light brownish gray or grayish brown to pale brown or very pale brown in color and fine sand to sand in texture. The content of silt and clay ranges from 3 to 10 percent.

Mustang fine sand (MS).—This nearly level to gently sloping soil is in areas adjacent to and on the leeward side of the Coastal dunes on Padre Island and Brazos Island. Slopes are 0 to 3 percent. Areas of this soil are irregularly shaped and range from less than 10 acres to about 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Galveston soils and Mustang fine sand, saline. In a few places effervescence can be obtained with hydrochloric acid because of sand-size shell fragments.

Permeability is rapid above the water table, and runoff is very slow. The hazard of soil blowing is severe. Areas of this soil are used for recreation, wildlife habitat, and urban development. Capability unit VIw–1, dryland; Coastal Sand range site.

Mustang fine sand, saline (MU).—This is a nearly level soil that is in broad, barren areas about 2 to 5 feet above mean high tide. Slopes are 0 to 1 percent. Most of the acreage of this mapping unit is a broad area of the western side of Padre Island extending from the Coastal dunes to the Laguna Madre.

The surface layer is very pale brown fine sand about 6 inches thick. Below this, extending to a depth of about 36 inches, is pale-brown fine sand that is saturated.

Included with this soil in mapping are areas of Mustang fine sand. Also included are a few small intermittent ponds or lagunas.

Permeability is rapid above the water table, and runoff is slow. The available water capacity is low. A saline or brackish water table is at a depth of a few inches to about 2 feet. This soil produces no vegetation. Most of the acreage is idle, but at the southern end of Padre Island, areas of this soil are the source of sand for use in housing developments. Capability unit VIIIs–2.

Olmito Series

The Olmito series consists of deep, moderately well drained, calcareous soils that are nearly level. These soils are on old flood plains and deltas.

In a representative profile the surface layer is calcareous silty clay about 23 inches thick; it is dark gray in the upper part and grayish brown in the lower part. The next layer is silty clay about 16 inches thick; it is dark brown in the upper part and light brownish gray in the lower part. Beneath this, to a depth of 63 inches, is very pale brown silty clay.

Permeability is slow. The available water capacity is medium to high.

Olmito soils are used for irrigated crops, dryfarmed crops, and pasture.

Representative profile of Olmito silty clay, in a cultivated field, 0.5 mile west on Farm Road 2893 from its junction with Farm Road 1575 in Laureles, 0.2 mile north on a field road and 200 feet east:

Ap—0 to 7 inches, dark-gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate, medium, granular structure; hard, friable; many roots and worm casts; calcareous; moderately alkaline; abrupt, smooth boundary.

A11—7 to 16 inches, dark-gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate, very fine, subangular blocky structure; very hard, firm but crumbly; few fine pores; few snail shell fragments; common worm casts; calcareous; moderately alkaline; clear, smooth boundary.

A12—16 to 23 inches, grayish-brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate, fine and medium, subangular blocky structure; very hard, firm but crumbly; few fine pores; shiny pres-

sure faces; few weakly cemented calcium carbonate concretions; calcareous; moderately alkaline; diffuse, wavy boundary.

B2—23 to 34 inches, dark-brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate, fine and medium, subangular blocky structure in upper 7 to 8 inches and moderate, fine, angular blocky structure in the lower part; very hard, firm but crumbly; few fine pores; shiny pressure faces; few fine weakly cemented calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C1—34 to 39 inches, light brownish-gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) moist; common, fine, distinct, brownish-yellow mottles along root channels; massive; very hard, firm but crumbly; few cemented concretions and soft lumps of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

C2ca—39 to 48 inches, very pale brown (10YR 7/3) silty clay, brown (10YR 5/3) moist; common, fine, distinct, brownish-yellow mottles; massive; very hard, firm; common fine pores; contains 8 percent, by volume, of cemented concretions and soft lumps of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

C3—48 to 63 inches, very pale brown (10YR 7/3) silty clay, brown (10YR 5/3) moist; few, fine, distinct, brownish-yellow mottles; massive; hard, firm; few thin strata of silt loam; few manganese concretions; few soft lumps of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 30 to 50 inches in thickness. Depth to contrasting strata of silt loam or very fine sandy loam ranges from 40 to 80 inches. These soils have cracks 0.4 to 1 inch wide and 12 inches or more long that extend to a depth of 20 inches or more. Texture of the 10- to 40-inch layer ranges from silty clay loam to silty clay; the content of clay is 35 to 55 percent, and the content of silt is 40 to 60 percent.

The A horizon ranges from silty clay to silty clay loam that is more than 35 percent clay. It ranges from 16 to 30 inches in thickness and from dark gray to grayish brown or dark grayish brown in color. The B horizon ranges from silty clay loam to silty clay in texture, from 5 to 19 inches in thickness, and from brown to dark brown or grayish brown in color. It has weak to moderate, subangular blocky and blocky structure. The C horizon ranges from silty clay loam to silty clay in texture. It is pale brown, very pale brown, or light brownish gray. A weakly expressed ca horizon is in the upper part of the C horizon and is 4 to 12 inches thick.

Olmito silty clay (OM).—This nearly level soil is on old flood plains and deltas. Most areas of this soil are in slight depressions within large areas of Laredo soils or in long narrow areas between areas of Laredo and Harlingen soils. Slopes are less than 0.5 percent, and the surface is plane to weakly concave. Areas of this soil vary widely in size and shape but are rarely more than about 150 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Cameron, Harlingen, and Laredo soils. Also included are small areas that have varying degrees of salinity, and a few areas of soils that are similar to Olmito soils but that have a lighter colored surface layer.

Permeability is slow, and runoff is slow. This soil is used for irrigated crops, dryfarmed crops, and pasture. Capability units IIs-1, dryland, and IIs-1, irrigated; pasture and hay group 7C; orchard group I.

Olmito-Urban land complex (ON).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is in Brownsville. Slopes are 0 to 1 percent. Olmito silty clay makes up about 45 percent of the complex, and Urban land makes up 35 percent.

The Olmito soil has a surface layer of silty clay about 23 inches thick that is dark gray in the upper part and grayish brown in the lower part. The next layer is brown silty clay about 16 inches thick. The underlying material, extending to a depth of about 60 inches, is very pale brown silty clay.

Urban land consists of areas where such works and structures as streets, sidewalks, buildings, driveways, and patios have been constructed. Most of the structures are single-unit dwellings. Part of this complex is the Brownsville Country Club and Golf Course, but few structures are in this area, which has undergone extensive alteration. Other than preparing sites for construction or cutting streets to grade, little alteration has taken place in the rest of the acreage. On most building sites, 6 inches to 1 foot of fill material has been added, a practice that helps the drainage.

Included with these soils in mapping are areas of Matamoros, Cameron, and Laredo soils.

Among the concerns of management for urban development are flooding from runoff, cracking and shifting of structures because of the shrink-swell potential, failure of pipelines and steel because of corrosivity and salinity, and failure of septic-tank filter fields because of permeability. Capability unit and other interpretative groups not assigned.

Orelia Variant

The Orelia variant consists of deep, somewhat poorly drained, noncalcareous, saline soils that are nearly level. These soils are on deltas or coastal terraces.

In a representative profile the surface layer is gray, noncalcareous clay loam about 8 inches thick. The next layer is gray, noncalcareous sandy clay about 10 inches thick. The next layer is grayish-brown, calcareous sandy clay about 30 inches thick. The underlying material, extending to a depth of 63 inches, is gray sandy clay loam mottled with strong brown.

Permeability is slow. The available water capacity is very low to low.

This mapping unit is used mainly for pasture and range. Many areas of these soils are idle, but a few areas are cropped.

Representative profile of Orelia clay loam, clayey subsoil variant, in a cultivated field, 1.7 miles north on Farm Road 506 from its junction with State Highway 107 in Santa Rosa, 0.7 mile west on a county road, then 150 feet north:

Ap—0 to 8 inches, gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; weak, fine, subangular blocky structure; very hard, friable, sticky and plastic; few very fine pores; saline; neutral; abrupt, smooth boundary.

B21t—8 to 18 inches, gray (10YR 5/1) sandy clay, dark gray (10YR 4/1) moist; few, fine, faint, brownish-yellow mottles; moderate, fine, blocky structure; very hard, very firm, sticky and plastic; few very fine pores; thick clay films on ped surfaces; few small manganese concretions; common films and threads of soluble salts; saline; neutral; clear, wavy boundary.

B22t—18 to 33 inches, grayish-brown (10YR 5/2) sandy clay, dark grayish brown (10YR 4/2) moist; common, fine, distinct, dark-brown mottles; moderate, fine, blocky structure; very hard, very firm, sticky and plastic; few very fine pores; thick clay films on ped surfaces; few small manganese concretions; saline; calcareous; moderately alkaline; gradual, wavy boundary.

B3—33 to 48 inches, grayish-brown (10YR 5/2) sandy clay, dark grayish brown (10YR 4/2) moist; common, fine, distinct, brownish-yellow mottles; weak, fine, blocky structure; very hard, very firm, sticky and plastic; few very fine pores; few clay films; few small man-

ganese concretions; few small cemented calcium carbonate concretions; saline; calcareous; moderately alkaline; gradual, wavy boundary.

C—48 to 63 inches, gray (10YR 5/1) sandy clay loam, dark gray (10YR 4/1) moist; common, medium, distinct, strong-brown mottles; massive; hard, friable; few small manganese concretions; few small cemented calcium carbonate concretions; saline; calcareous; moderately alkaline.

The solum ranges from 36 to 55 inches in thickness. The A horizon and B21t horizon are gray, dark gray, dark grayish brown, or grayish brown and are neutral to mildly alkaline. The B21t horizon and B22t horizon are sandy clay or clay. The B22t horizon and B3t horizon are dark grayish brown, grayish brown, or brown and have few to common, faint to distinct mottles in shades of gray, brown, and yellow. The B3 horizon is sandy clay, clay loam, or sandy clay loam. The C horizon is gray, grayish brown, or light brownish gray and has common to many distinct mottles in shades of gray, brown, or yellow. The C horizon is sandy clay loam or clay loam.

Orelia clay loam, clayey subsoil variant (OR).—This nearly level soil is on coastal terraces. Slopes are less than 0.5 percent, and the surface is plane to concave. Most areas of this soil are rounded in shape and range from about 6 to 40 acres in size. Included in mapping are areas of Tiocano, Lyford, and Willamar soils.

Permeability is slow, and runoff is very slow. A seasonal high saline water table is at a depth of 1 to 4 feet. Subsurface tile drains are generally not practical because this soil has a high content of clay. The surface of this soil is generally crusty and cloddy. Areas of this soil are used for pasture and range. Many areas are idle, but a few are cropped. Capability unit IVs-3, dryland; pasture and hay group 7F; orchard group I; Clay Loam range site.

Point Isabel Series

The Point Isabel series consists of deep, well-drained, calcareous soils that are gently sloping to sloping. These soils are on clayey dunes along the lower part of the Gulf Coast in this county.

In a representative profile the surface layer is light brownish-gray clay loam about 8 inches thick over 4 inches of dark grayish-brown clay. The next layer is light brownish-gray clay 7 inches thick. Beneath this is grayish-brown clay loam about 3 inches thick. The next layer, extending to a depth of 65 inches, is clay. It is light brownish gray in the upper 15 inches, gray in the next 5 inches, and light gray in the lower 23 inches.

Permeability is slow, and runoff is rapid. The available water capacity is very low to medium, depending on the degree of salinity.

Point Isabel soils are used for range and wildlife habitat. A few areas are in pasture.

Representative profile of Point Isabel clay loam, in an area of native range, 7.6 miles east on State Highway 4 from its junction with Farm Road 511, then 0.2 mile north on a field road and 250 feet west:

A11—0 to 8 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular and subangular blocky structure; slightly hard, friable; calcareous; moderately alkaline; clear, smooth boundary.

A12—8 to 12 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; hard, firm; calcareous; moderately alkaline; clear, wavy boundary.

B2—12 to 19 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; moderate, coarse, prismatic structure parting to moderate, fine and medium, angular blocky; hard, firm; common films and threads of carbonates; calcareous; moderately alkaline; abrupt, wavy boundary.

IIAb—19 to 22 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, fine, angular blocky; hard, firm; common films and threads of carbonates; calcareous; moderately alkaline; abrupt, wavy boundary.

IIBb—22 to 37 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; moderate, fine and medium, angular blocky structure; hard, firm; few films and threads of carbonates; calcareous; moderately alkaline; abrupt, wavy boundary.

IIIAb—37 to 42 inches, gray (10YR 5/1) clay, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; hard, firm; few threads of carbonates; calcareous; moderately alkaline; clear, wavy boundary.

IIIBb—42 to 65 inches, light-gray (10YR 7/2) clay, grayish brown (10YR 5/2) moist; moderate, fine and medium, angular blocky structure; hard, firm; common threads and films of carbonates; calcareous; moderately alkaline.

Depth to an underlying contrasting layer of loamy material or seams of shells is more than 6 feet. Depth to a buried A horizon or B horizon ranges from 18 to 50 inches. The A horizon is clay loam, clay, or silty clay loam. The A11 horizon is grayish brown, light brownish gray, or pale brown, and the A12 horizon is grayish brown or dark grayish brown. The B horizon is grayish brown, light brownish gray, brown, or pale brown. It is clay loam or clay that is 35 to 55 percent clay. This horizon contains few to common films, threads, and filaments of secondary carbonates. In areas where the buried horizons are at a depth of 40 to 50 inches, there is a weakly developed ca horizon in some places.

Point Isabel clay loam (PO).—This is a gently sloping to sloping soil on long, narrow, "clayey" dunes along the lower part of the Gulf Coast (fig. 4) in this county. Most areas are on the northwestern edge of large areas of Barrada soils. Slopes range from 1 to 8 percent, and the surface is convex. Elevations range from 5 to 30 feet above mean high tide. Areas of this soil range from 10 to about 250 acres in size. This soil has the profile described as representative of the series.

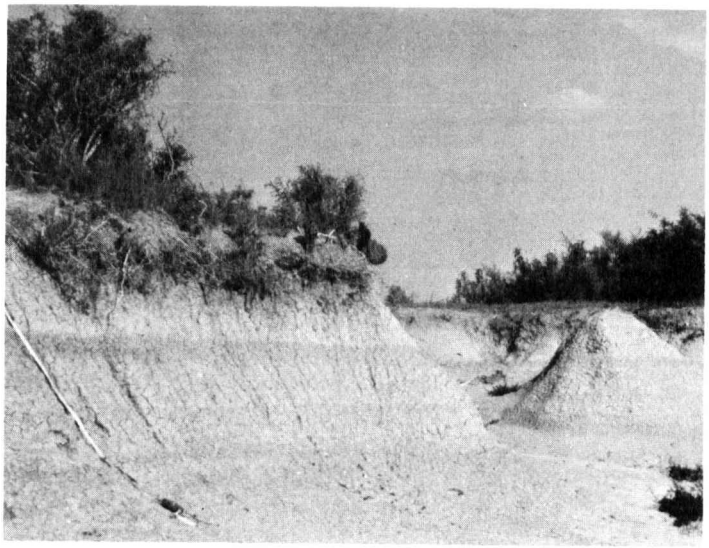

Figure 4.—**Point Isabel clay loam. Darker colored streaks are buried surface layers.**

Included with this soil in mapping are areas of Lomalta and Sejita soils, and some areas where slopes are as much as 15 percent. Also included are a few areas of soils that are similar to Point Isabel soils, but they are less clayey.

Permeability is slow, and runoff is rapid. The hazard of erosion is severe. Most areas are gullied to a depth of 1 to 5 feet on both sides of the dunes. Salinity ranges from low to very high. Areas of this soil are used for range and wildlife habitat. A few areas are in improved pasture. Capability unit VIe–1, dryland; pasture and hay group 7G; Coastal Ridge range site.

Point Isabel-Urban land complex (PU).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is in Port Isabel. Areas are saline. Slopes range from 1 to 8 percent. Point Isabel clay loam makes up about 55 percent of the complex, and Urban land makes up 30 percent.

The Point Isabel soil has a surface layer of light brownish-gray clay loam about 8 inches thick. The next layer is dark grayish-brown clay 4 inches thick. The next layer is light brownish-gray clay 7 inches thick. The underlying material, reaching to a depth of 65 inches, is brownish and grayish clay loam and clay.

Urban land is in areas where such works and structures as houses, churches, schools, small industrial buildings, streets, sidewalks, and paved parking lots have been constructed. Little alteration has taken place on the Point Isabel soil, but fills are common along the edges adjacent to the bay and ship channels. Areas of this soil continuously receive small additions of dust from nearby spoil areas.

Included with these soils in mapping are areas of Lomalta and Sejita soils, and Ustifluvents, clayey.

Among the concerns of management for urban development are failure of pipelines and steel because of corrosivity and salinity and failure of septic-tank filter fields because of permeability. Excess soluble salts, continuous salt spray, and dust prevent the growth of many plants. Capability unit and other interpretative groups not assigned.

Racombes Series

The Racombes series consists of deep, well-drained, noncalcareous soils that are nearly level. These soils are on deltas or coastal terraces.

In a representative profile the surface layer is dark-gray, noncalcareous sandy clay loam about 13 inches thick. The next layer is sandy clay loam that is about 18 inches thick and that is dark grayish brown in the upper part and grayish brown in the lower part. Beneath this, to a depth of 74 inches, is pale-brown sandy clay loam.

Permeability is moderate, and runoff is slow. The available water capacity is high.

Racombes soils are used for irrigated crops, dryfarmed crops, and pasture. A few areas are used for citrus.

Representative profile of Racombes sandy clay loam, in a citrus grove, 240 feet south and 60 feet west of the northeast corner of Block 87, Hodges Subdivision; Block 87 is 3.7 miles south on Farm Road 733 from its junction with State Highway 107 in Santa Rosa:

Ap—0 to 7 inches, dark-gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; weak, fine, subangular blocky structure; slightly hard, friable; few earthworm casts; mildly alkaline; abrupt, smooth boundary.

A1—7 to 13 inches, dark-gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; weak, fine, subangular blocky structure; slightly hard; friable; few earthworm casts; mildly alkaline; clear, smooth boundary.

B1t—13 to 17 inches, dark grayish brown (10YR 4/2) sandy clay loam, very dark brown (10YR 2/2) moist; weak, medium, blocky structure; hard, friable; common fine pores; few earthworm casts; few clay films on ped surfaces; mildly alkaline; gradual, smooth boundary.

B2t—17 to 31 inches, grayish-brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, blocky and prismatic structure; very hard, firm; common fine pores; common earthworm casts; common clay films; mildly alkaline; gradual, wavy boundary.

B3—31 to 44 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; weak, fine, subangular blocky structure; hard, friable; common fine pores; common earthworm casts; few snail shell fragments; common films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

Cca—44 to 74 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; few, fine, distinct strong-brown mottles in lower part; massive; hard, friable; common fine pores; few snail shell fragments; about 5 percent, by volume, weakly cemented and strongly cemented calcium carbonate concretions; calcareous; moderately alkaline.

The solum ranges from 30 to 55 inches in thickness. The A horizon is dark-gray or dark grayish-brown sandy clay loam, loam, or clay loam 10 to 17 inches thick. It is mildly alkaline or neutral. The B horizon has thin, patchy to nearly continuous clay films on both the horizontal and vertical surfaces of the peds. The B1 horizon and B2 horizon are dark grayish brown, grayish brown, or dark brown and 14 to 23 inches thick. They are sandy clay loam or clay loam, and the content of clay is 25 to 35 percent. They range from weak to moderate blocky and prismatic in structure and are neutral to mildly alkaline. The B3 horizon is grayish brown, light brownish gray, or pale brown and is sandy clay loam or loam 7 to 15 inches thick. The C horizon is pale-brown, very pale brown, or light-gray loam or sandy clay loam. The C horizon is 3 to 12 percent, by volume, weakly cemented calcium carbonate concretions.

Racombes sandy clay loam (RA).—This nearly level soil is on coastal terraces. Slopes are less than 0.5 percent, and the surface is plane to slightly concave. Areas of this soil vary widely in size and shape. Most are in long, narrow drainageways; a few areas are small, rounded slight depressions; and near Primera and Santa Rosa, the areas are broad, level and irregularly shaped. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Hidalgo, Willacy, and Raymondville soils. Also included are areas of Rio soils in a few small depressions, and a few, small, irregularly shaped areas that are high in content of sodium.

Permeability is moderate, and runoff is slow. A few areas of this soil lack adequate surface drainage, and surface drains need to be provided. Some areas have a seasonal high water table of saline ground water, but tile drains can be used effectively to lower the water table. Areas of this soil are used for irrigated crops, dryfarmed crops, and pasture. A few areas are used for citrus. Capability units IIc–4, dryland, and I–5, irrigated; pasture and hay group 7C; orchard group F.

Racombes soils and Urban land (RDX).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is in Harlingen and Rio Hondo. Slopes range from 0 to 1 percent. Racombes sandy clay loam makes up about 40 percent of the complex, and Urban land makes up 30 percent.

The Racombes soil has a surface layer of dark-gray, noncalcareous sandy clay loam about 13 inches thick. The next layer is sandy clay loam about 18 inches thick; it is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material, extending to a depth of 74 inches, is pale-brown sandy clay loam.

Urban land consists of areas where such works and structures as streets, sidewalks, buildings, driveways, and patios have been constructed. Most of the structures are single-unit dwellings. Other than preparing the sites for construction or cutting streets to grade, little alteration has taken place on the Racombes soils. Filling with materials brought in from other places is negligible.

Included with these soils in mapping are areas of Lyford, Willacy, Raymondville, and Hidalgo soils.

Nearly all areas of this complex support good stands of large mesquite, hackberry, ash, or ebony trees. Among the concerns for urban development are mainly corrosive failure of pipelines and steel and flooding from runoff in some areas. Capability unit and other interpretative groups not assigned.

Raymondville Series

The Raymondville series consists of deep, moderately well drained, calcareous soils that are nearly level. These soils are on deltas or coastal terraces.

In a representative profile the surface layer is calcareous clay loam about 14 inches thick that is gray in the upper part and dark gray in the lower part. The next layer is gray clay loam about 11 inches thick. Beneath this, to a depth of about 78 inches, is clay. The upper 12 inches is light brownish gray, the next 23 inches is light gray, and the lower 18 inches is light brownish gray.

Permeability is slow, and runoff is slow. The available water capacity is very low to high, depending on the degree of salinity. A seasonal water table is at a depth of 5 to 8 feet in areas where the soil is irrigated.

Raymondville soils are used for irrigated crops, dryfarmed crops, and pasture.

Representative profile of Raymondville clay loam, in a cultivated field, 260 feet east and 85 feet south of the northwest corner of Block 8, Agua Dulce Farms Subdivision; Block 9 is 2.7 miles east on Farm Road 508 from its junction with U.S. Highway 77 in Combes, 2 miles north on a county road:

Ap—0 to 6 inches, gray (10YR 5/1) clay loam, very dark gray (10YR 3/1) moist; massive; hard, friable; calcareous; moderately alkaline; abrupt, smooth boundary.

A1—6 to 14 inches, dark-gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; weak, subangular blocky structure; hard, friable; calcareous; moderately alkaline; clear, wavy boundary.

B2—14 to 25 inches, gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; moderate, medium, blocky structure; few wedge-shaped peds; very hard, firm; common fine pores; few films and threads of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

B2ca—25 to 37 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; moderate, medium, blocky structure; many wedge-shaped peds; few slickensides; very hard, very firm; few films, threads, and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

C1ca—37 to 60 inches, light-gray (10YR 7/2) clay, light brownish gray (10YR 6/2) moist; moderate, fine and medium, blocky structure; very hard, very firm; about 5 percent, by volume, of concretions and soft lumps of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

C2ca—60 to 78 inches, light brownish-gray (10YR 6/2) clay, brown (10YR 5/3) moist; weak, blocky structure; very hard, very firm; few weakly cemented calcium carbonate concretions; calcareous; moderately alkaline.

The solum ranges from 32 to 50 inches in thickness. When dry, these soils have cracks that are 3/4 inch to 2 inches wide and that extend to a depth of 30 to 40 inches. In undisturbed areas, the soil is locally weakly cyclic, and within the limits of a profile, in microbasins, the surface soils are dark gray or very dark gray and, on microknolls, they are gray or grayish brown. The A horizon is gray, dark gray, or dark grayish brown. The A1 horizon is clay loam or sandy clay 15 to 26 inches thick. The B2 horizon is light gray, gray, grayish brown, or light brownish gray. It is clay loam or clay; the content of clay ranges from 35 to 50 percent. The B2 horizon is 16 to 32 inches thick. The C horizon ranges from light gray or light brownish gray to pale brown in color and from clay to clay loam in texture.

Raymondville clay loam (RE).—This nearly level soil is on broad coastal terraces. Slopes are less than 0.5 percent, and the surface is plane to slightly concave. Most areas of this soil are irregularly shaped and several hundred acres in size. A few areas occupy long, narrow drainageways. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Hidalgo, Willacy, and Racombes soils. Also included are small areas that have varying degrees of salinity.

Permeability is slow, and runoff is slow. A few areas of this soil lack adequate surface drainage, and surface drains need to be provided. Some areas have a seasonal high water table of saline ground water, but tile drains can be used effectively to lower the water table. Areas of this soil are used for irrigated crops, dryfarmed crops, and pasture. This soil is poorly suited to citrus because of poor surface and subsurface drainage. Capability units IIs–1, dryland, and IIs–1, irrigated; pasture and hay group 7C; orchard group I; Clay Loam range site.

Raymondville clay loam, saline (RG).—This nearly level soil is on small coastal terraces. Slopes are less than 0.5 percent, and the surface is plane to slightly convex. Areas of this soil are irregularly shaped but somewhat elongated. They range from 10 to 25 acres in size.

The surface layer is gray, calcareous clay loam about 15 inches thick. The next layer is grayish-brown clay about 25 inches thick. The underlying material, extending to a depth of about 63 inches, is light-gray clay.

Included with this soil in mapping are areas of Raymondville clay loam and Racombes soils. Also included are a few irregularly shaped spots that are high in sodium content.

Permeability is slow, and runoff is slow. Areas of this soil are used for irrigated crops or pasture. The surface of this soil generally is crusty and cloddy. Where adequate outlets are available, tile drain sys-

tems can be used effectively to reduce the salinity of this soil. Capability units IVs–3, dryland, and IIIs–4, irrigated; pasture and hay group 7F; orchard group I.

Raymondville-Urban land complex (RM).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is in Harlingen. Slopes are 0 to 1 percent. Raymondville clay loam makes up about 55 percent of the complex, and Urban land makes up 35 percent.

The Raymondville clay loam has a surface layer of dark-gray calcareous clay loam about 15 inches thick. The next layer is gray clay loam about 11 inches thick. The underlying material, extending to a depth of about 78 inches, is light brownish-gray clay.

Urban land consists of areas where such works and structures as streets, sidewalks, buildings, driveways, and patios have been constructed. Most of the structures are single-unit dwellings, but about 15 percent of them are multiple-unit dwellings, businesses, shopping centers, schools, and churches that have paved parking lots. Other than preparing the site for construction, little alteration has taken place on the Raymondville soils. Filling with materials brought in from other places is negligible.

Included with these soils in mapping are areas of Hidalgo, Willacy, and Racombes soils.

Among the concerns of management for urban development are cracking and shifting of structures because of the shrink-swell potential, failure of pipelines and steel because of corrosivity, failure of septic-tank filter fields because of permeability, and in some areas flooding from runoff. Capability unit and other interpretative groups not assigned.

Reynosa Series

The Reynosa series consists of deep, well-drained, calcareous soils that are nearly level to gently sloping. These soils are on old flood plains and deltas.

In a representative profile the surface layer is grayish-brown, calcareous silt loam about 11 inches thick. The next layer is light brownish-gray silt loam about 26 inches thick. The underlying material, extending to a depth of about 71 inches, is stratified. The upper 4 inches is brown silty clay loam, the next 7 inches is pale-brown silt loam, the next 7 inches is grayish-brown silty clay loam, and the lower 16 inches is pale-brown very fine sandy loam.

Permeability is moderate, and runoff is slow. The available water capacity is high to very high.

Reynosa soils are used for irrigated crops, dryfarmed crops, pasture, and citrus.

Reynosa soils are mapped only in a complex with Laredo soils.

Representative profile of Reynosa silt loam, in an area of Laredo-Reynosa complex, 0 to 1 percent slopes, in a cultivated field, 1.5 miles east on U.S. Highway 281 from its junction with Farm Road 506 in Blue Town, 1.1 miles north on County Road and 0.1 mile west:

Ap—0 to 11 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, fine, subangular blocky structure; slightly hard, friable; few fine pores; common mica flakes; calcareous; moderately alkaline; abrupt, smooth boundary.

B2—11 to 37 inches, light brownish-gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; weak, fine, subangular blocky structure; hard, friable; common fine pores; common films and threads of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

Cca—37 to 41 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; massive; hard, friable; few fine pores; 3 percent, by volume, soft lumps of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

C—41 to 48 inches, pale-brown (10YR 6/3) silt loam containing thin strata of silty clay loam, brown (10YR 5/3) moist; massive; hard, friable; few fine pores; few soft lumps of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

IIAb—48 to 55 inches, grayish-brown (10YR 5/2) silty clay loam that has been considerably mixed with light-colored silt loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable; calcareous; moderately alkaline; abrupt, wavy boundary.

IIC—55 to 71 inches, pale-brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; calcareous; moderately alkaline.

The solum ranges from 30 to 50 inches in thickness. The A horizon is grayish brown or brown and is 9 to 20 inches thick. The B horizon ranges from silt loam to silty clay loam in texture and from 20 to 40 inches in thickness. It has weak to moderate subangular blocky structure and few to common films, threads, or soft lumps of calcium carbonate. The B horizon ranges from grayish brown or brown to very pale brown or light brownish gray in color. The C horizon consists mainly of stratified layers of silty clay loam, silt loam, and very fine sand. In most places there is a weakly to moderately expressed ca horizon as well as thin remnants of a buried A horizon.

Rio Series

The Rio series consists of deep, somewhat poorly drained, noncalcareous soils that are nearly level to slightly depressional. These soils are on deltas or coastal terraces.

In a representative profile the surface layer is dark-gray, noncalcareous clay loam about 10 inches thick. The next layer is gray clay 27 inches thick. Below this is light brownish-gray clay loam about 12 inches thick. The underlying material, extending to a depth of about 63 inches, is pale-brown sandy clay loam.

Permeability is slow, and runoff is very slow to ponded. The available water capacity is medium to high.

Rio soils are used for irrigated crops, dryfarmed crops, and pasture.

Representative profile of Rio clay loam, in a cultivated field, 0.2 mile north on Tamm Lane Road from its junction with U.S. Highway 83 Expressway, 4 miles west of Harlingen, and 50 feet east:

Ap—0 to 7 inches, dark-gray (10YR 4/1) clay loam, black (10YR 2/1) moist; weak, fine, granular and subangular blocky structure; hard, firm, sticky and plastic; neutral; abrupt, smooth boundary.

A1—7 to 10 inches, dark-gray (10YR 4/1) clay loam, black (10YR 2/1) moist; weak, fine, subangular blocky structure; hard, firm, sticky and plastic; few fine pores; neutral; clear, smooth boundary.

B21t—10 to 23 inches, gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; few, fine brownish-yellow mottles; moderate, medium, blocky structure; very hard, very firm, sticky and plastic; few fine pores; common thick clay films on ped surfaces; mildly alkaline; gradual, wavy boundary.

B22t—23 to 37 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; few, fine, brownish-yellow mottles; moderate, medium, blocky structure; very hard, very firm, sticky and plastic; few fine pores; thick clay films on

ped surfaces; mildly alkaline; gradual, wavy boundary.

B3—37 to 49 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; few, fine, distinct, strong-brown mottles and common medium gray streaks; weak, medium, blocky structure; very hard, firm, sticky and plastic; few small round magnesium concretions; few films and threads of carbonates and few weakly cemented calcium carbonate concretions; calcareous; moderately alkaline; gradual, wavy boundary.

Cca—49 to 63 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; common, fine, gray and strong-brown mottles; massive; hard, firm; few small round magnesium concretions; about 3 percent, by volume, weakly cemented calcium carbonate concretions; calcareous; moderately alkaline.

The solum ranges from about 32 to 56 inches in thickness. The A horizon ranges from gray or grayish brown to very dark grayish brown or dark gray in color. It ranges from neutral to mildly alkaline. The Bt horizon ranges from clay loam to clay, and the content of clay is 35 to 50 percent. This horizon is very dark grayish brown or very dark gray to grayish brown or gray and has mottles that range from yellow or brown to gray. This horizon ranges from mildly alkaline to moderately alkaline. The Cca horizon ranges from gray to pale brown or very pale brown in color, from sandy clay loam to clay in texture, and from 1 to about 5 percent, by volume, in content of calcium carbonate.

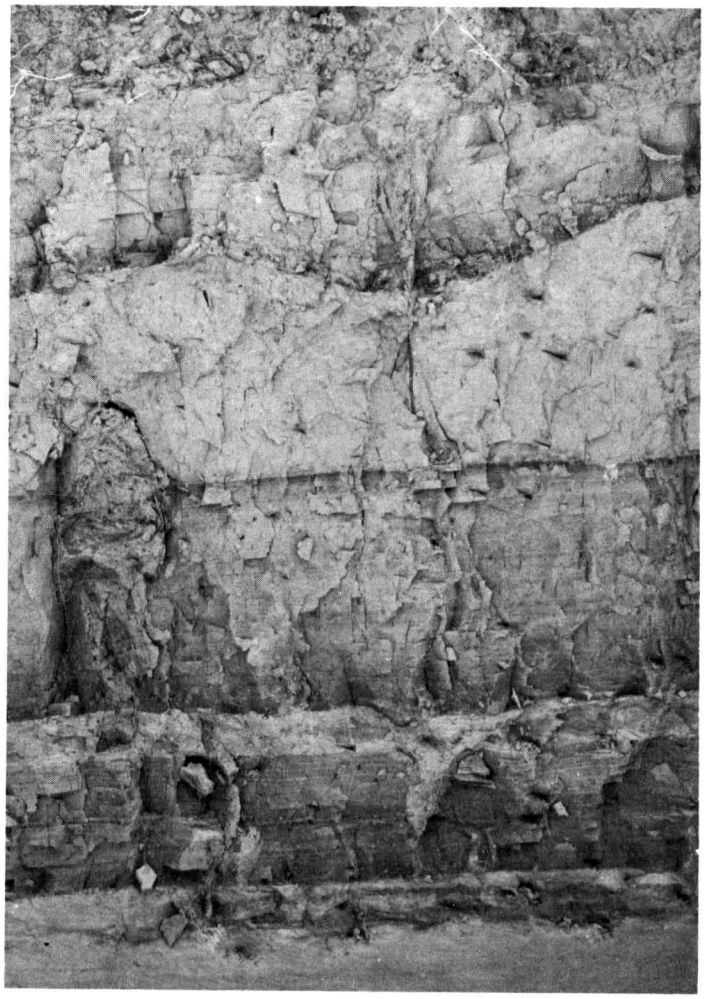

Figure 5.—**Profile of Rio Grande silt loam showing the stratification of layers.**

Rio clay loam (RO).—This nearly level soil is on coastal terraces. Most areas occur as small, rounded depressions about 3 to 10 acres in size, but many areas occupy the outer rim of small enclosed potholes. Slopes are less than 0.5 percent.

Included with this soil in mapping are areas of Tiocano and Racombes soils. Also included are small areas of Willacy soils.

Permeability is slow, and runoff is very slow to ponded. Surface drains are needed to remove excess runoff. Areas of this soil are used for irrigated crops, dryfarmed crops and pasture. Capability units IIs-2, dryland, and IIs-2, irrigated; pasture and hay group 7E; orchard group I.

Rio Grande Series

The Rio Grande series consists of deep, well-drained, calcareous soils that are nearly level to gently sloping. These soils are on the active flood plain of the Rio Grande. The surface is plane to slightly convex.

In a representative profile (fig. 5) the plow layer is light-gray, calcareous silt loam about 9 inches thick. The underlying material, extending to a depth of about 63 inches, is light-gray and very pale brown, stratified silt loam, silty clay loam, and very fine sandy loam.

Permeability is moderate, and runoff is slow. The available water capacity is high to very high. These soils are rarely flooded. The high lime content of the soils causes chlorosis of some plants.

Rio Grande soils are used for irrigated crops and pasture.

Representative profile of Rio Grande silt loam, in a cultivated field, 0.2 mile west on U.S. Highway 281 from its junction with Farm Road 2520, 0.2 mile south on field road and 100 feet east:

Ap—0 to 9 inches, light-gray (10YR 7/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; friable; few mica flakes; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—9 to 16 inches, light-gray (10YR 7/2) silt loam, dark grayish brown (10YR 4/2) moist; few brownish-yellow mottles along root channels and cleavages on bedding planes; massive; bedding planes evident; friable; common fine pores; few mica flakes; calcareous; moderately alkaline; clear, wavy boundary.

C2—16 to 28 inches, very pale brown (10YR 7/3) silt loam that has few pockets of very fine sandy loam, dark grayish brown (10YR 4/2) moist; few brownish-yellow mottles along root channels and cleavages of bedding planes; massive; bedding planes evident; friable; common fine pores; few mica flakes; calcareous; moderately alkaline; clear, wavy boundary.

C3—28 to 33 inches, very pale brown (10YR 7/3) silty clay loam, grayish brown (10YR 5/2) moist; common strong-brown mottles along root channels and cleavage planes; massive; bedding planes evident; firm; few fine pores; few mica flakes; calcareous; moderately alkaline; clear, wavy boundary.

C4—33 to 39 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; few yellow-brown mottles along root channels; massive; bedding planes evident; friable; common fine pores; few mica flakes; calcareous; moderately alkaline; diffuse, wavy boundary.

C5—39 to 63 inches, light-gray (10YR 7/2) very fine sandy loam, brown (10YR 5/3) moist; few yellowish-brown mottles along cleavage planes and pores; massive; bedding planes evident; friable; common fine pores; few mica flakes; calcareous; moderately alkaline.

The texture in the uppermost 40 inches of the profile ranges from silt loam to very fine sandy loam. The A horizon ranges from grayish brown to light brownish gray or light gray in color, from silt loam to silty clay loam in texture, and from 5 to 17 inches in thickness. The C horizon ranges from grayish brown to light gray, pale brown, or very pale brown in color, and in texture from silt loam to very fine sandy loam that contains thin strata of more clayey or sandy material. The content of clay ranges from about 9 to 18 percent. Cleavage planes along unaltered bedding planes are weakly expressed to strongly expressed. The sediment below a depth of 40 inches is stratified and ranges from fine sand to silty clay.

Rio Grande silt loam (RR).—This nearly level soil is on the flood plain of the Rio Grande. Slopes are less than 1 percent, and the surface is plane to slightly convex. Areas of this soil are irregularly shaped and range from 10 to about 250 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Camargo soils and Rio Grande silty clay loam, which occur as narrow streaks or rounded pockets. Also included are a few minor depressions in which Matamoros soils occur.

Permeability is moderate, and runoff is slow. This soil is used for irrigated crops and pasture. Because of the contrasting textures throughout the soil, a perched water table is common after heavy irrigation or rainfall. Capability unit I-1, irrigated; pasture and hay group 2A; orchard group C.

Rio Grande silty clay loam (RT).—This nearly level soil is on the flood plain of the Rio Grande. Slopes are less than 0.5 percent, and the surface is plane. Areas of this soil are irregularly shaped and range from about 5 to 30 acres in size.

The surface layer is light brownish-gray silty clay loam about 17 inches thick. Below this, extending to a depth of about 40 inches, is very pale brown silt loam that contains thin strata of very fine sandy loam and silty clay loam. The underlying material is pale-brown, stratified sediment that ranges from very fine sand to silty clay.

Included with this soil in mapping are areas of Rio Grande silt loam and Camargo soils which occur as narrow streaks or rounded pockets. Also included are a few minor areas of Matamoros soils in depressions.

Permeability is moderate, and runoff is slow. This soil is used for irrigated crops and pasture. Because of the contrasting texture throughout the soil, a perched water table is common after heavy irrigation or rainfall. Capability unit I-2, irrigated; pasture and hay group 2A; orchard group C.

Rio Grande-Urban land complex (RU).—This mapping unit is in the built-up areas of cities and towns. The entire acreage is in Brownsville. Rio Grande silt loam makes up about 55 percent of the complex, and Urban land makes up 30 percent. Slopes range from 0 to 3 percent.

The Rio Grande soil has a surface layer of light-gray, calcareous silt loam about 9 inches thick. The underlying material, reaching to a depth of about 63 inches, is light-gray and very pale brown stratified silt loam and very fine sandy loam.

Urban land consists of areas where such works and structures as streets, sidewalks, buildings, driveways, and patios have been constructed. Most of the structures are single-unit dwellings, but about 15 percent are industrial buildings, businesses, streets, and paved parking lots near the International Bridge. Only minor alteration of the Rio Grande soils has taken place.

Included with these soils in mapping are areas of Rio Grande silty clay loam and Camargo and Zalla soils.

Nearly all areas of this complex support good strands of large mesquite, hackberry, ash, or ebony trees. Among the concerns of management for urban development are corrosive failure of pipelines and steel and chlorosis of some plants because of the high alkalinity and high lime content of the soil material. Nearly all areas are protected from flooding by the Brownsville levee system. Capability unit and other interpretative groups not assigned.

Rio Grande-Zalla complex (RZ).—The soils of this complex occur in such intricate patterns that it is not feasible to map them separately. Rio Grande silt loam makes up about 50 percent of the complex, and Zalla silt loam makes up 40 percent. These soils are on the inside bends of abandoned channels on the active flood plain of the Rio Grande. Slopes range from 0.5 to 2 percent. Both soils have plane to slightly convex surfaces. Areas are oblong or rounded and range from 5 to about 50 acres in size.

The Rio Grande soil has a surface layer of light brownish-gray, calcareous silt loam about 10 inches thick. The underlying material, extending to a depth of about 63 inches, is pale-brown and very pale brown, stratified silt loam and very fine sandy loam.

The Zalla soil has a surface layer of light brownish-gray, calcareous silt loam about 11 inches thick. The underlying material, extending to a depth of about 63 inches, is light-gray and very pale brown, stratified fine sand.

Included with these soils in mapping are areas of Camargo and Zalla soils.

Permeability is moderate in the Rio Grande soils and rapid in the Zalla soils. Runoff is slow on both soils. These soils are used for irrigated crops and pasture. Land leveling on the soils of this unit should be done carefully in order not to expose the fine sand in the profile of Zalla silt loam. Capability unit IIIs-3, irrigated; pasture and hay group 2A; orchard group C.

Sejita Series

The Sejita series consists of deep, poorly drained, saline, and calcareous soils that are level. These soils are in semimarshy areas along the lower Gulf Coast in this county only a few feet above mean high water level.

In a representative profile the surface layer is light brownish-gray, calcareous silt loam about 2 inches thick. The next layer is light-gray silty clay loam about 18 inches thick. The underlying material, extending to a depth of about 40 inches, is very pale brown, stratified silt loam, silty clay loam, and clay loam.

Permeability is moderately slow, and runoff is very slow to ponded. Depth to the water table is typically

about 30 inches but ranges from 20 to 48 inches. The available water capacity is very low.

Sejita soils are used for range and as wildlife habitat.

Representative profile of Sejita silty clay loam, in range, 4.3 miles northeast on Farm Road 1792 from its junction with Farm Road 511 at Port Brownsville, 0.6 mile north on trail and 100 feet east:

A1sa—0 to 2 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, fine, subangular blocky structure; slightly hard, friable; common salt threads; saline; calcareous; strongly alkaline; clear, wavy boundary.

B2sa—2 to 7 inches, light-gray (10YR 7/2) silty clay loam; common, medium, distinct, gray (10YR 6/1) streaks, light brownish gray (10YR 6/2) moist; weak, coarse, blocky structure; hard, friable, sticky; few calcium sulfate crystals; few fine iron-manganese concretions; common salt threads; saline; calcareous; strongly alkaline; gradual, wavy boundary.

B3sa—7 to 20 inches, light-gray (10YR 7/2) silty clay loam, light brownish gray (10YR 6/2) moist; few gray (10YR 6/1) streaks; weak, coarse, prismatic structure; hard, friable, sticky; few calcium sulfate crystals; common salt masses and threads; saline; calcareous; strongly alkaline; disfuse, wavy boundary.

Csa—20 to 40 inches, very pale brown (10YR 7/3), stratified silt loam, silty clay loam, and clay loam, pale brown (10YR 6/3) moist; common, medium, distinct, dark-gray (10YR 4/1) and strong-brown (7.5YR 5/6) mottles; massive; hard, friable; few calcium sulfate crystals; few black concretions; saline; calcareous; strongly alkaline.

The solum ranges from 15 to 30 inches in thickness. Reaction ranges from mildly alkaline through strongly alkaline throughout the profile. The A horizon is light brownish-gray, light-gray, or grayish-brown silt loam, loam, or silty clay loam. The B horizon is light-gray, light brownish-gray, grayish-brown, or pale-brown silt loam, silty clay loam, or clay loam. It has weak blocky or weak prismatic structure. The C horizon is light gray, light brownish gray, or very pale brown and has few to common grayish and brownish mottles. It is stratified loam, silt loam, silty clay loam, and clay loam. The content of clay in the 10- to 40-inch layer averages about 25 to 35 percent.

Sejita silty clay loam (SE).—This soil is only a few feet above mean sea level. Areas are broad, level, and several hundred acres in size. Slopes are less than 0.5 percent, and the surface is plane to concave. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Latina soils at a slightly higher elevation and Lomalta soils in slight depressions. Also included are small areas of Barrada soils.

Permeability is moderately slow, and runoff is very slow to ponded. This soil is saline, and it is high in exchangeable sodium. Subsurface tile drains are not practical because of the location of the land. Areas of this soil are used for range and as wildlife habitat. Capability unit VIIs-2, dryland; Salt Flat range site.

Sejita-Urban land complex (SU).—This mapping unit is in the built-up areas of cities and towns. Most of the acreage is in Port Brownsville. Sejita silty clay loam makes up about 40 percent of the complex, and Urban land makes up 40 percent. Slopes are less than 0.5 percent.

The Sejita soil has a surface layer of light brownish-gray, calcareous silt loam about 2 inches thick. The next layer is light-gray silty clay loam about 18 inches thick. The underlying material, extending to a depth of about 40 inches, is very pale brown, stratified silt loam, silty clay loam, and clay loam.

Urban land consists of areas of industrial buildings, storage tanks, and other works and structures that are connected with a chemical plant and port operations. Areas of this complex at Port Isabel consist of single-unit dwellings, and the accompanying streets, driveways, sidewalks, and utility services. Most structures are built on 1 to 3 feet of fill dirt, a practice that helps the drainage. Most of the surface of this complex has been altered by the addition of oil and other waste connected with port operations.

Included with these soils in mapping are areas of Latina, Lomalta, and Barrada soils and Ustifluvents, clayey.

Among the concerns of management for urban development are flooding from runoff, failure of pipelines, concrete, and steel because of corrosivity and salinity, and failure of septic-tank filter fields because of the high water table. Capability unit and other interpretative groups not assigned.

Tiocano Series

The Tiocano series consists of deep, somewhat poorly drained soils that are level to depressional. These soils are at an elevation 1 to 3 feet lower than the surrounding nearly level topography.

In a representative profile the surface layer, to a depth of about 38 inches, is very dark gray clay. The next layer is gray clay about 19 inches thick. The underlying material, extending to a depth of 74 inches, is light brownish-gray clay.

Permeability is very slow, and runoff is ponded. The available water capacity is medium to high.

In most years Tiocano soils are saturated or covered with water during the growing season. These soils are used mainly for pasture, but many areas are idle.

Representative profile of Tiocano clay, 0.6 mile south on U.S. Highway 77 from its junction with the Cameron-Willacy County line, 0.2 mile east on a county road and 0.1 mile north in a small depression:

A11—0 to 11 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate, fine, granular and subangular blocky structure; hard, firm, very sticky and very plastic; few fine pores; neutral; abrupt, smooth boundary.

A12—11 to 21 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate, fine, blocky structure; very hard, very firm, very sticky and very plastic; few fine pores; mildly alkaline; diffuse, smooth boundary.

A13—21 to 38 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate, fine, blocky structure that forms parallelepipeds; many intersecting slickensides; very hard, very firm, very sticky and very plastic; few fine pores; calcareous; moderately alkaline; diffuse, smooth boundary.

AC—38 to 57 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; common very dark gray streaks along old cracks; moderate, fine, blocky structure that forms parallelepipeds; distinct slickensides; very hard, very firm, very sticky and very plastic; few fine pores; few small weakly cemented calcium carbonate

concretions; calcareous; moderately alkaline; gradual, wavy boundary.

C—57 to 74 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; massive; hard, firm, sticky and plastic; few, very small, weakly cemented calcium carbonate concretions; calcareous; moderately alkaline.

The solum ranges from about 40 to 60 inches in thickness. These soils have cracks that are 3/8 inch to about 4 inches in width and 30 to 40 inches in depth and that remain open from 90 to 150 days during most years. Reaction is neutral to moderately alkaline throughout, and the soil ranges from noncalcareous to calcareous. The thickness of the A horizon ranges from 12 inches in the center of the microknolls to about 50 inches in the center of the microbasins. The A horizon is dark gray or very dark gray. The AC horizon ranges in thickness from about 6 inches in the microbasins to 24 inches in the microknolls. It is gray or dark gray.

Tiocano clay (TC).—This soil is in small enclosed level depressions that are 1 to 3 feet lower than the surrounding soils. Slopes are less than 0.5 percent, and the surface is concave. Areas of this soil are round. Most are 1 to about 7 acres in size, but a few are more than 100 acres.

Included with this soil in mapping are narrow bands of Rio and Racombes soils. Also included are a few areas that have 3 to 5 inches of sandy overwash material on the surface.

Permeability is very slow, and runoff is ponded. In most years this soil is saturated or covered with water during the growing season. Areas of this soil are used mainly for pasture. Capability unit Vw-1, dryland; pasture and hay group 7E.

Urban Land

Urban land consists of areas where such works and structures as streets, sidewalks, buildings, driveways, churches, schools, yards, and patios have been constructed. Most of the structures are single-unit dwellings, but some are industrial buildings, business and professional buildings, paved parking lots, and airports.

The installation of works and structures has so altered soil features that the soils cannot be recognized.

Urban land is mapped in a complex with Benito, Harlingen, Hidalgo, Laredo, Lomalto, Mercedes, Olmito, Point Isabel, Raymondville, Rio Grande, and Sejita soils. It is also mapped in an undifferentiated unit with the Racombes soils.

Ustifluvents, Clayey

Ustifluvents, clayey (USX), consists of nearly level to steep areas of silty and clayey materials that have been excavated from canals and ditches or from the floor of lagoons and bays and deposited on other soils (fig. 6). Slopes range from 1 to 25 percent. The steeper, short-gully areas have cut into the larger mounds of soil material.

The soil material, to a depth of about 60 inches, is grayish and brownish-gray clayey sediment that is stratified with silty and sandy materials and shell fragments of various kinds and sizes.

Included with this soil in mapping are areas of

Figure 6.—Area of Ustifluvents, clayey. Brownsville ship channel is in the background.

Sejita and Lomalta soils. Also included are a few areas of soils similar to Ustifluvents, clayey, but they are more sandy throughout.

Permeability is very slow, and runoff is slow to rapid. This soil is not suited to crops or pasture, but it is suited to wildlife habitat or urban development. Among the concerns of management for urban development are failure of pipelines and steel because of corrosivity and salinity and failure of septic-tank filter fields because of permeability. Because this material was saturated with seawater when it was excavated, it contains large amounts of salts that prevent the growth of most plants. Capability unit VIIIs-3, dryland.

Willacy Series

The Willacy series consists of deep, well-drained, noncalcareous soils that are nearly level to gently sloping. These soils are on deltas or coastal terraces.

In a representative profile the surface layer is dark grayish-brown, noncalcareous fine sandy loam about 14 inches thick. The next layer is about 5 inches of dark grayish-brown fine sandy loam and 23 inches of brown sandy clay loam. The underlying material, extending to a depth of about 74 inches, is pale-brown sandy clay loam.

Permeability is moderate, and runoff is medium. The available water capacity is medium to high.

Willacy soils are used for irrigated crops, dryfarmed crops, citrus, and pasture. A few areas are used for range.

Representative profile of Willacy fine sandy loam, 0 to 1 percent slopes, 135 feet north and 215 feet west of the southeast corner of Block 16, Combes Subdivision; Block 16 is 1 mile south on U.S. Highway 77 from its junction with the Cameron-Willacy County line and 1 mile east on a county road:

Ap—0 to 7 inches, dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular structure; slightly hard, friable; mildly alkaline; abrupt, smooth boundary.

A1—7 to 14 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular and subangular blocky structure; slightly hard, friable; many fine and very fine pores and root channels; mildly alkaline; clear, smooth boundary.

B21t—14 to 19 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure and weak, fine, subangular blocky structure; slightly hard, friable; many insect channels; many fine pores and root channels; patchy clay films on prism faces and in pores; mildly alkaline; clear, wavy boundary.

B22t—19 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 structure; hard, friable; many fine pores and root channels; patchy clay films on prism faces and in pores; mildly alkaline; clear, wavy boundary.

B3—36 to 42 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; hard, friable; few films and threads and few soft masses of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

Cca—42 to 52 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive; hard, friable; common fine and very fine pores; 5 percent is soft lumps and weakly cemented concretions of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.

C—52 to 74 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive; hard, friable; 4 percent of soft lumps and strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 39 to 60 inches in thickness. Secondary lime occurs at a depth of 34 to 50 inches.

The A horizon is very dark grayish brown, dark grayish brown, or grayish brown and is 11 to 20 inches thick. Reaction is neutral or mildly alkaline.

The B horizon is dark grayish brown, grayish brown, or brown and is 21 to 40 inches thick. It is fine sandy loam or sandy clay loam and has a content of clay that ranges from 18 to 27 percent. It has structure that ranges from weak to moderate prismatic and subangular blocky. It is neutral or mildly alkaline in the upper part and moderately alkaline in the lower part.

The C horizon is pale brown, very pale brown, or light brownish gray. The accumulation of calcium carbonate in the C horizon ranges from 3 to 5 percent and remains relatively constant with increasing depth.

Willacy fine sandy loam, 0 to 1 percent slopes (WAA).—This soil is on broad coastal terraces. Slopes are about 0.5 percent, and the surface is plane to convex. Areas of this soil vary widely in size and shape, but most areas are several hundred acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of Hidalgo and Racombes soils. Also included are a few areas of soils similar to Willacy soils, but they contain secondary lime at a depth of less than 34 inches.

Permeability is moderate, and runoff is medium. A few areas of this soil have been altered by land leveling for irrigation. Some areas have a thick surface layer because of filling operations, and some have a thin surface layer because of cutting operations. All of the surface layer has been removed from a few areas.

This soil is used for irrigated crops, dryfarmed crops, citrus, and pasture (fig. 7). A few areas are in range. Capability units IIc-3, dryland, and I-6, irrigated; pasture and hay group 8C; orchard group A; Sandy Loam range site.

Figure 7.—**Irrigated cotton and citrus on Willacy fine sandy loam, 0 to 1 percent slopes. Palm trees are in the background.**

Willacy fine sandy loam, 1 to 3 percent slopes (WAB).—This soil is on long, narrow coastal terraces generally adjacent to old lakebeds or enclosed depres-

sions. Slopes are dominantly about 2 percent, and the surface is convex. Areas of this soil range from 5 to about 50 acres in size.

The surface layer is dark grayish-brown, noncalcareous fine sandy loam about 16 inches thick. The next layer is brown sandy clay loam about 21 inches thick. The underlying material, extending to a depth of about 60 inches, is pale-brown sandy clay loam.

Included with this soil in mapping are areas of Willacy fine sandy loam, 0 to 1 percent slopes, and Hidalgo soils. Also included are a few areas of soils that are similar to Willacy soils, but they either contain secondary lime at a depth of less than 34 inches, or they are less clayey throughout.

Permeability is moderate, and runoff is medium. A few areas of this soil have been altered by land leveling for irrigation. Some areas have a thin surface layer because of cutting operations, and a few areas have a thick surface layer because of filling operations. All of the surface layer has been removed from a few areas.

This soil is used for irrigated crops, dryfarmed crops, citrus, and pasture. Capability units IIe-3, dryland, and IIe-2, irrigated; pasture and hay group 8C; orchard group B; Sandy Loam range site.

Willamar Series

The Willamar series consists of deep, somewhat poorly drained, noncalcareous soils that are nearly level. These soils are saline and have a high content of sodium below the surface layer. They are on deltas or coastal terraces.

In a representative profile the surface layer is grayish-brown fine sandy loam about 3 inches thick. Below this is gray fine sandy loam about 2 inches thick. The next layer is about 13 inches of dark grayish-brown clay loam that is saline and high in content of exchangeable sodium. The next layer is light brownish-gray, saline clay loam 12 inches thick. The underlying material, extending to a depth of about 60 inches, is very pale brown, saline sandy clay loam.

Permeability is very slow, and runoff is very slow. The available water capacity is very low to low.

Willamar soils are used for dryfarmed crops, pasture, and range.

Representative profile of Willamar fine sandy loam in an area of Willamar soils, in native range, 1.8 miles on General Brandt Road from its junction with Farm Road 2358, then 1.4 miles north on a field road and 100 feet east:

A1—0 to 3 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; extremely hard, friable; mildly alkaline; clear, wavy boundary.

A2—3 to 5 inches, gray (10YR 5/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak, fine, granular structure; soft, very friable; mildly alkaline; abrupt, wavy boundary.

B2t—5 to 18 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong, coarse, columnar structure and strong, medium, angular blocky structure; extremely hard, very firm; prism faces have thin clay coatings of gray (10YR 5/1) dry, and vertical and horizontal faces of blocks have clay or organic coatings of black (10YR 2/1) moist; saline; strongly alkaline; gradual, wavy boundary.

B3ca—18 to 30 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; few, faint and distinct, brownish-yellow mottles; moderate, fine and medium, blocky structure; hard, firm; thin clay films; black thin clay flows in insect tunnels; few weakly cemented concretions and soft masses of calcium carbonate; saline; calcareous; strongly alkaline; gradual, smooth boundary.

Ccasa—30 to 60 inches, very pale brown (10YR 7/4) sandy clay loam, light yellowish brown (10YR 6/4) moist; few to common, distinct, brownish-yellow mottles; massive; hard, friable; few fine pores; few dark stains along old root channels; common films and nests of salts; common soft masses and weakly cemented concretions of calcium carbonate; saline; calcareous; strongly alkaline.

The solum ranges from 20 to 38 inches in thickness. Sodium saturation is more than 15 percent in the B horizon and C horizon and increases with increasing depth.

The A horizon is grayish-brown or gray fine sandy loam or sandy loam 1 to 7 inches thick. It is neutral to mildly alkaline. In cultivated areas the Ap horizon is a mixture of the A and B horizons and is sandy clay loam. In these areas an A2 horizon is lacking. Great differences in thickness occur within short distances of 5 to 20 feet.

The B2t horizon is dark grayish-brown or dark-gray sandy clay loam or clay loam, and the content of clay is 25 to 35 percent. The B3 horizon is grayish-brown or light brownish-gray sandy clay loam or clay loam. The B2t horizon and B3 horizon are mildly alkaline to strongly alkaline.

The C horizon is very pale brown or pale-brown sandy clay loam or clay loam. The C horizon is moderately alkaline or strongly alkaline, and contains as much as 7 or 8 percent, by volume, of weakly cemented concretions and soft masses of calcium carbonate.

Willamar soils (WM).—In this unit are nearly level, somewhat poorly drained soils on coastal terraces. Willamar fine sandy loam makes up about 40 percent of this mapping unit, and Willamar sandy clay loam makes up about 40 percent. In areas of range the surface layer is fine sandy loam. In cultivated areas, the surface layer has been mixed with the underlying material and averages sandy clay loam. Slopes are less than 0.5 percent, and the surface is plane. Areas of this soil are broad and irregularly shaped, and most are several hundred acres in size.

Willamar fine sandy loam has the profile described as representative of the series.

Willamar sandy clay loam has a profile similar to that described as representative of the series, but the surface layer and upper part of the subsoil have been mixed by plowing.

Included with these soils in mapping are areas of Latina, Lyford, and Lozano soils.

Permeability is very slow, and runoff is very slow. If cultivated, these soils crust badly. Salinity is low in the upper 6 to 8 inches of these soils, but at a depth of about 18 inches, it has increased to very high. Areas of this soil are used for irrigated crops, dryfarmed crops, pasture, and range. Capability units IVs-2, dryland, and IIIs-2, irrigated; pasture and hay group 7F; Sandy Coastal Flat range site.

Zalla Series

The Zalla series consists of deep, somewhat excessively drained, calcareous soils that are gently sloping. These soils are on the active flood plain of the Rio Grande. The soil surface is plane to convex.

In a representative profile the surface layer is pale-brown loamy fine sand about 3 inches thick. The underlying material extends to a depth of 63 inches.

In sequence from the top, this material is pale-brown loamy fine sand that is about 15 inches thick and that has thin strata of very fine sandy loam, light-gray silty clay loam that is about 4 inches thick, and light-gray loamy fine sand that is about 41 inches thick and that has thin strata of fine sandy loam.

Permeability is rapid, and runoff is slow. The available water capacity is low.

Zalla soils are used almost entirely for pasture.

Representative profile of Zalla loamy fine sand, in a pasture, 0.4 mile east of junction of U.S. Highway 281 and Farm Road 732, 0.2 mile south on field road, 3.4 miles southeast on IBWC levee, 0.8 mile southwest and 0.5 mile east on a field road, 150 feet south of termination of trail:

A1—0 to 3 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; single grained; loose; very friable, nonsticky; calcareous; moderately alkaline; clear, smooth boundary.

C1—3 to 18 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; single grained, but contains thin strata of very fine sandy loam and bedding planes are evident; few brownish organic stains along root channels; few mica flakes; calcareous; moderately alkaline; abrupt, wavy boundary.

C2—18 to 22 inches, light-gray (10YR 7/2) silty clay loam, brown (10YR 5/3) moist; massive, but bedding planes are evident; common yellowish-brown mottles along pores and cleavage planes; very hard, very firm; calcareous; moderately alkaline; abrupt, wavy boundary.

C3—22 to 63 inches, light-gray (10YR 7/2) loamy fine sand, brown (10YR 5/3) moist; single grained, but bedding planes are evident; loose; thin strata of very fine sandy loam 2 to 4 inches thick; few brownish organic stains along root channels; few mica flakes; calcareous; moderately alkaline.

The average texture of the uppermost 40 inches ranges from loamy fine sand to sand. The A horizon is light brownish gray, brown, pale brown, or very pale brown and ranges from silt loam to loamy fine sand in texture. Textures finer than loamy fine sand are less than 18 inches thick. The C horizon is light brownish gray, pale brown, very pale brown, or light gray. The C horizon, to a depth of about 40 inches, ranges from loamy fine sand to fine sand and has thin strata of silt loam, very fine sandy loam, or silty clay loam. The sediment, below a depth of 40 inches, is stratified and ranges from fine sand to silty clay.

Zalla loamy fine sand (ZA).—This gently sloping soil is in hummocky areas on the flood plain of the Rio Grande. Most areas are in the large inside curves of, and adjacent to, the river (fig. 8); a few are narrow, elongated areas parallel to the river. Areas of this soil range from about 5 to 60 acres in size. Slopes are mainly less than 2 percent but are as much as 5 percent, and the surface is plane to convex.

Included with this soil in mapping are areas of Rio Grande and Camargo soils. Also included are areas of soils consisting of small dunes formed by wind, and small areas of thin overwash that consist of more clayey or silty sediment.

Permeability is rapid, and runoff is slow. Lower areas of this soil are flooded each year by the water released from Falcon Reservoir during peak periods of irrigation. Areas of this soil are idle or are used for pasture. A few areas are used for irrigated crops. Capability unit IIIs-3, irrigated; pasture and hay group 3A.

Figure 8.—**Area of Zalla loamy fine sand on the inside curve of the river.**

Use and Management of the Soils

This section concerns the use and management of the soils of the county for crops, orchard, pasture, range, wildlife habitat, and in engineering works. Also included in this section are interpretations for recreation and use of the soils for gardening and landscaping.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. 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 rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range or engineering.

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

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or to esthetic purposes.

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

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-3 or IIIe-1. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units in Cameron County are described and suggestions for the use and management of the soils are given.

Management by capability units

In the following pages the irrigated and the dryland capability units in Cameron County are described, and suggestions for their use and management are briefly given. All the soils in the county have been placed in dryland capability units, but only those soils suited to irrigation have been placed in irrigated capability units. To find the capability classification of any given mapping unit, refer to the "Guide to Mapping Units."

A properly designed surface irrigation system that provides ditches and pipelines is effective in the soils of Cameron County (fig. 9). Surface systems allow for proper water application to meet soil and crop needs without waste and losses of soil through erosion. Land leveling controls soil erosion and increases the efficiency of water use. The surface irrigation system and land leveling need to be designed to provide for surface drainage to remove excess rainwater.

Fertilizer is added to most of the cropped soils in the county. The amount added is based on previous cropping history, soil tests, results of research, and farm production goals. Help can be obtained from technicians of the Soil Conservation Service or the Agricultural Extension Service in planning fertilizer programs.

Figure 9.—**Level furrow irrigation of cabbage on Laredo silty clay loam, 0 to 1 percent slopes.**

CAPABILITY UNIT I-1, IRRIGATED

This unit consists of deep, nearly level soils on bottom lands. These soils have a surface layer of silt loam. Permeability is moderate, and the available water capacity is high to very high. These soils are subject to flooding.

These soils are well suited to cultivation. The main crops are cotton, grain sorghum, and a wide variety of cool-season vegetables.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. A cropping system that includes such high residue-producing crops as grain sorghum is needed to help maintain soil tilth. Crop residue left on or near the surface helps to prevent surface crusting. Land leveling minimizes soil erosion and increases the efficiency of irrigation. Land-leveling cuts should be made carefully because of the contrasting textures below the surface layer. Undesirable material may be exposed in places. Temporary field ditches are difficult to maintain.

CAPABILITY UNIT I-2, IRRIGATED

This unit consists of deep, nearly level soils on bottom lands. These soils have a surface layer of silty clay loam. Permeability is moderate, and the available water capacity is high to very high. These soils are subject to flooding.

These soils are well suited to cultivation. The main crops are cotton, grain sorghum, and cool-season vegetables.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. A cropping system that includes such high residue-producing crops as grain sorghum is needed to maintain soil tilth. Land leveling controls soil erosion and increases the efficiency of irrigation. Land-leveling cuts should be made carefully because of the contrasting textures below the surface layer. Undesirable material may be exposed in places.

CAPABILITY UNIT I-3, IRRIGATED

The only soil in this unit is Hidalgo fine sandy loam,

0 to 1 percent slopes. It is a deep, nearly level soil. Permeability is moderate, and the available water capacity is medium to high.

This soil is well suited to cultivation. The main crops are cotton, grain sorghum, citrus, and a wide variety of cool-season vegetables.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. A cropping system that includes such high residue-producing crops as grain sorghum is needed to maintain soil tilth. Crop residue left on or near the surface helps to control soil blowing. Land leveling controls soil erosion and increases the efficiency of irrigation. Areas where land-leveling cuts are deeper than about 2 feet need special management practices such as mulching or manuring, to offset the loss of organic matter. The risk of chlorosis increases in the more limy material below a depth of 2 feet. Temporary field ditches are difficult to maintain.

CAPABILITY UNIT I-4, IRRIGATED

This unit consists of deep, nearly level soils that have a surface layer of silt loam, sandy clay loam, or silty clay loam. Permeability is moderate, and the available water capacity is medium to very high.

The soils of this unit are well suited to cultivation. The main crops are cotton, grain sorghum, a wide variety of cool-season vegetables, and some citrus.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to maintain soil tilth. Land leveling controls soil erosion and increases the efficiency of irrigation.

CAPABILITY UNIT I-5, IRRIGATED

The only soil in this unit is Racombes sandy clay loam. It is a deep, nearly level soil. Permeability is moderate, and the available water capacity is high.

This soil is well suited to cultivation. The main crops are cotton, grain sorghum, a wide variety of cool-season vegetables, and some citrus.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to maintain soil tilth. Land leveling controls soil erosion and increases the efficiency of irrigation. The soil in this unit receives extra water as runoff from surrounding areas. Heavy rains cause flooding in places for short periods of time.

CAPABILITY UNIT I-6, IRRIGATED

The only soil in this unit is Willacy fine sandy loam, 0 to 1 percent slopes. It is a deep, nearly level soil. Permeability is moderate, and the available water capacity is medium to high.

This soil is well suited to cultivation. The main crops are cotton, grain sorghum, citrus, and a wide variety of cool-season vegetables.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to maintain soil tilth. Crop residue left on or near the surface helps to control soil blowing. Land leveling controls soil erosion and increases the efficiency of irrigation. Areas where land-leveling cuts are deeper than about 3 feet need such special management practices as mulching or manuring to offset the loss of organic matter. The risk of chlorosis increases in the more limy material below a depth of 3 to 4 feet. Temporary field ditches are difficult to maintain.

CAPABILITY UNIT IIe-1, DRYLAND

The only soil in this unit is Hidalgo fine sandy loam, 1 to 3 percent slopes. It is a deep, gently sloping soil. Permeability is moderate, and the available water capacity is medium to high. The hazard of water erosion is moderate. The hazard of soil blowing is slight.

This soil is suited to cultivation. The main crops are cotton and grain sorghum. The high content of lime in this soil causes chlorosis in grain sorghum.

The main concerns of management are controlling erosion and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to reduce evaporation, improve soil structure, provide a continuing supply of organic material, and to help control erosion. Contour farming helps to reduce soil losses from erosion. Stripcropping helps to control soil blowing.

CAPABILITY UNIT IIe-1, IRRIGATED

The only soil in this unit is Hidalgo fine sandy loam, 1 to 3 percent slopes. It is a deep, gently sloping soil. Permeability is moderate, and the available water capacity is medium to high. The hazard of water erosion is moderate. The hazard of soil blowing is slight.

This soil is suited to cultivation. The main crops are cotton, grain sorghum, citrus, and a wide variety of cool-season vegetables.

The main concerns of management are controlling erosion, maintaining or improving soil condition, and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to maintain soil tilth. Crop residue left on the surface helps to control soil blowing. Land leveling controls soil erosion and increases the efficiency of irrigation. Bench leveling reduces the depth of required land-leveling cuts. Areas that have land-leveling cuts that are deeper than about 2 feet need such special management practices as mulching or manuring to offset the loss of organic material. Chlorosis is a greater risk in the more limy materials below a depth of 2 feet. Temporary field ditches are difficult to maintain.

CAPABILITY UNIT IIe-2, DRYLAND

This unit consists of deep, gently sloping soils that have a surface layer of silty clay loam and silt loam. Permeability is moderate, and the available water capacity is high to very high. The hazard of water erosion is moderate.

These soils are suited to cultivation. The main crops are cotton and grain sorghum.

The main concerns of management are controlling erosion and maintaining or improving soil condition. Cropping systems that include high residue-producing crops are needed to reduce evaporation, improve

soil structure, provide a continuing supply of organic material, and to help control erosion. Contour farming helps to reduce soil losses from erosion.

CAPABILITY UNIT IIe-2, IRRIGATED

The only soil in this unit is Willacy fine sandy loam, 1 to 3 percent slopes. It is a deep, gently sloping soil. Permeability is moderate, and the available water capacity is medium to high. The hazard of water erosion is moderate. The hazard of soil blowing is slight.

This soil is suited to cultivation. The main crops are cotton, grain sorghum, citrus, and a wide variety of cool-season vegetables.

The main concerns of management are controlling erosion, maintaining or improving soil condition, and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to maintain soil tilth. Crop residue left on or near the surface helps to control soil blowing. Land leveling controls soil erosion and increases the efficiency of irrigation. Bench leveling reduces the depth of required land-leveling cuts. Areas that have land-leveling cuts deeper than 3 feet need such special management practices as mulching or manuring to offset the loss of organic matter. The risk of chlorosis is greater in the more limy materials below a depth of 3 to 4 feet. Temporary field ditches are difficult to maintain.

CAPABILITY UNIT IIe-3, DRYLAND

The only soil in this unit is Willacy fine sandy loam, 1 to 3 percent slopes. It is a deep, gently sloping soil. Permeability is moderate, and the available water capacity is medium to high. The hazard of water erosion is moderate. The hazard of soil blowing is slight.

This soil is suited to cultivation. The main crops are cotton and grain sorghum.

The main concerns of management are controlling erosion and maintaining or improving soil condition. Cropping systems that include high residue-producing crops are needed to reduce evaporation, improve soil structure, provide a continuing supply of organic material, and to help control erosion. Contour farming helps to reduce soil losses from erosion. Stripcropping helps to control soil blowing.

CAPABILITY UNIT IIe-3, IRRIGATED

This unit consists of deep, gently sloping soils that have a surface layer of silty clay loam and silt loam. Permeability is moderate, and the available water capacity is high to very high. The hazard of water erosion is moderate.

These soils are suited to cultivation. The main crops are cotton, grain sorghum, a wide variety of cool-season vegetables, and some citrus.

The main concerns of management are controlling erosion, maintaining or improving soil condition, and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to maintain soil tilth. Land leveling minimizes soil erosion and increases the efficiency of irrigation. Bench leveling reduces the depth of the cuts required for land-leveling.

CAPABILITY UNIT IIw-1, DRYLAND

This unit consists of deep, nearly level to gently sloping soils that have a surface layer of fine sandy loam. These soils have a seasonal high saline water table. Permeability is moderately slow, and the available water capacity is medium to high. The hazard of soil blowing is slight.

These soils are suited to crops. The main crops are cotton and grain sorghum.

The main concerns of management are conserving moisture and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure, reduce evaporation, and provide a continuing supply of organic material. Residue left on the surface helps to reduce evaporation which brings harmful salts to the surface from the saline ground water. Mulches, such as cotton burs, are also beneficial. Stripcropping helps to control soil blowing.

CAPABILITY UNIT IIw-1, IRRIGATED

This unit consists of deep, nearly level to gently sloping soils that have a surface layer of fine sandy loam. These soils have a seasonal high saline water table. Permeability is moderately slow, and the available water capacity is medium to high. The hazard of soil blowing is slight.

These soils are suited to crops. The main crops are cotton, grain sorghum, and a wide variety of cool-season vegetables.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to maintain soil tilth. Residue left on or near the surface help to reduce evaporation, which brings harmful salts to the surface. Mulches, such as cotton burs, are also beneficial. Land leveling controls soil erosion and increases the efficiency of irrigation. Tile drains help to lower the seasonal high water table. Areas where land-leveling cuts are deeper than about 2 feet need such special management practices as mulching or manuring to offset the loss of organic matter. The risk of chlorosis is greater in the more limy material below a depth of 2 feet. Temporary field ditches are difficult to maintain.

CAPABILITY UNIT IIw-2, DRYLAND

The only soil in this unit is Lyford sandy clay loam. It is a deep, nearly level soil that has a seasonal high saline water table. Permeability is moderate, and the available water capacity is medium to high.

This soil is suited to crops. The main crops are cotton and grain sorghum.

The main concerns of management are conserving moisture and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure, reduce evaporation, and provide a continuing supply of organic material. Residue left on the surface helps to reduce evaporation which brings harmful salts to the surface from the saline ground water. Mulches, such as cotton burs, are also beneficial.

CAPABILITY UNIT IIw-2, IRRIGATED

The only soil in this unit is Lyford sandy clay loam. It is a deep, nearly level soil that has a seasonal high saline water table. Permeability is moderate, and the available water capacity is medium to high.

This soil is suited to crops. The main crops are cotton, grain sorghum, and a wide variety of cool-season vegetables.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and maintain soil tilth. Land leveling increases the efficiency of irrigation, and tile drains help to lower the seasonal high water table.

CAPABILITY UNIT IIs-1, DRYLAND

This unit consists of deep, nearly level soils that have a surface layer of clay loam and silty clay. Permeability is moderately slow to slow, and the available water capacity is medium to high.

These soils are suited to cultivation. The main crops are cotton and grain sorghum.

The main concerns of management are conserving soil moisture and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and to conserve moisture. These soils receive extra water as runoff from surrounding areas. In years of above average rainfall or heavy rains, the soils are flooded in places for short periods of time.

CAPABILITY UNIT IIs-1, IRRIGATED

This unit consists of deep, nearly level soils that have a surface layer of clay loam and silty clay. Permeability is moderately slow to slow, and the available water capacity is medium to high.

These soils are suited to cultivation. The main crops are cotton, grain sorghum, and a few such cool-season vegetables as onions, carrots, bell peppers, and okra. The soils of this unit are poorly suited to citrus.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and maintain soil tilth. Land leveling increases the efficiency of irrigation.

CAPABILTY UNIT IIs-2, DRYLAND

The only soil in this unit is Rio clay loam. It is a deep, nearly level soil that has a surface layer of clay loam. Permeability is slow, and the available water capacity is medium to high.

This soil is suited to cultivation. The main crops are cotton and grain sorghum.

The main concerns of management are conserving soil moisture and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and to conserve soil moisture. This soil is subject to flooding, and in places surface drains are needed to remove ponded water.

CAPABILITY UNIT IIs-2, IRRIGATED

The only soil in this unit is Rio clay loam. It is a deep, nearly level soil. Permeability is slow, and the available water capacity is medium to high.

This soil is suited to cultivation. The main crops are cotton and grain sorghum. This soil is poorly suited to citrus.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and maintain soil tilth. Land leveling increases the efficiency of irrigation. This soil is subject to flooding, and in places surface drains are needed to remove ponded water.

CAPABILITY UNIT IIs-3, DRYLAND

The only soils in this unit are in the Laredo-Olmito complex. These are deep, nearly level soils that have a surface layer of silty clay loam and silty clay. Permeability is moderate to slow, and the available water capacity is medium to very high.

These soils are suited to cultivation, but uniform growth and production are difficult to achieve. The main crops are cotton and grain sorghum.

The main concerns of management are conserving moisture and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and to reduce evaporation.

CAPABILITY UNIT IIs-3, IRRIGATED

This unit consists of deep, nearly level soils that have a surface layer of silty clay loam, silt loam, and silty clay. Permeability is moderate to slow, and the available water capacity is medium to very high.

These soils are suited to cultivation, but uniform growth and production are difficult to achieve. The main crops are cotton, grain sorghum, and cool-season vegetables.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and maintain soil tilth. Uniform application of irrigation water is difficult on these soils, but land leveling increases the efficiency of irrigation.

CAPABILITY UNIT IIs-4, IRRIGATED

The only soil in this unit is Laredo silty clay loam, saline. It is a deep, nearly level to gently sloping soil that contains excess soluble salts within the root zone. Permeability is moderate, and the available water capacity is very low to medium. A seasonal high saline water table is at a depth of 2 to 5 feet.

This soil can be cultivated, but special management and careful selection of crops are necessary. The main crop is cotton. Grain sorghum and a few vegetables are grown in some of the less saline areas.

The main concerns of management are maintaining or improving soil condition, adapting cropping systems to the soil limitations, and managing irrigation water. Crop residue should be left on the surface to help reduce evaporation that brings harmful salts to the surface. Mulches, such as cotton burs, also help to

reduce evaporation. Land leveling increases the efficiency of irrigation, and tile drains help to provide uniform leaching of harmful salts.

CAPABILITY UNIT IIc-1, DRYLAND

The only soil in this unit is Hidalgo fine sandy loam, 0 to 1 percent slopes. It is a deep, nearly level soil that has a surface layer of fine sandy loam. Permeability is moderate, and the available water capacity is high to very high.

This soil is well suited to cultivation. The main crops are cotton and grain sorghum, but the high content of lime in this soil causes chlorosis in grain sorghum.

The main concerns of management are conserving soil moisture and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to reduce evaporation, improve soil structure, provide a continuing supply of organic material, and control soil blowing. Stripcropping or wind strips help to reduce soil blowing.

CAPABILITY UNIT IIc-2, DRYLAND

This unit consists of deep, nearly level soils that have a surface layer of silt loam, sandy clay loam, or silty clay loam. Permeability is moderate, and the available water capacity is medium to very high.

The soils of this unit are well suited to cultivation. The main crops are cotton and grain sorghum.

The main concerns of management are conserving soil moisture and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to reduce evaporation, improve soil structure, and to provide a continuing supply of organic material.

CAPABILITY UNIT IIc-3, DRYLAND

The only soil in this unit is Willacy fine sandy loam, 0 to 1 percent slopes. It is a deep, nearly level soil that has a surface layer of fine sandy loam. Permeability is moderate, and the available water capacity is medium to high. The hazard of soil blowing is slight to moderate.

This soil is well suited to cultivation. The main crops are cotton and grain sorghum.

The main concerns of management are conserving soil moisture and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to reduce evaporation, improve soil structure, provide a continuing supply of organic material, and to control soil blowing. Stripcropping helps to control soil blowing.

CAPABILITY UNIT IIc-4, DRYLAND

The only soil in this unit is Racombes sandy clay loam. It is a deep, nearly level soil. Permeability is moderate, and the available water capacity is high.

This soil is well suited to cultivation. The main crops are cotton and grain sorghum.

The main concerns of management are conserving moisture and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to reduce evaporation, improve soil structure, and to provide a continuing supply of organic material. The soils of this unit receive extra water as runoff from surrounding areas. During years of above average rainfall or heavy rains, the soils are flooded in places for short periods of time.

CAPABILITY UNIT IIIe-1, DRYLAND

The only soil in this unit is Mercedes clay, 1 to 3 percent slopes. It is a deep, gently sloping soil. The intake of water is high when the soil is dry and cracked, but permeability is very slow when the soil is wet. The available water capacity is low to high. The hazard of water erosion is moderate.

This soil is suited to crops. The main crops are cotton and grain sorghum.

The main concerns of management are controlling erosion and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and to reduce the hazard of erosion. Oats, forage sorghum, or another cover crop is also beneficial.

CAPABILITY UNIT IIIe-1, IRRIGATED

The only soil in this unit is Mercedes clay, 1 to 3 percent slopes. It is a deep, gently sloping soil. The intake of water is high when the soil is dry and cracked, but permeability is very slow when the soil is wet. The available water capacity is low to high. The hazard of water erosion is moderate.

This soil is suited to cultivation. The main crops are cotton and grain sorghum.

The main concerns of management are controlling erosion, maintaining or improving soil condition, and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and maintain soil tilth. A cover crop of oats, forage sorghum, or clover is also beneficial. Land leveling controls soil erosion and increases the efficiency of irrigation.

CAPABILITY UNIT IIIs-1, DRYLAND

This unit consists of deep, level soils that have a surface layer of clay. The intake of water is high when the soil is dry and cracked, but permeability is very slow when the soil is wet. The available water capacity is low to high.

These soils are suited to crops. The main crops are cotton and grain sorghum.

The main concerns of management are controlling erosion and maintaining or improving soil condition. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and conserve moisture. Oats, forage sorghum, or another cover crop is also beneficial. In some areas surface drains are needed to remove ponded water after heavy rains.

CAPABILITY UNIT IIIs-1, IRRIGATED

This unit consists of deep, level soils that have a surface layer of clay. The intake of water is high when the soil is dry and cracked, but permeability is very slow when the soil is wet. The available water capacity is low to high.

These soils are suited to cultivation. The main

crops are cotton, grain sorghum, and a few such cool-season vegetables as carrots and onions.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Cropping systems that include such high residue-producing crops as grain sorghum are needed to improve soil structure and maintain soil tilth. Oats, forage sorghum, or another cover crop is also beneficial. In some areas surface drains are needed to remove ponded water after heavy rains. Land leveling increases the efficiency of irrigation.

CAPABILITY UNIT IIIs-2, DRYLAND

The only soil in this unit is Laredo silty clay loam, saline. It is a deep, nearly level to gently sloping soil that has excess soluble salts in the root zone. Permeability is moderate, and the available water capacity is very low to medium.

These soils can be cultivated, but special management and careful selection of crops are necessary. The main crop is cotton. Grain sorghum is grown in some of the less saline areas.

The main concerns of management are maintaining or improving soil condition and adapting cropping systems to soil limitations. Crop residue should be left on the surface to help reduce evaporation, which brings harmful salts to the surface. Mulches, such as cotton burs, are also beneficial. Tile drains help to provide uniform leaching of harmful salts.

CAPABILITY UNIT IIIs-2, IRRIGATED

The only soils in this unit are Willamar soils. These are deep, nearly level, saline soils that have a surface layer of fine sandy loam and sandy clay loam. They have a seasonal high water table. Permeability is very slow, and the available water capacity is low to very low.

These soils can be cultivated, but special management and careful selection of crops are necessary. The main crops are cotton and grain sorghum.

The main concerns of management are maintaining or improving soil condition, adapting cropping systems to the soil limitations, and managing irrigation water. Crop residue should be left on or near the surface to help reduce evaporation and surface crusting. Mulches, such as cotton burs, are also beneficial. Soil salinity increases with increasing depth, and deep plowing should be avoided because it brings to the surface those materials that are higher in salt content. Land leveling increases the efficiency of irrigation.

CAPABILITY UNIT IIIs-3, IRRIGATED

This unit consists of deep, nearly level to gently sloping soils that have a surface layer of loamy fine sand and silt loam. Permeability is rapid to moderate, and the available water capacity is low to high. In places the soils are loamy fine sand, but in other places they are loamy fine sand and silt loam that are intricately mixed.

These soils can be cultivated, but most areas are idle or are used for pasture.

The main concerns of managment are maintaining or improving soil condition, adapting cropping systems to the soil limitations, and managing irrigation water. Crop residue should be left on or near the surface to control soil blowing. Efficient irrigation by sprinkler helps to conserve water.

CAPABILITY UNIT IIIs-4, IRRIGATED

This unit consists of deep, nearly level, saline soils that have a surface layer of clay loam or silty clay. Permeability is moderately slow to slow, and the available water capacity is very low to medium.

These soils can be cultivated, but special management and careful selection of crops are necessary. The main crop is cotton, but grain sorghum is grown in some of the less saline areas.

The main concerns of management are maintaining or improving soil condition, adapting cropping systems to soil limitations, and managing irrigation water. Crop residue should be left on or near the surface to reduce evaporation and surface crusting. Mulches, such as cotton burs, are also beneficial. Land leveling increases the efficiency of irrigation, and tile drains help to provide uniform leaching of harmful salts.

CAPABILITY UNIT IVe-1, DRYLAND

The only soil in this unit is Galveston fine sand, hummocky. It is a deep, nearly level to sloping soil. Permeability is rapid, and the available water capacity is low. The hazard of soil blowing is severe.

This soil is suited to limited cultivation, but special management and careful selection of crops are necessary. The soil in this unit is not cultivated. It is used for recreation, wildlife habitat, and range.

CAPABILITY UNIT IVe-2, DRYLAND

The only soil in this unit is Mercedes clay, loamy substratum, 1 to 5 percent slopes. It is a deep, gently sloping soil. The intake of water is high when the soil is dry and cracked, but permeability is very slow when the soil is wet. The available water capacity is low to high. The hazard of water erosion is severe.

This soil is suited to limited cultivation, but special management and careful selection of crops are necessary. Most of the soil in this unit is left idle or is used for pasture or as wildlife habitat.

CAPABILITY UNIT IVw-1, IRRIGATED

The only soil in this unit is Benito clay. It is a deep, level to slightly depressional, saline soil. The intake of water is high when the soil is dry and cracked, but permeability is very slow when the soil is wet.

This soil can be cultivated, but special management and careful selection of crops are necessary. The main crop is cotton. Although poorly suited to this soil, grain sorghum is also grown; the soil is better suited to pasture.

The main concerns of management are maintaining or improving soil conditon, adapting cropping systems to the soil limitations, and managing irrigation water. Crop residue should be left on or near the surface. Mulches, such as cotton burs, are also beneficial. Land leveling increases the efficiency of irrigation. Surface drains are needed to remove excess water from this soil.

CAPABILITY UNIT IVw-2, IRRIGATED

The only soil in this unit is Grulla clay. It is a deep, nearly level soil. Permeability is very slow, and the

available water capacity is medium to high. This soil is subject to flooding.

This soil can be cultivated, but loss of crops is a risk because of flooding. The main crops are cotton, grain sorghum, and some cool-season vegetables.

The main concerns of management are maintaining or improving soil condition and managing irrigation water. Crop residue should be left on or near the surface. Land leveling increases the efficiency of irrigation. Surface drains are needed to remove ponded water.

CAPABILITY UNIT IVs-1, DRYLAND

The only soil in this unit is Harlingen clay, saline. It is a deep, level, saline soil. The intake of water is high when the soil is dry and cracked, but permeability is very slow when the soil is wet. The available water capacity is very low to medium.

This soil can be cultivated, but special management and careful selection of crops are necessary. The main crop is cotton, but most areas are better suited to pasture.

The main concerns of management are maintaining or improving soil condition and adapting cropping systems to the soil limitations. Crop residue should be left on the surface to reduce evaporation. Mulches, such as cotton burs, also are beneficial. Because of the high content of clay in this soil, tile drainage systems cannot be used to leach out harmful salts. In some areas surface drains are needed to remove ponded water after heavy rains.

CAPABILITY UNIT IVs-1, IRRIGATED

The only soil in this unit is Harlingen clay, saline. It is a deep, level, saline soil. The intake of water is high when the soil is dry and cracked, but permeability is very slow when the soil is wet. The available water capacity is very low to medium.

This soil can be cultivated, but special management and careful selection of crops are necessary. The main crop is cotton, but most areas are better suited to pasture.

The main concerns of management are maintaining or improving soil condition, adapting cropping systems to the soil limitations, and managing irrigation water. Crop residue should be left on the surface to reduce evaporation and improve soil structure. Mulches, such as cotton burs, are also beneficial. Land leveling increases the efficiency of irrigation. Because of the high content of clay in this soil, tile drainage systems cannot be used to leach out harmful salts. Some areas need surface drains to remove ponded water after heavy rains.

CAPABILITY UNIT IVs-2, DRYLAND

The only soils in this unit are Willamar soils. These are deep, nearly level, saline soils that have a surface layer of fine sandy loam or sandy clay loam. They have a seasonal high water table. Permeability is very slow, and the available water capacity is very low to low.

These soils can be cultivated, but special management and careful selection of crops are necessary. The main crops are cotton and grain sorghum.

The main concerns of management are maintaining or improving soil condition and adapting cropping systems to the soil limitations. Crop residue should be left on or near the surface to reduce evaporation and surface crusting. Mulches, such as cotton burs, are also beneficial. Soil salinity increases with increasing depth, and deep plowing should be avoided because it brings to the surface those materials that are higher in salt content.

CAPABILITY UNIT IVs-3, DRYLAND

This unit consists of deep, nearly level, saline soils that have a surface layer of clay loam and silty clay. Permeability is moderately slow to slow, and the available water capacity is very low to medium.

These soils can be cultivated, but special management and careful selection of crops are necessary. The main crop is cotton. Grain sorghum is grown in some of the less saline areas.

The main concerns of management are maintaining or improving soil condition and adapting cropping systems to the soil limitations. Crop residue should be left on the surface to reduce evaporation and surface crusting. Mulches, such as cotton burs, are also beneficial. Tile drains help to provide uniform leaching of harmful salts.

CAPABILITY UNIT Vw-1, DRYLAND

The only soil in this unit is Tiocano clay. It is a deep, nearly level to depressional soil that has a surface layer of clay. Permeability is very slow, and the available water capacity is medium to high. This soil is subject to frequent flooding.

Areas of this soil are not suitable for cultivation, but are better suited to pasture or wildlife habitat.

CAPABILITY UNIT VIe-1, DRYLAND

The only soil in this unit is Point Isabel clay loam. It is a deep, gently sloping to sloping soil. Permeability is slow, and the available water capacity is very low to medium. The hazard of erosion is severe.

Areas of this soil are not suitable for cultivation but are better suited to range or wildlife habitat.

CAPABILITY UNIT VIw-1, DRYLAND

The only soil in this unit is Mustang fine sand. It is a deep, nearly level to gently sloping soil. Permeability is rapid above the water table, which is within 3 feet of the surface. The available water capacity is very low.

Areas of this soil are not suitable for cultivation but are better suited to recreation, wildlife habitat, or range.

CAPABILITY UNIT VIs-1, DRYLAND

The only soil in this unit is Benito clay. It is a deep, nearly level to slightly depressional, saline soil. The intake of water is high when the soil is dry and cracked, but permeability is very slow when the soil is wet. The available water capacity is low to very low.

Areas of this soil are not suitable for cultivation but are better suited to pasture, range, or wildlife habitat.

CAPABILITY UNIT VIs-2, DRYLAND

The only soil in this unit is Latina sandy clay loam. It is a deep, nearly level, saline soil. Permeability is slow, and the available water capacity is very low.

Areas of this soil are not suitable for cultivation but are better suited to range or wildlife habitat.

CAPABILITY UNIT VIIs-1, DRYLAND

The only soil in this unit is Lomalta clay. It is a deep, nearly level to slightly depressional, saline soil that is only a few feet above tidal water. Permeability is very slow, and the available water capacity is very low.

Areas of this soil are not suitable for cultivation but are better suited to range or wildlife habitat.

CAPABILITY UNIT VIIs-2, DRYLAND

The only soil in this unit is Sejita silty clay loam. It is a deep, nearly level, saline soil that is only a few feet above tidal water. Permeability is moderately slow, and the available water capacity is very low.

Areas of this soil are not suitable for cultivation, but are better suited to range or wildlife habitat.

CAPABILITY UNIT VIIIs-1, DRYLAND

The only land type in this unit is Coastal dunes. It consists of deep, gently sloping to steep, loose sand that is subject to shifting by wind and tide. Most areas are unstable, but some are partly stable. Use of this unit is limited to recreation and wildlife habitat. The areas should be protected so as to permit the growth of native grasses and weeds in order to control soil blowing.

CAPABILITY UNIT VIIIs-2, DRYLAND

This unit consists of deep, nearly level to gently sloping, saline, barren soils that have a surface layer of sand or clay. Most areas are at or near sea level, but some are below sea level. Most areas are frequently flooded. A water table is at or near the surface throughout the year.

Areas of these soils support no vegetation because of the salinity. These soils are used mainly for wildlife habitat and recreation.

CAPABILITY UNIT VIIIs-3, DRYLAND

The only soil in this unit is Ustifluvents, clayey. It consists of nearly level to steep silty and clayey materials that have been excavated from canals and ditches or from the bottoms of lagoons and bays. Permeability is very slow.

Areas of this soil are not suitable for crops or pasture. They are better suited to wildlife habitat or urban development than to most other uses. The salinity of this soil is very high and prevents the growth of most plants.

Predicted Yields

Table 2 lists predicted yields of the main crops grown in the county on irrigated and nonirrigated soils. The estimates are based on information taken from research data and on interviews with farmers

TABLE 2.—*Predicted average acre yields of principal crops under a high level of management*

[Dashes indicate that yields were not estimated. The Urban land part of mapping units BU, HE, HU, LG, LO, MM, ON, PU, RDX, RM, RU, and SU is not considered suited to the crops specified and is not listed in this table]

Soil series and map symbols	Carrots, irrigated	Cotton (lint)		Grain sorghum		Onions, irrigated	Pasture		Grapefruit	Oranges
		Nonirrigated	Irrigated	Nonirrigated	Irrigated		Nonirrigated	Irrigated		
	Tons	*Lb*	*Lb*	*Lb*	*Lb*	*50-lb sacks*	*AUM* [1]	*AUM* [1]	*Boxes*	*Boxes*
Barrada: BA										
Benito: BE, BU	4	150	250		2,000	225	3.0	3.5		
Camargo: CA, CC	16		1,100		7,100	850		10.5		
Cameron:										
CE	13		900		6,600	700		10.5		
CF	5	150	360		2,250	270	3.0	4.0		
Chargo: CH	5	150	360		2,250	270	3.0	4.0		
Coastal beach: CO										
Coastal dunes: CU										
Delfina: DE	12	375	900	3,000	5,600	675	5.5	10.5	325	225
Galveston: GA										
Grulla: GR	7		450		4,000	360		10.0		
Harlingen:										
HA, HE	15	350	1,100	3,500	7,000	850	5.0	13.0		
HC	4	150	300		1,800	225	3.0	3.5		
Hidalgo:										
HGA, HO, HU	17	450	1,200	3,000	7,500	900	7.0	14.0	375	270
HGB	14	380	950	2,400	6,000	720	6.0	14.0	375	270

TABLE 2.—*Predicted average acre yields of principal crops under a high level of management—Continued*

Soil series and map symbols	Carrots, irrigated	Cotton (lint)		Grain sorghum		Onions, irrigated	Pasture		Grapefruit	Oranges
		Nonirrigated	Irrigated	Nonirrigated	Irrigated		Nonirrigated	Irrigated		
	Tons	*Lb*	*Lb*	*Lb*	*Lb*	*50-lb sacks*	*AUM* [1]	*AUM* [1]	*Boxes*	*Boxes*
Laredo:										
LAA, LD, LEA, LG	17	500	1,200	4,000	7,500	900	8.0	14.0	375	270
For the Olmito part of LD and the Reynosa part of LEA, see the Olmito and Reynosa series.										
LAB, LEB	14	425	950	3,400	6,000	720	8.0	14.0	375	270
For the Reynosa part of LEB, see the Reynosa series.										
LC	5	150	360		2,250	270	3.0	4.0		
Latina: LK										
Lomalta: LM, LO										
Lozano: LR	12	375	900	3,000	5,600	675	5.5	10.0		
Lyford: LY	12	400	900	3,200	5,600	675	6.0	10.0		
Matamoros: MA, MC	15		1,000		6,750	810		12.5		
For the Rio Grande part of MC, see the Rio Grande series.										
Mercedes:										
MEA, MM	15	400	1,100	3,400	7,100	850	6.0	13.0		
MEB	10	240	725	2,400	4,500	540	5.0	13.0		
MGC		200		2,000			5.0	12.0		
Mustang: MS, MU										
Olmito: OM, ON	13	425	900	3,400	5,800		6.5	10.5		
Orelia variant: OR	4	150	300		2,000	225	3.0	3.5		
Point Isabel: PO, PU							3.0			
Racombes: RA, RDX	17	500	1,000	3,500	7,500	900	8.0	14.0	325	225
Raymondville:										
RE, RM	13	425	900	3,400	5,800	700	6.5	10.5		
RG	5	150	360		2,250	270	3.0	4.0		
Reynosa	16	375	1,100	3,000	7,100	850	7.0	11.0		
Mapped only in a complex with Laredo soils.										
Rio: RO	10	240	725	2,400	4,500	540	4.0	8.5		
Rio Grande: RR, RT, RU, RZ	16		1,100		7,100	850		13.0		
For the Zalla part of RZ, see the Zalla series.										
Sejita: SE, SU										
Tiocano: TC										
Ustifluvents, clayey: USX										
Willacy:										
WAA	17	500	1,200	4,000	7,500	900	8.0	14.0	380	310
WAB	14	425	950	3,400	6,000	810	8.0	14.0	380	310
Willamar: WM		150	360	1,200	2,250		3.0	4.0		
Zalla: ZA							2.0	3.0		

[1] AUM is animal-unit-months, a term used to express the carrying capacity of pasture. It is the number of months during the year that 1 acre will provide grazing for 1 animal unit (one cow, one horse, one mule, five hogs, or seven sheep) without damage to the pasture.

and others who have knowledge of yields in the county. The yields are average yields that can be expected by commercial farmers at the level of management that tends to produce the highest economic return per acre.

Yields are given for irrigated and nonirrigated soils if the soils are used for both methods of farming, otherwise, yields for only one method are given. Not included in this table are soils that are used only as range or for recreation.

Crops other than those shown in table 2 are grown in the county, but their yields are not included because their acreage is small or reliable data on yields are not available.

The predicted yields given in table 2 can be expected if the following management practices are used:

For nonirrigated soils:

1. Rainfall is effectively used and conserved.
2. Surface or subsurface drainage systems, or both, are installed.
3. Crop residue is managed to maintain soil tilth.
4. Minimum but timely tillage is used.
5. Measures to control insects, plant diseases, and weeds are consistently used.
6. Fertilizer is applied according to soil test and crop needs.
7. Adapted crop varieties are used at recommended seeding rates.

For irrigated soils, the following additional practices are used:

8. Irrigation water of suitable quality is applied.
9. Irrigation is timed to meet the need of the soil and crops.
10. Irrigation systems are properly designed and effectively used.

Suitability of the Soils for Specified Yard and Garden Plants

Homeowners, businesses, garden clubs, and others who want to landscape and garden need to know what kinds of soil they have on their property and what kinds of flowers, shrubs, and trees are best suited to their soils (fig. 10).

The ideal soils for yard and garden plants are those that have a deep root zone, a loamy texture, a balanced supply of nutrients, large amounts of organic matter in various stages of decomposition, adequate available water capacity, good drainage, a granular or crumb structure that allows free movement of water, air, and roots, and a degree of acidity or alkalinity suitable for the particular plants to be grown. Roses, annual flowers, most vegetables, grasses, and most other plants, grow best in soils that are neutral or only slightly acid (pH of 6.1 to 7.3). In this county, plants requiring an acid soil should not be planted, unless sufficient acid is provided and maintained.

Of the many kinds of soil in Cameron County, some differ considerably from the ideal in texture, reaction, permeability, and other characteristics that affect their suitability for flowers, shrubs, and trees. Success in gardening and landscaping depends on recog-

Figure 10.—**Landscaping and beautification on Laredo silty clay loam, 1 to 3 percent slopes.**

nizing the limitations of the soils for such uses and on the use of management practices that offset the limitations as much as possible. The main factors that affect gardening in this county are high temperatures for long periods and alkalinity of the soil and water.

Yard and garden suitability groups

In table 3 the soils in the county are grouped according to texture, reaction, salinity, and other characteristics that affect their suitability for gardening and landscaping. Each group is rated according to the relative suitability of the soils for specified plants, and some of the limitations and management needs are noted.

The ratings used in table 3 are *good, fair,* and *poor.* A rating of *good* indicates that the soil properties are generally favorable and that limitations can be easily overcome. A rating of *fair* means that the soil properties are moderately favorable, but the soils have one or two major limitations that can be overcome or modified with planning and special practices. A rating of *poor* indicates that the soil properties are generally unfavorable. Limitations are difficult and costly to modify or overcome, requiring major soil reclamation, special planning, and intensive management.

In the following paragraphs, the yard and garden suitability groups in Cameron County are described and the soil series in each group are named. Not all soils of a given series are necessarily in the same group. To find the yard and garden suitability group of each soil, refer to the "Guide to Mapping Units" at the back of this survey.

TABLE 3.—*Suitability of the soils for specified yard and garden plants*

Plant	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Flowers:						
Amaryllis	Good: fertilize each year, add organic matter.	Good: fertilize each year, add organic matter.	Good: fertilize each year, add organic matter.	Good: fertilize each year, add organic matter.	Fair: fertilize each year.	Poor.
Aster, annual	Good: fertilize, add organic matter.	Fair: too limy, chlorosis is a problem; fertilize, add organic matter.	Fair: too limy, slow permeability; fertilize, add organic matter.	Fair: too limy, slow permeability; fertilize, add organic matter.	Poor	Poor.
Bird-of-paradise	Good: fertilize, add organic matter, keep moist.	Fair: too limy; keep moist, fertilize, add organic matter.	Fair: too limy, slow permeability.	Fair: too limy, too clayey.	Poor	Poor.
Caladium	Good: water regularly.	Fair: too limy, but plant may adapt.	Fair: too limy, slow permeability.	Fair: too limy, poor internal drainage.	Poor	Poor.
Chrysanthemum	Good: fertilize, keep in good tilth.	Fair: too limy, but plant may adapt.	Fair: too limy, slow internal drainage.	Fair: too limy, too clayey.	Poor	Poor.
Geranium	Good: fertilize regularly.	Fair: too limy, chlorosis is a problem.	Fair: too limy, slow internal drainage.	Fair: too limy, slow internal drainage.	Poor	Poor.
Dahlia	Good: water regularly, fertilize.	Fair: too limy; water and fertilize regularly.	Fair: too limy, slow internal drainage.	Fair: too limy, too clayey.	Poor	Poor.
Daisy	Good: fertilize, add organic matter.	Good: fertilize, add organic matter.	Good: fertilize, add organic matter.	Fair: too clayey; add organic matter.	Poor	Poor.
Day lily	Good: fertilize, keep in good tilth.	Fair: too limy; fertilize, keep in good tilth.	Fair: too limy, poor internal drainage.	Fair: too limy and too clayey, but plant may adapt.	Poor	Poor.
Lily	Good: fertilize, keep in good tilth.	Fair: too limy; fertilize, keep in good tilth.	Fair: too limy, poor internal drainage.	Fair: too limy, poor internal drainage.	Fair: fertilize each year, add organic matter.	Poor.

TABLE 3.—*Suitability of the soils for specified yard and garden plants—Continued*

Plant	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Flowers—Continued						
Marigold	Good: fertilize, keep in good tilth.	Good: keep in good tilth.	Good: add organic matter, keep in good tilth.	Fair: add organic matter, keep in good tilth.	Poor	Poor.
Pansy	Good: water often, fertilize with phosphate.	Good: fertilize with phosphate.	Fair: slow permeability; fertilize with phosphate.	Fair: slow permeability, too clayey.	Poor	Poor.
Petunia	Good	Good	Good	Fair	Poor	Poor.
Periwinkle	Good	Good	Good	Fair	Poor	Poor.
Snapdragon	Good: water regularly.	Fair: too limy, fertilize, water regularly.	Fair: too limy, poor internal drainage; water regularly.	Poor: too limy, too clayey; water regularly.	Poor	Poor.
Sweetpea	Good: keep in good tilth.	Fair: too limy; fertilize, add organic matter.	Fair: too limy, poor internal drainage.	Poor: too limy, too clayey, root growth limited.	Poor	Poor.
Zinnia	Good	Good	Good	Fair: too clayey.	Poor	Poor.
Shrubs:						
Barbados-cherry	Good	Good	Good: keep in good tilth.	Fair: too clayey.	Poor	Poor.
Bougainvillaea	Good	Good: young plants may develop chlorosis.	Fair: add organic matter, keep in good tilth.	Fair: keep in good tilth, add organic matter.	Poor	Poor.
Boxwood	Good	Fair: too limy; add chelates.	Fair: too limy; add chelates.	Fair: too limy; add chelates.	Poor	Poor.
Cenizo	Good	Good	Good	Fair: poor drainage.	Fair	Poor.
Copper leaf	Good	Good	Fair: poor internal drainage.	Fair: poor internal drainage.	Poor	Poor.
Firecracker bush	Good	Good	Good	Fair: too clayey, poor internal drainage.	Poor	Poor.
Gardenia	Fair: fertilize twice a year, water regularly.	Poor: too limy; fertilize, water regularly.	Poor: too limy, poor internal drainage.	Poor: too limy, poor internal drainage.	Poor	Poor.
Hibiscus	Good: fertilize, water often.	Fair: too limy; fertilize, water often.	Poor: poor internal drainage.	Poor: too clayey, poor internal drainage.	Poor	Poor.
Hydrangea	Fair: not acid enough; add organic matter, fertilize, and water regularly.	Poor: too limy; chlorosis is a problem.	Poor: too limy, slow permeability.	Poor: too limy, too clayey.	Poor	Poor.
Jasmine, yellow	Good: fertilize, keep in good tilth.	Good: fertilize, keep in good tilth.	Good: fertilize, keep in good tilth.	Fair: too clayey; fertilize, keep in good tilth.	Poor	Poor.

TABLE 3.—*Suitability of the soils for specified yard and garden plants—Continued*

Plant	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Shrubs—Continued						
Ligustrum (Privet)	Good	Fair: too limy	Fair: too limy, poor internal drainage.	Fair: too limy, poor internal drainage.	Poor	Poor.
Natal-plum (Carissa)	Good	Fair: too limy	Fair: too limy, poor internal drainage.	Fair: too limy, poor internal drainage.	Poor	Poor.
Oleander	Good	Good	Good	Good	Fair: water regularly.	Poor: plants may adapt.
Pfitzer juniper	Good	Good	Fair: poor internal drainage.	Fair: poor internal drainage.	Poor	Poor.
Philodendron	Good	Fair: too limy	Fair: too limy	Poor: too limy, too clayey.	Poor	Poor.
Pittosporum	Good	Fair: too limy; add chelates.	Fair: too limy: add chelates.	Fair: too limy; add chelates.	Poor	Poor.
Plumbago, blue	Good	Good	Good	Fair: poor internal drainage.	Poor	Poor.
Pyracantha	Good	Fair: too limy; add chelates.	Fair: too limy; add chelates.	Fair: too limy; add chelates.	Poor	Poor.
Roses, common root stock.	Fair: not acid enough; fertilize, water regularly.	Poor: too limy; add chelates.	Poor: too limy, poor internal drainage.	Poor: too limy, poor internal drainage.	Poor	Poor.
Roses, Mexican root stock.	Good	Fair: keep in good tilth.	Poor	Poor	Poor	Poor.
Cacti and succulents:						
Aloe vera	Good	Good	Good	Fair	Fair	Poor.
Pricklypear	Good	Good	Good	Fair	Fair	Poor.
Strawberry cactus	Good	Good	Good	Fair	Fair	Poor.
Tasajillo	Good	Good	Good	Fair	Fair	Poor.
Yucca, Spanish dagger	Good	Good	Good	Fair	Fair	Poor.
Yucca, soft leaf	Good	Good	Good	Fair	Fair	Poor.
Trees:						
Anaqua	Good	Good	Good	Fair: poor internal drainage.	Fair: water regularly.	Poor.
Avocado	Good: fertilize, water regularly.	Fair: chlorosis is a problem.	Poor: slow internal drainage, too clayey.	Poor: slow internal drainage, too clayey.	Poor	Poor.
Ash, Arizona	Good	Good	Good	Fair: too clayey.	Poor	Poor.
Ash, Rio Grande	Good	Good	Good	Fair: too clayey.	Poor	Poor.
Bottlebrush	Good	Good	Good	Fair: poor internal drainage.	Poor	Poor.
Brazilian pepper	Good	Good	Good	Fair: poor internal drainage.	Poor	Poor.

TABLE 3.—*Suitability of the soils for specified yard and garden plants—Continued*

Plant	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Trees—Continued						
Citrus (all varieties)	Good: fertilize, water when needed.	Fair: too limy; add chelates, fertilize, water frequently.	Poor: too clayey, poor internal drainage, too limy.	Poor: too clayey, poor internal drainage, too limy.	Poor	Poor.
Chinese tallow	Good: fertilize, water regularly.	Good: fertilize, water regularly.	Good: internal drainage is a problem.	Fair: too clayey, poor internal drainage.	Poor	Poor.
Cottonwood	Good	Good	Good	Fair: poor internal drainage.	Poor	Poor.
Crapemyrtle	Good: fertilize at time of pruning.	Good: fertilize at time of pruning.	Good: fertilize at time of pruning.	Fair: too clayey; fertilize at time of pruning.	Poor	Poor.
Desert willow	Good	Good	Good	Fair: poor internal drainage.	Fair	Poor.
Hackberry	Good	Good	Good	Good	Poor	Poor.
Japanese yew	Good	Good	Fair: poor internal drainage.	Fair: poor internal drainage.	Poor	Poor.
Live oak	Good	Good	Fair: slow permeability.	Poor: too clayey, slow permeability.	Poor	Poor.
Loquat	Good	Good	Good	Fair: poor internal drainage.	Poor	Poor.
Mesquite	Good	Good	Good	Fair	Fair	Poor.
Orchid tree	Good	Good	Fair: poor internal drainage.	Fair: poor internal drainage.	Poor	Poor.
Palm (all varieties)	Good	Good	Good	Good	Fair: water regularly.	Poor.
Papaya	Good	Fair: chlorosis may be a problem.	Poor: too clayey, slow permeability.	Poor: too clayey, slow permeability.	Poor	Poor.
Peach	Good	Fair: too limy	Poor: poor internal drainage.	Poor: poor internal drainage.	Poor	Poor.
Royal Poinciana	Good	Good	Fair	Poor	Poor	Poor.
Texas ebony	Good	Good	Fair	Poor	Poor	Poor.

Group 1.—This group consists of soils of the Delfina, Lozano, Lyford, Racombes, and Willacy series. These soils have a surface layer of fine sandy loam or sandy clay loam that is neutral to mildly alkaline. The underlying material is moderately permeable to moderately slowly permeable. These soils are well drained to moderately well drained, and their available water capacity is medium to high. Under good management, the soils in this group are well suited to most flowers, shrubs, and trees grown in the county.

Group 2.—This group consists of soils of the Camargo, Hidalgo, Laredo, and Rio Grande series. These soils have a surface layer of silt loam, silty clay loam, or sandy clay loam that is calcareous and moderately alkaline and is 9 to 18 inches thick. The underlying material is moderately permeable. These soils are well drained, and their available water capacity is medium to very high. Under special management, the soils in this group are well suited to most flowers, shrubs, and trees grown in the county.

Group 3.—This group consists of soils of the Cameron, Olmito, Matamoros, Raymondville, and Rio series. These soils have a surface layer of clay loam or silty clay that is neutral to moderately alkaline. The underlying material is slowly permeable to moderately slowly permeable. These soils are moderately well drained to somewhat poorly drained, and their available water capacity is medium to high. Under special management, the soils in this group are suited to many flowers, shrubs, and trees grown in the county.

Group 4.—This group consists of soils of the Grulla, Harlingen, Mercedes, and Tiocano series. These soils have a surface layer of clay that is neutral to moderately alkaline. The underlying material is very slowly permeable. These soils are somewhat poorly drained to moderately well drained, and their available water capacity is low to high. The soils in this group are suited to poorly suited for flowers, shrubs, and trees grown in the county. Special management practices are needed for good growth.

Group 5.—This group consists of soils of the Galveston, Mustang, and Zalla series. These soils have a surface layer of fine sand or loamy fine sand that is moderately alkaline to mildly alkaline. The underlying material is rapidly permeable. These soils are poorly drained to somewhat excessively drained, and their available water capacity is low to very low. Soils in this group on Padre Island and Boca Chica are influenced by salt sprays. The soils in this group are fairly well suited to poorly suited for most flowers, shrubs, and trees grown in the county.

Group 6.—This group consists of soils of the Barrada, Benito, Chargo, Latina, Lomalta, Point Isabel, Sejita, and Willamar series. Also in the group are Orelia, clayey subsoil variant, and Ustifluvents, clayey. The soils in this group are saline and high in content of sodium. The surface layer is sandy clay loam, clay loam, fine sandy loam, silt loam, silty clay, or clay and is neutral to strongly alkaline. The underlying material is very slowly permeable to moderately slowly permeable. These soils are very poorly drained to well drained, and their available water capacity is very low to medium. They are poorly suited to most flowers, shrubs, and trees grown in the county.

Use of the Soils for Orchards

Citrus orchards are important in Cameron County. Grapefruit and oranges are the major crops. Tangerines, tangelos, and lemons are of less importance. Small acreages of peaches and avocados are also grown. Citrus crops are best suited to such loamy soils as Delfina, Laredo, Hidalgo, and Willacy soils.

The citrus industry has undergone many changes since its beginning in 1910. Most of the changes have been gradual, but many were brought about by disasters including the 1933 hurricane, the 1949, 1951, and 1962 freezes, and the 1967 hurricane. The potential for expanding the citrus industry in this area is favorable because of the relatively low production costs and the high-quality fruit. The major limitation to citrus is the hazard of a killing freeze. Recurrent freezes have prevented citrus trees from maturing enough to produce heavily for sustained periods.

The trend in Cameron County is to convert cropland to orchards if the soils are suitable for orchards.

Orchard suitability groups

The soils in Cameron County have been placed in orchard groups according to their suitability for producing orchard crops. The soils in each group are enough alike to be suited to the same orchard crop, to have similar limitations and hazards, to require similar management, and to have similar productivity and other responses to management. Thus, the orchard group is a convenient grouping of soils for their management. The orchard suitability groups in Cameron County are identified by capital letters A through I. Groups E, G, and H have been omitted because none of the soils in these groups occur in Cameron County. Some of the soils in Cameron County were not placed in an orchard group because soil limitations or location preclude their use for orchards. The "Guide to Mapping Units" at the back of this survey lists the soils assigned to orchard suitability groups.

ORCHARD SUITABILITY GROUP A

This group consists of deep, nearly level to gently sloping soils that have a surface layer of fine sandy loam. Permeability is moderate to moderately slow, and the available water capacity is medium to high.

These soils are well suited to all orchard crops commonly grown in the county. Citrus is the major orchard crop, and grapefruit is grown on about 60 percent of the citrus acreage. Oranges are also important; lemons, tangerines, and tangelos are of minor importance. A small acreage of peaches and avocados is also grown.

Good orchard managment includes proper fertilization and weed and insect control. If herbicides are used, the soils should be in good tilth before herbicides are applied. If herbicides are not used, weeds and grass should be managed so that good tilth is maintained. Land leveling increases the efficiency of irrigation. Temporary field ditches are difficult to maintain.

ORCHARD SUITABILITY GROUP B

The only soil in this group is Willacy fine sandy loam, 1 to 3 percent slopes. It is a gently sloping soil that has a surface layer of fine sandy loam. Permeability is moderate, and the available water capacity is medium to high.

This soil is well suited to all orchard crops commonly grown in the county. Citrus is the major orchard crop, and grapefruit is grown on about 60 percent of the citrus acreage. Oranges are also important; lemons, tangerines, and tangelos are of minor importance. A small acreage of peaches and avocados is also grown.

Good orchard management includes proper fertilization and weed and insect control. If herbicides are used, the soils should be in good tilth before herbicides are applied. If herbicides are not used, weeds and grass should be managed so that good tilth is maintained. Land leveling reduces soil erosion and increases the efficiency of irrigation, but if the cuts are deeper than 3 feet, special management practices such as mulching or manuring are needed to offset the chlorosis caused by the loss of organic matter. Bench leveling reduces the depth of land-leveling

cuts. Temporary field ditches are difficult to maintain.

ORCHARD SUITABILITY GROUP C

This group consists of deep, nearly level to gently sloping soils that have a surface layer of fine sandy loam, silt loam, sandy clay loam, loamy fine sand, or silty clay loam. Permeability is moderate to rapid, and the available water capacity is very low to high.

These soils are suited to citrus trees. Grapefruit is the major citrus crop; oranges are important; lemons, tangerines, and tangelos are of minor importance. These soils are poorly suited to peaches and avocados because they have a high content of calcium.

Good orchard managment includes proper fertilization and weed and insect control. If herbicides are used, the soils should be in good tilth before herbicides are applied. If herbicides are not used, weeds and grass should be managed so that good tilth is maintained. Land leveling increases the efficiency of irrigation, but if the cuts are deeper than 18 inches special management practices such as mulching or manuring are needed to offset chlorosis caused by the loss of organic matter. In some places these soils have a seasonal high saline water table. Tile drains can be used effectively to lower the water table. Temporary field ditches are difficult to maintain on the fine sandy loam and silt loam soils.

ORCHARD SUITABILITY GROUP D

This group consists of deep, gently sloping, calcareous soils that have a surface layer of fine sandy loam, loam, or silty clay loam. Permeability is moderate, and the available water capacity is medium to very high.

These soils are suited to citrus trees. Grapefruit is the major citrus crop; oranges are important; lemons, tangerines, and tangelos are of minor importance. These soils are poorly suited to peaches and avocados because they have a high content of calcium.

Good orchard management includes proper fertilization and weed and insect control. If herbicides are used, the soils should be in good tilth before herbicides are applied. If herbicides are not used, weeds and grass should be managed so that good tilth is maintained. Land leveling reduces soil erosion and increases the efficiency of irrigation, but if the cuts are deeper than 2 feet, special management practices such as mulching or manuring are needed to offset chlorosis caused by the loss of organic matter. Bench leveling reduces the depth of land-leveling cuts. In some places these soils have a seasonal high saline water table. Tile drains can be used effectively to lower the water table. Temporary field ditches are difficult to maintain on the fine sandy loam soils.

ORCHARD SUITABILITY GROUP F

This group consists of deep soils that have a surface layer of fine sandy loam, silty clay loam, sandy clay loam, or silty clay. These soils are on low terraces and uplands. Permeability is moderate to slow, and the available water capacity is medium to very high.

These soils are suited to citrus trees, but tree growth is not uniform on some of the soils because of somewhat restricted surface and subsurface drainage. Grapefruit and oranges are the major citrus crops. Theses soils are poorly suited to avocados. The noncalcareous soils of this group are suited to peaches.

Good orchard management includes proper fertilization and weed and insect control. If herbicides are used, the soils should be in good tilth before herbicides are applied. If herbicides are not used, weeds and grass should be managed so that good tilth is maintained. Land leveling increases the efficiency of irrigation. In some places these soils have a seasonal high saline water table. Tile drains can be used effectively to lower the water table.

ORCHARD SUITABILITY GROUP I

This group consists of deep, nearly level to gently sloping, calcareous soils that have a surface layer of silt loam, clay loam, silty clay, or silty clay loam. Some of these soils are saline. Permeability is slow to moderate, and the available water capacity is high to very low.

These soils are poorly suited to the orchard crops commonly grown in the county because of salinity or restricted drainage. Although orchards generally are not economically feasible, a few small acreages are in grapefruit.

Use of the Soils for Pasture

Pasture and hay are important in Cameron County for livestock production. The most important grasses are common and Coastal bermudagrass, African stargrass, and Angleton bluestem. These grasses grow best on such loamy soils as Laredo, Hidalgo, and Willacy soils (fig. 11).

The trend in Cameron County is to convert land used for crops to improved pasture and hay. This is particularly true of those cultivated soils that have been made marginal for crops by excess soluble salts. Most improved pasture is irrigated.

Pasture and hay suitability groups

The soils in Cameron County have been placed in pasture and hay groups according to their suitability for the production of forage. The soils in each group are enough alike to be suited to the same grasses, to have similar limitations and hazards, to require similar management, and to have similar productivity and other responses to management. Thus, the pasture or hay group is a convenient way of grouping the soils for their management. The pasture and hay suitability groups in Cameron County are identified by a symbol such as 8C. Some of the soils in Cameron County have not been placed in a pasture and hay group because soil limitation or location preclude their use for improved pasture.

PASTURE AND HAY GROUP 1A

The only soil in this group is Grulla clay. It is a nearly level soil that is subject to overflow in places. This soil has a high water intake rate when dry and cracked, but it is very slowly permeable when wet. The available water capacity is medium to high.

This soil is used only for pasture. Production potential is high for common bermudagrass and Coastal bermudagrass.

Pasture management that includes proper use, fer-

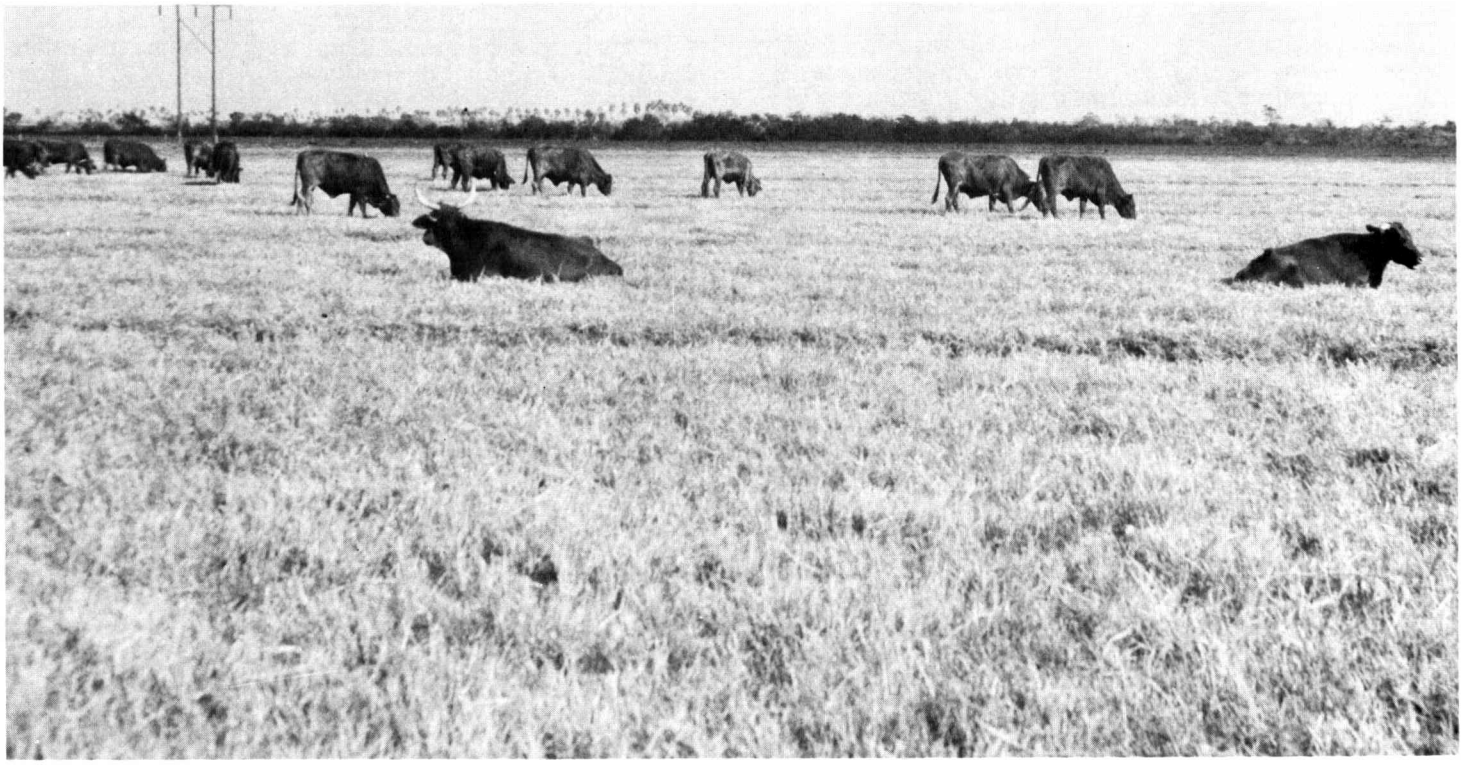

Figure 11.—**Cattle grazing irrigated Coastal bermudagrass pasture on Laredo silty clay loam, 0 to 1 percent slopes.**

tilization, rotational grazing, and weed control is needed on this soil. An adequate water supply is also necessary. The soil puddles if it is grazed when wet. Seedbed preparation is difficult on this clayey soil.

PASTURE AND HAY GROUP 1C

This group consists of deep, nearly level, clayey to loamy soils. These soils are subject to overflow. Permeability is moderate to slow, and the available water capacity is medium to very high.

These soils are used mostly for pasture, but a few areas are used for hay. Production potential is high for Coastal bermudagrass, African stargrass, and other grasses.

Pasture management that includes proper use, fertilization, rotational grazing, and weed control is needed on these soils. An adequate water supply is also necessary. Land leveling increases the efficiency of irrigation.

PASTURE AND HAY GROUP 2A

This group consists of deep, nearly level to gently sloping, loamy to sandy soils that are subject to overflow. These soils have a surface layer of silty clay loam or silt loam about 8 inches thick. The underlying material is stratified, friable silt loam or silty clay loam. Permeability is moderate to rapid, and the available water capacity is low to very high.

These soils are used mostly for pasture, but a few areas are used for hay. Production potential is high for Coastal bermudagrass, African stargrass, and other grasses.

Pasture management that includes proper use, fertilization, rotation grazing, and weed control is needed on these soils. An adequate water supply is also needed. Land leveling increases the efficiency of irrigation.

PASTURE AND HAY GROUP 3A

The only soil in this group is Zalla loamy fine sand. It is a gently sloping soil that is subject to overflow. Permeability is rapid, and the available water capacity is low.

This soil is used only for pasture. Production potential is medium to high for common or improved bermudagrass.

Pasture management that includes proper use, fertilization, rotation grazing, and weed control is needed on this soil. An adequate water supply is also needed. The loose seedbeds of this soil make establishing grass difficult. Fertilizer should be applied frequently during the growing season.

PASTURE AND HAY GROUP 7A

This group consists of deep, nearly level to gently sloping, clayey soils. These soils have a high water intake rate when they are dry and cracked, but they are very slowly permeable when wet. The available water capacity is low to high.

These soils are used for pasture and hay. Production potential is high for Coastal bermudagrass, African stargrass, and introduced bluestems.

Pasture management that includes proper use, fertilization, rotation grazing, and weed control is needed on these soils. An adequate water supply is also needed. The soils puddle if they are grazed when wet. Seedbed preparation is difficult because the soils are clayey.

PASTURE AND HAY GROUP 7C

This group consists of deep, nearly level to gently sloping, loamy to clayey soils. Permeability is moderate to slow, and the available water capacity is medium to very high.

These soils are used for pasture and hay. Production potential is high for Coastal bermudagrass, African stargrass, introduced bluestems, and other grasses.

Pasture managment that includes proper use, fertilization, rotation grazing, and weed control is needed on these soils. An adequate water supply is also needed. Land leveling increases the efficiency of irrigation.

PASTURE AND HAY GROUP 7E

This group consists of deep, nearly level and slightly depressional to gently sloping, clayey soils. Permeability is slow to very slow, and the available water capacity is medium to high.

These soils are used mostly for pasture, but a few areas are used for hay. Production potential is moderate for improved bermudagrass, introduced bluestems, and other grasses.

Pasture management that includes proper use, fertilization, rotation grazing, and weed control is needed on these soils. An adequate water supply is also needed. These soils puddle if they are grazed when wet. Surface drains are necessary in most areas.

PASTURE AND HAY GROUP 7F

This group consists of deep, nearly level and slightly depressional to gently sloping saline soils. These soils have a surface layer of sandy clay loam, clay loam, silty clay, or clay. The underlying material is firm clay loam, silty clay, or clay. Permeability is moderately slow, slow, or very slow, and the available water capacity is very low to medium.

These soils are used mostly for pasture, but a few areas are used for hay. Production potential is low to medium for improved bermudagrass, some of the introduced bluestems, and other grasses.

Pasture management that includes proper use, fertilization, rotation grazing, and weed control is needed on these soils. An adequate water supply is also needed. These soils puddle if they are grazed when wet, and surface drains are necessary in some places. Establishing grass is difficult, especially from seed.

PASTURE AND HAY GROUP 7G

This group consists of deep, gently sloping to sloping, loamy, saline soils. Permeability is moderate to slow, and the available water capacity is low to medium.

These soils are used mostly for pasture, but a few areas are used for hay. Production potential is low to medium for improved bermudagrass, introduced bluestems, and other grasses.

Pasture management that includes proper use, fertilization, rotation grazing, and weed control is needed on these soils. An adequate water supply is also needed. Establishing grass is difficult, especially from seed. Tile drains help to lower the seasonal water table and remove excess soluble salts.

PASTURE AND HAY GROUP 8C

This group consists of deep, nearly level to gently sloping, loamy soils. Permeability is moderate to moderately slow, and the available water capacity is medium to high.

These soils are used for pasture and hay. Production potential is high for improved bermudagrass and buffelgrass.

Pasture management that includes proper use, fertilization, rotation grazing, and weed control is needed on these soils. An adequate water supply is also needed. Land leveling increases the efficiency of irrigation. Forage production is used mainly for grazing, any excess is cut for hay.

Use of the Soils for Range[2]

Approximately 145,000 acres in Cameron County is used as range, and the native vegetation is used for grazing livestock and for food and cover for wildlife. Some introduced grasses are successfully grown on range, most of which is adjacent to the coast. In coastal areas, the soils generally are saline to some degree, and in many places the topography is uneven. Small isolated areas of sandy loam and clay loam occur throughout the county, and in many places they have been severely grazed and consequently invaded by mesquite and other woody vegetation.

Range sites and condition classes

Different kinds of soil vary in their capacity to produce grass and other plants for grazing. Soils that produce about the same kinds and amounts of forage, if the range is in similar condition, make up a range site.

Range sites are kinds of range that differ in their ability to produce vegetation. The soils of any one range site produce about the same kind of climax vegetation. Climax vegetation is the stabilized plant community; it reproduces itself and does not change as long as the environment remains unchanged. Throughout the prairie and the plains, the climax vegetation consists of the plants that were growing there when the region was first settled. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

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

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

Invaders are plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. Consequently, invaders come in and grow along with increasers after the climax vegetation has been reduced by grazing. Many are annual weeds, and some are shrubs that have some grazing value, but others have little value for grazing.

[2] CLIFFORD W. CARTER, range conservationist, Soil Conservation Service, helped prepare this section.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand. It is in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is less than 25.

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

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during the growing season.

A primary objective of good range management is to keep range in excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected. The problem is recognizing important changes in the kind of cover on a range site. The changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may make the range appear to be in good condition, when actually the cover is weedy and the long-term trend is toward lower production. In other places, range that has been closely grazed for short periods, but that has been carefully managed may have a degraded appearance that temporarily conceals its quality and ability to recover.

Descriptions of range sites

In the following pages, the range sites of Cameron County are described and the climax plants and principal invaders on the sites are named. Also given is an estimate of the potential annual yield of air-dry herbage for each site when it is in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this survey. Not all of the soils of Cameron County, but only those that are in native vegetation, or range, have been placed in a range site.

CLAY LOAM RANGE SITE

The soils that make up this site are deep, nearly level, clay loams and sandy clay loams. They are moderately permeable to slowly permeable and are moderately well drained to somewhat poorly drained. These soils receive very little runoff from surrounding soils.

The climax vegetation is grasses, some forbs, and a few scattered woody plants. In excellent condition, the site has fourflowered trichloris, Arizona cottontop, and lovegrass tridens. These plants make up about 65 percent of the vegetation. Among other less numerous plants are pink pappusgrass, plains bristlegrass, curly-mesquite, slim tridens, and perennial forbs.

Under continued heavy grazing by cattle, trichloris, cottontop, and lovegrass tridens decrease and pink pappusgrass and curly mesquite increase. If the range condition deteriorates, red grama, three-awn, whorled dropseed, and many annual forbs invade the site. Other invaders are mesquite, spiny hackberry, whitebrush, condalias, and other woody plants.

If this site is in excellent condition, the total annual production of air-dry forage is about 2,500 pounds per acre in unfavorable years and 4,500 pounds per acre in favorable years. This site can be reseeded successfully after the seedbed has been prepared and the brush controlled.

COASTAL RIDGE RANGE SITE

The soils that make up this site are deep, nearly level to sloping, saline clay loams and silty clay loams. They are moderately permeable to slowly permeable and well drained.

This site is preferred by livestock because it is on high ground and because the vegetation is more palatable than that on adjacent sites. In dry years, the vegetation is severely damaged because deposits of saline soil particles blown from nearly barren mud flats accumulate.

The climax vegetation is grasses, forbs, and shrubs, dominated by big sacaton, fourflowered trichloris, Arizona cottontop, and lovegrass tridens. These plants make up about 70 percent of the vegetation. Among the other less numerous plants are pink pappusgrass, slim tridens, plains bristlegrass, fall witchgrass, and hooded windmillgrass. Among the palatable browse plants are fiddlewood, Texas kidneywood, and desert yaupon.

Under continued heavy grazing by cattle, sacaton, trichloris, cottontop, and lovegrass tridens decrease and pink pappusgrass, plains bristlegrass, and hooded windmillgrass increase. If the range condition deteriorates, slim tridens, fall witchgrass, scrub mesquite, spiny hackberry, condalias, wolfberry, cactus, and coyotillo brush invade. Deer use this site for food and cover.

If this site is in excellent condition, the total annual production of air-dry forage is about 2,000 pounds per acre in unfavorable years and 4,000 pounds per acre in favorable years.

COASTAL SAND RANGE SITE

The soils that make up this site are deep, nearly level to gently sloping, fine sands. They are rapidly permeable and are poorly drained to somewhat excessively drained. These soils are in small mounds and depressions adjacent to the Gulf.

The climax vegetation is open grassland and some forbs. The site has dependably high forage production, but the forage is deficient in phosphorus. The mounds support the taller grasses, and the depressions support the short water-tolerant grasses. If this site is in excellent condition, about 75 percent of the vegetation is seacoast bluestem, crinkle-awn, and gulfdune paspalum. Among the other less numerous plants are brownseed paspalum, knotroot bristlegrass, and perennial legumes and forbs. Some marshhay cordgrass, switchgrass, sedges, and rushes grow particularly in the depressions.

Under continued heavy grazing by cattle, seacoast bluestem and crinkle-awn on the mounds and marshhay cordgrass and switchgrass in the depression decrease, and gulfdune paspalum, brownseed paspalum, and knotroot bristlegrass increase. If the range condition deteriorates, red lovegrass, grass bur, annual forbs, and annual grasses invade the site.

The hazard of soil blowing is severe on this site as vegetation becomes scarce.

If this site is in excellent condition, the total annual production of air-dry forage is about 1,000 pounds per acre in unfavorable years and 2,500 pounds per acre in favorable years.

SALT FLAT RANGE SITE

The soils that make up this site are nearly level, saline, silty clay loams. They are moderately slowly permeable and poorly drained. These soils are in nearly level, semimarshy areas along the lower Gulf Coast only a few feet above high tide. They are subject to flooding by saltwater during hurricanes or other tropical storms.

The climax vegetation is open grass, but it can become a bare salt flat under continuous heavy grazing. If the grass has been overgrazed, salt rises to the surface and forms a crust. Revegetation is difficult where a crust has formed. If this site is in excellent condition, shore grass dominates the site and makes up about 75 percent of the vegetation. Among the less numerous plants are gulf cordgrass and seashore saltgrass. Among the woody forbs on this site are bushy sea-oxeye, matrimonyvine, and woody glasswort.

Under continued heavy grazing by cattle and in unfavorable weather, gulf cordgrass decreases, and shoregrass, seashore saltgrass, and bushy sea-oxeye increase. If the range condition deteriorates, bigleaf sumpweed, glasswort, whorled dropseed, and annuals invade the site.

If this site is in excellent condition, the total annual production of air-dry forage is about 500 pounds per acre in unfavorable years and 1,000 pounds per acre in favorable years.

SALTY RANGE SITE

The soils that make up this site are nearly level to level, slightly depressional, saline silty clays and clays. They are slowly permeable to very slowly permeable and are moderately well drained to poorly drained. They generally receive runoff from surrounding sites. These soils are along the lower part of the Gulf Coast. The soils at lower elevations are subject to flooding by sea water during tropical disturbances.

The climax vegetation is salt-tolerant grasses, water-tolerant grasses, and a few forbs. This site is preferred as a wintering area by livestock. If it is in excellent condition, it is dominated by gulf cordgrass that makes up about 70 percent of the vegetation. Among other less numerous plants are marshhay cordgrass, alkali sacaton, seashore saltgrass, switchgrass, shoregrass, and hartweg paspalum. Among the woody forbs are busy sea-oxeye, matrimonyvine, and some bigleaf sumpweed.

Under heavy grazing by cattle, the marshhay cordgrass, alkali sacaton, switchgrass, and hartweg paspalum, all of which are palatable but less numerous, decrease. Gulf cordgrass, which produces most of the forage, persists well. If the range condition deteriorates, bushy sea-oxeye, matrimonyvine, whorled dropseed, and salt-tolerant annuals invade the site.

If this site is in excellent condition, the total annual production of air-dry forage is about 2,000 pounds per acre in unfavorable years and 5,000 pounds per acre in favorable years.

SANDY COASTAL FLAT RANGE SITE

The soils that make up this site are deep, level to nearly level fine sandy loams and sandy clay loams. They are very slowly permeable to slowly permeable and are somewhat poorly drained. If left bare, the soils crust severely. This site is close to the coast.

The climax vegetation is grassland on which the dominant plants are big sacaton, fourflowered trichloris, twoflowered trichloris, Arizona cottontop, feathery bluestem, and plains bristlegrass. These plants make up about 60 percent of the vegetation. Among other less numerous plants are slim tridens, Texas bristlegrass, pink pappusgrass, knotroot panicum, and fall witchgrass. Gulf cordgrass grows in many of the transitional areas of this site.

Under continued heavy grazing by cattle, sacaton, trichloris, and cottontop decrease and slim tridens, bristlegrass, pappusgrass, and fall witchgrass increase. If the range condition deteriorates, red grama, three-awns, and annual forbs invade the site. Among the other invaders are mesquite, condalias, night-blooming cereus, spiny hackberry, and other woody plants.

If this site is in excellent condition, total annual production of air-dry forage is about 2,000 pounds per acre in unfavorable years and about 4,500 pounds per acre in favorable years.

SANDY LOAM RANGE SITE

The soils that make up this site are deep, nearly level to gently sloping fine sandy loams. They are moderately permeable to moderately slowly permeable and are well drained. If left bare, the soils crust, and runoff is accelerated.

The climax vegetation is open grassland that is about 65 percent fourflowered trichloris, Arizona cottontop, and plains bristlegrass. Among the other plants that grow in smaller amounts are tanglehead, pink pappusgrass, whiplash pappusgrass, hooded windmillgrass, fall witchgrass, knotroot panicum, and Texas bristlegrass. Among the palatable forbs and woody plants are Texas kidneywood, vine ephedra, desert yaupon, bush sunflower, orange zexmenia, daleas, and many perennial legumes.

Under continued heavy grazing by cattle, trichloris, cottontop, and plains bristlegrass decrease, and pappusgrass, hooded windmillgrass, fall witchgrass, and Texas bristlegrass increase. If the range condition deteriorates, annual forbs, grassbur, red lovegrass, three-awn, fringed signalgrass, red grama, and Halls panicum invade the site. Among the other invaders are mesquite, blackbrush, wolfberry, Texas colubrina, pricklypear, coyotillo brush, condalias, elbowbush, and other woody plants.

If this site is in excellent condition, the total annual production of air-dry forage is about 3,000 pounds per acre in unfavorable years and about 5,500 pounds per acre in favorable years.

Use of the Soils for Wildlife

In Cameron County, the principal kinds of wildlife are whitetail deer, turkey, javelina, bobwhite quail,

scaled (blue) quail, white-winged dove, mourning dove, cottontail rabbit, jackrabbit, waterfowl, and many kinds of nongame birds. There are also raccoon, fox, skunk, opossum, and other furbearers. The whitetail deer, javelina, and turkey are found only on or near the Laguna Atascosa National Wildlife Refuge, which occupies about 45,000 acres in the northeastern corner of the county. Common predators are bobcats and coyotes. The Laguna Madre and associated saltwater and freshwater marshes attract many waterfowl during the winter. The Arroyo Colorado, Brownsville Ship Channel, Laguna Madre, and the Gulf of Mexico provide an abundance of saltwater sport fishing throughout the year. Freshwater fishing is also available in the Rio Grande, numerous winding resacas, irrigation reservoirs, and main irrigation canals. Fish and wildlife resources are of great economic importance to landowners in this county.

Soils directly influence kinds and amounts of vegetation and amounts of water available, and in this way they indirectly influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are thickness of soil useful to crops, surface texture, available water capacity to a depth of 40 inches, wetness, surface stoniness or rockiness, flood hazard, slope, and permeability of the soil to air and water.

In table 4 the suitability of soils of this survey area is shown for six elements of wildlife habitat and for three kinds of wildlife. The relative suitability for various elements is given as good, fair, poor, and very poor. Good means that the element of wildlife habitat generally is easily created, improved, and maintained, that few or no limitations affect management in this category, and that satisfactory results can be expected for the specified use.

Fair means that the element of wildlife habitat can be created, improved, or maintained in most places, but that moderate intensity of management and fairly frequent attention may be required for satisfactory results.

Poor means that the limitations for the designated use are rather severe, that habitats can be created, improved, or maintained in most places, but that management is difficult and requires intensive effort.

Very poor means that the limitations are very severe and that unsatisfactory results are to be expected. It is either impossible or impractical to create, improve, or maintain habitats on soils in this category.

Each heading in table 4 is defined in the following paragraphs.

Elements of wildlife habitat.—Each soil is rated in table 4 according to its suitability for producing various kinds of plants and other elements that make up wildlife habitats. The ratings take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and people. For this reason, selection of a site for development as a habitat for wildlife requires inspection at the site.

Grain and seed crops.—These crops are annual grain-producing plants, such as corn, sorghum, wheat, and rye.

Grasses and legumes.—Making up this group are domestic grasses and legumes that are established by planting. These plants provide food and cover for wildlife. Among the grasses are Kleingrass, ryegrass, and panicgrass; among the legumes are hubam and sweetclover.

Wild herbaceous upland plants.—This group consists of native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Pigweed, western ragweed, wildbean, bristlegrass, panicums, and partridgepea are typical examples.

Shrubs and trees.—These plants are shrubs, nonconiferous trees, and woody vines that produce wildlife food in the form of fruits, nuts, buds, catkins, or browse. Such plants commonly grow in their natural environment, but they may be planted and developed through wildlife management programs. Typical plants in this category are Texas ebony, mesquite, bumelia, wolfberry, kidneywood, fiddlewood, and ephedra.

Wetland food and cover plants.—In this group are annual and perennial herbaceous plants that grow wild on moist and wet sites. These plants furnish food and cover mostly for wetland wildlife. Typical examples are smartweed, wild millet, spikerush, and other rushes, sedges, and widgeongrass. Submerged and floating aquatics are not included in this category.

Shallow water developments.—These developments are impoundments or excavations for controlling water, generally not more than 5 feet deep, to create habitats that are suitable for waterfowl. Some are designed to be drained, planted, and then flooded; others are permanent impoundments that grow submersed aquatics.

Kinds of wildlife.—Table 4 rates soils according to their suitability as habitat for the three kinds of wildlife in the county—openland, rangeland, and wetland wildlife. These ratings are related to ratings made for the elements of habitat. For example, soils rated very poor for shallow water developments are rated very poor for wetland wildlife.

Openland wildlife are birds and mammals that normally live in meadows, pastures, and open areas where grasses, herbs, and shrubby plants grow. Quail, doves, meadowlarks, field sparrows, cottontail rabbits, and foxes are typical examples of openland wildlife.

Rangeland wildlife are birds and mammals that normally live in brushy areas of hardwood trees and shrubs. Javelina, bobcats, wild turkeys, deer, and raccoons are typical examples of rangeland wildlife.

Wetland wildlife are birds and mammals that normally live in wet areas, marshes, and swamps. Ducks, geese, rails, shore birds, herons, minks, and muskrats are typical examples of wetland wildlife.

Engineering Uses of the Soils[3]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

[3] BILLY J. GARNER, area engineer, Soil Conservation Service, Harlingen, Texas, helped prepare this section.

TABLE 4.—*Suitability of the soils for elements*

Soil series and map symbols	Elements of wildlife habitat				
	Grain and seed crops		Grasses and legumes		Wild herbaceous upland plants
	Dryland	Irrigated	Dryland	Irrigated	
Barrada: BA	Very poor		Very poor		Very poor
Benito: BE, BU Ratings are for Benito soils only in these mapping units. Urban land in BU is too variable to be rated.	Poor	Poor	Poor	Fair	Fair
Camargo: CA, CC	Good	Good	Good	Good	Good
Cameron:					
CE	Good	Good	Good	Good	Fair
CF	Poor	Fair	Poor	Fair	Poor
Chargo: CH	Poor	Fair	Poor	Fair	Poor
Coastal beach: CO. Too variable to be rated.					
Coastal dunes: CU. Too variable to be rated.					
Delfina: DE	Good	Good	Good	Good	Good
Galveston: GA	Fair	Fair	Fair	Fair	Fair
Grulla: GR	Poor	Poor	Fair	Fair	Fair
Harlingen:					
HA, HE Ratings are for Harlingen soils only in these mapping units. Urban land in HE is too variable to be rated.	Fair	Fair	Fair	Fair	Fair
HC	Poor	Poor	Poor	Poor	Poor
Hidalgo: HGA, HGB, HO, HU Ratings are for Hidalgo soils only in these mapping units. Urban land in HU is too variable to be rated.	Good	Good	Good	Good	Good
Laredo:					
LAA, LAB, LD, LEA, LEB, LG Ratings are for Laredo soils only in these mapping units. For the Olmito part of LD and the Reynosa part of LEA, LEB, see Olmito and Reynosa series. Urban land in LG is too variable to be rated.	Good	Good	Good	Good	Good
LC	Fair	Good	Fair	Good	Poor
Latina: LK	Very poor		Very poor		Very poor
Lomalta: LM, LO Ratings are for Lomalta soils only in these mapping units. Urban land in LO is too variable to be rated.	Very poor		Very poor		Very poor
Lozano: LR	Good	Good	Good	Good	Good
Lyford: LY	Good	Good	Good	Good	Good
Matamoros: MA, MC Ratings are for Matamoros soils only in these mapping units. For the Rio Grande part of MC, see the Rio Grande series.	Good	Good	Good	Good	Fair
Mercedes: MEA, MEB, MGC, MM Ratings are for Mercedes soils only in these mapping units. Urban land in MM is too variable to be rated.	Fair	Fair	Fair	Fair	Fair
Mustang:					
MS	Poor		Poor		Fair
MU	Very poor		Very poor		Very poor

of wildlife habitat and kinds of wildlife

Elements of wildlife habitat—Continued			Kinds of wildlife			
			Openland		Rangeland	Wetland
Shrubs and trees	Wetland food and cover plants	Shallow water developments	Dryland	Irrigated		
Very poor	Very poor	Very poor	Very poor		Very poor	Very poor.
Poor	Poor	Good	Poor	Fair	Poor	Fair.
Good	Fair	Fair	Good	Good	Good	Fair.
Fair	Poor	Fair	Good	Good	Fair	Poor.
Poor	Poor	Fair	Poor	Fair	Poor	Poor.
Poor	Poor	Good	Poor	Fair	Poor	Fair.
Good	Fair	Fair	Good	Good	Good	Fair.
Fair	Very poor	Very poor	Fair	Fair	Fair	Very poor.
Fair	Poor	Good	Fair	Fair	Fair	Fair.
Fair	Poor	Good	Fair	Fair	Fair	Fair.
Poor	Poor	Good	Poor	Poor	Poor	Fair.
Good	Fair	Fair	Good	Good	Good	Fair.
Good	Fair	Fair	Good	Good	Good	Fair.
Poor	Fair	Fair	Fair	Fair	Poor	Fair.
Very poor	Fair	Fair	Very poor		Very poor	Fair.
Very poor	Poor	Good	Very poor		Very poor	Fair.
Good	Fair	Fair	Good	Good	Good	Fair.
Good	Fair	Fair	Good	Good	Good	Fair.
Fair	Poor	Good	Good	Good	Fair	Fair.
Fair	Poor	Good	Fair	Fair	Fair	Fair.
Fair	Poor	Very poor	Poor		Fair	Very poor.
Very poor	Very poor	Very poor	Very poor		Very poor	Very poor.

TABLE 4.—*Suitability of the soils for elements*

Soil series and map symbols	Elements of wildlife habitat				
	Grain and seed crops		Grasses and legumes		Wild herbaceous upland plants
	Dryland	Irrigated	Dryland	Irrigated	
Olmito: OM, ON Ratings are for Olmito soils only in these mapping units. Urban land in ON is too variable to be rated.	Good	Good	Good	Good	Fair
Orelia variant: OR	Poor	Poor	Poor	Poor	Poor
Point Isabel: PO, PU Ratings are for Port Isabel soils only in these mapping units. Urban land in PU is too variable to be rated.	Poor		Poor		Poor
Racombes: RA, RDX Ratings are for Racombes soils only in these mapping units. Urban land in RDX is too variable to be rated.	Good	Good	Good	Good	Good
Raymondville: RE, RM Ratings are for Raymondville soils only in these mapping units. Urban land in RM is too variable to be rated.	Good	Good	Good	Good	Good
RG	Poor	Fair	Poor	Fair	Poor
Reynosa Mapped only in a complex with Laredo soils.	Good	Good	Good	Good	Good
Rio: RO	Good	Good	Good	Good	Fair
Rio Grande: RR, RT, RU, RZ Ratings are for Rio Grande soils only in these mapping units. For the Zalla part of RZ, see the Zalla series. Urban land in RU is too variable to be rated.	Good	Good	Good	Good	Good
Sejita: SE, SU Ratings are for Sejita soils only in these mapping units. Urban land in SU is too variable to be rated.	Very poor		Very poor		Very poor
Tiocano: TC	Very poor		Poor		Poor
Urban land. Mapped only in complexes with Benito, Harlingen, Hidalgo, Laredo, Lomalta, Mercedes, Olmito, Point Isabel, Raymondville, Rio Grande, and Sejita soils and in an undifferentiated unit with Racombes soils. Too variable to be rated.					
Ustifluvents, clayey: USX. Too variable to be rated.					
Willacy: WAA, WAB	Good	Good	Good	Good	Good
Willamar: WM	Poor	Fair	Poor	Fair	Poor
Zalla: ZA	Fair	Fair	Fair	Fair	Fair

Among properties of soils highly important in engineering are permeability, strength, compressibility, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of sand or clay.
4. Plan farm drainage systems, irrigation systems, ponds, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the

of wildlife habitat and kinds of wildlife—Continued

Elements of wildlife habitat—Continued			Kinds of wildlife			
			Openland		Rangeland	Wetland
Shrubs and trees	Wetland food and cover plants	Shallow water developments	Dryland	Irrigated		
Fair	Poor	Good	Good	Good	Fair	Fair.
Poor	Fair	Fair	Poor	Poor	Poor	Fair.
Poor	Poor	Very poor	Poor	----------	Poor	Very poor.
Good	Fair	Fair	Good	Good	Good	Fair.
Fair	Good	Good	Good	Good	Fair	Good.
Poor	Good	Good	Poor	Fair	Poor	Good.
Good	Fair	Fair	Good	Good	Good	Fair.
Good	Good	Good	Good	Good	Fair	Good.
Good	Fair	Fair	Good	Good	Good	Fair.
Very poor	Good	Fair	Very poor	----------	Very poor	Fair.
Very poor	Poor	Good	Poor	----------	Very poor	Fair.
Good	Fair	Fair	Good	Good	Good	Fair.
Poor	Good	Good	Poor	Fair	Poor	Good.
Fair	Very poor	Very poor	Fair	Fair	Fair	Very poor.

same or similar kinds of soil in other locations.

6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables. Table 5 shows several estimated soil properties significant in engineering; table 6 gives interpretations for various engineering uses; and table 7 gives the results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in table 5 and 6, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly

TABLE 5.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such to other series that appear in the first column of this table. The symbol <

Soil series and map symbols	Flood hazard		Depth to seasonal high water table	Hydrologic soil group	Depth from surface [1]	USDA texture	Classification		Liquid limit
	Frequency	Duration					Unified	AASHO	
			Inches		*Inches*				*Percent*
Barrada: BA	Frequent	Long	8–36	D	0–52	Clay	CH	A–7–6	55–70
					52–63	Silty clay loam	CL	A–6, A–7–6	35–50
Benito: BE, BU	Frequent	Brief	60–120	D	0–8	Clay	CH	A–7–6	79–88
Properties of Urban land in BU are too variable to be rated.					8–54	Clay	CH	A–7–6	70–88
					54–63	Silty clay loam	CL	A–6, A–7–6	35–50
					63–84	Silt loam	CL	A–6	28–40
Camargo:									
CA	Infrequent	Brief	(2)	B	0–14	Silt loam	CL, CL-ML	A–4, A–6	20–35
					14–51	Silty clay loam	CL, ML	A–6, A–7	30–50
					51–63	Silt loam	CL, CL-ML	A–4, A–6	20–35
CC	Infrequent	Brief	(2)	B	0–11	Silty clay loam	CL	A–7	41–50
					11–63	Silty clay loam, silt loam.	CL	A–6, A–7	30–50
Cameron:									
CE	None	None	(3)	D	0–23	Silty clay	CH	A–7–6	51–70
					23–63	Silt loam	CL, CL-ML	A–4, A–6	20–40
CF	None	None	24–60	D	0–26	Silty clay	CH	A–7–6	51–70
					26–32	Silty clay loam	CL	A–7	41–50
					32–38	Silt loam	CL, CL-ML	A–4, A–6	20–40
					38–63	Very fine sandy loam.	ML, CL-ML	A–4	25
Chargo: CH	None	None	24–36	D	0–12	Silty clay	CH	A–7–6	51–70
					12–41	Silty clay	CH	A–7–6	51–70
					41–47	Silt loam	CL	A–4, A–6	25–40
					47–63	Silty clay	CH	A–7–6	51–70
Coastal beach: CO. Properties are too variable to be estimated.									
Coastal dunes: CU. Properties are too variable to be estimated.									
Delfina: DE	None	None	(3)	B	0–15	Fine sandy loam	SC, SM-SC	A–4, A–2–4	20–28
					15–34	Sandy clay loam	CL, SC	A–6, A–7	35–45
					34–72	Sandy clay loam	SC	A–6	30–40
Galveston: GA	Infrequent	Extremely brief.	40–72	A	0–63	Fine sand	SP-SM	A–3	-------
Grulla: GR	Frequent	Long	(2)	D	0–62	Clay	CH	A–7–6	51–70
Harlingen:									
HA, HE	None	None	60–120	D	0–11	Clay	CH	A–7–6	60–80
Properties of Urban land in HE are too variable to be estimated.					11–35	Clay	CH	A–7–6	60–80
					35–71	Clay	CH	A–7–6	60–80
HC	None	None	60–120	D	0–63	Clay	CH	A–7–6	60–80

See footnotes at end of table.

significant in engineering

mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring means less than. Dashes indicate that the properties were not estimated]

Plasticity index	Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity to—	
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						Uncoated steel	Concrete
					Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos per cm*			
30–45	100	100	100	95–100	<0.06	0.0–0.01	7.9–9.0	50–150	High	Very high	High.
15–25	100	100	100	70–90	<0.06	0.0–0.01	7.9–9.0	50–150	High	Very high	High.
45–60	100	100	100	95–100	<0.06	0.06–0.14	7.9–9.0	4–8	Very high	Very high	Low.
45–60	100	100	100	95–100	<0.06	0.01–0.10	7.9–9.0	7–20	Very high	Very high	Low.
15–25	100	100	100	70–90	0.20–0.63	0.01–0.11	7.9–9.0	7–20	Moderate	Very high	Low.
11–20	100	100	90–100	70–90	0.63–2.0	0.01–0.14	7.9–9.0	7–20	Low	Very high	Low.
4–16	100	100	100	70–95	0.63–2.0	0.16–0.24	7.9–8.4	0–2	Low	Moderate	Low.
11–28	100	100	100	90–100	0.63–2.0	0.18–0.22	7.9–8.4	0–2	Moderate	Moderate	Low.
4–16	100	100	100	70–95	0.63–2.0	0.16–0.24	7.9–8.4	0–2	Low	Moderate	Low.
20–28	100	100	100	95–100	0.63–2.0	0.18–0.22	7.9–8.4	0–2	Moderate	Moderate	Low.
16–28	100	100	100	90–100	0.63–2.0	0.18–0.24	7.9–8.4	0–2	Moderate	Moderate	Low.
25–45	100	100	100	95–100	0.20–0.63	0.11–0.18	7.9–8.4	0–4	Very high	Very high	Low.
4–20	100	100	100	70–95	2.0–6.3	0.08–0.18	7.9–8.4	2–8	Low	Very high	Low.
25–45	100	100	100	95–100	0.20–0.63	0.01–0.15	7.9–8.4	4–30	Very high	Very high	Moderate.
20–28	100	100	100	90–100	0.63–2.0	0.01–0.18	7.9–8.4	4–30	Moderate	Very high	Moderate.
4–20	100	100	100	70–95	2.0–6.3	0.01–0.18	7.9–8.4	4–30	Low	Very high	Moderate.
2–7	100	100	90–100	60–80	2.0–6.3	0.01–0.14	7.9–8.4	4–30	Low	Very high	Moderate.
30–45	100	100	100	90–100	0.06–0.20	0.07–0.18	7.9–8.4	3–10	Very high	Very high	Low.
30–45	100	100	100	90–100	0.06–0.20	0.01–0.11	7.9–8.4	6–30	Very high	Very high	Low.
8–20	100	100	100	70–85	2.0–6.3	0.01–0.16	7.9–8.4	6–30	Low	Very high	Low.
30–45	100	100	100	90–100	0.06–0.20	0.01–0.11	7.9–8.4	6–30	Very high	Very high	Low.
4–10	100	100	95–100	25–50	2.0–6.3	0.10–0.15	6.6–7.8	0–2	Low	Low	Low.
15–23	100	100	95–100	40–55	0.20–0.63	0.09–0.17	6.6–7.8	0–4	Moderate	High	Low.
11–20	100	95–100	80–90	36–50	0.63–2.0	0.06–0.17	7.9–8.4	1–8	Moderate	High	Low.
[4] NP	100	95–100	65–80	5–10	6.3–20	0.05–0.08	7.4–8.4	0–2	Low	High	Low.
30–45	100	100	100	97–100	< 0.06	0.12–0.18	7.9–8.4	0–2	Very high	Very high	Low.
45–60	100	100	100	95–100	< 0.06	0.08–0.18	7.9–8.4	2–6	Very high	High	Low.
45–60	100	100	100	95–100	< 0.06	0.03–0.18	7.9–8.4	3–12	Very high	High	Low.
45–60	100	100	100	95–100	< 0.06	0.01–0.11	7.9–8.4	6–30	Very high	High	Low.
45–60	100	100	100	95–100	< 0.06	0.01–0.11	7.9–9.0	6–30	Very high	High	Moderate.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Flood hazard		Depth to seasonal high water table	Hydrologic soil group	Depth from surface [1]	USDA texture	Classification		Liquid limit
	Frequency	Duration					Unified	AASHO	
			Inches		*Inches*				*Percent*
Hidalgo:									
HGA, HGB	None	None	(3)	B	0–15	Fine sandy loam	SM, SM-SC	A–4, A–6, A–2–4, A–2–6	20–30
					15–39	Sandy clay loam	CL, SC	A–6	30–40
					39–60	Sandy clay loam	CL	A–6	30–40
HO, HU	None	None	(3)	B	0–12	Sandy clay loam	CL, SC	A–6	30–40
					12–37	Sandy clay loam	CL, SC	A–6	30–40
					37–63	Sandy clay loam	CL	A–6	30–40
Properties of Urban land in HU are too variable to be estimated.									
*Laredo:									
LAA, LAB, LD, LEA, LEB, LG. For Olmito part of LD and the Reynosa part of LEA and LEB, see the Olmito and Reynosa series. Properties of Urban land in LG are too variable to be estimated.	None	None	(3)	B	0–8	Silty clay loam	CL	A–6, A–7–6	30–45
					8–72	Silty clay loam, silt loam.	CL	A–6	30–40
LC	None	None	36–72	B	0–12	Silty clay loam	CL	A–6	30–40
					12–43	Silt loam	CL	A–6	30–40
					43–60	Silty clay loam	CL	A–6	30–40
					60–80	Silt loam	CL	A–6	30–40
Latina: LK	Infrequent	Brief	12–36	D	0–4	Sandy clay loam	CL	A–6	30–40
					4–63	Sandy clay loam	CL	A–6, A–7	35–45
Lomalta: LM, LO	Frequent	Brief	48–120	D	0–53	Clay	CH	A–7–6	70–85
					53–57	Silty clay loam	CH, CL	A–7	41–55
					57–72	Silt loam	CL	A–6	30–40
Properties of Urban land in LO are too variable to be estimated.									
Lozano: LR	None	None	36–72	B	0–11	Fine sandy loam	SC, SM-SC	A–4	20–30
					11–35	Sandy clay loam	CL	A–6, A–7	35–45
					35–63	Sandy clay loam	CL	A–6, A–7	35–45
Lyford: LY	None	None	36–72	C	0–11	Sandy clay loam	CL	A–6	30–40
					11–25	Sandy clay loam	CL	A–6, A–7	35–45
					25–63	Sandy clay loam	CL	A–6, A–7	35–45
*Matamoros: MA, MC	Infrequent	Brief	(2)	C	0–50	Silty clay	CH	A–7–6	51–65
For the Rio Grande part of MC, see the Rio Grande series.									

See footnotes at end of table.

significant in engineering—Continued

Plasticity index	Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity to—	
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						Uncoated steel	Concrete
					Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos per cm*			
5–15	100	100	100	30–50	0.63–2.0	0.10–0.15	7.9–8.4	0–2	Low	High	Low.
11–20	100	100	100	36–55	0.63–2.0	0.09–0.17	7.9–8.4	1–4	Moderate	High	Low.
11–20	100	100	100	51–70	0.63–2.0	0.09–0.17	7.9–8.4	1–4	Moderate	High	Low.
11–20	100	100	100	36–55	0.63–2.0	0.10–0.17	7.9–8.4	0–2	Moderate	High	Low.
11–20	100	100	100	36–55	0.63–2.0	0.09–0.17	7.9–8.4	1–4	Moderate	High	Low.
11–20	100	100	100	51–70	0.63–2.0	0.09–0.17	7.9–8.4	1–4	Moderate	High	Low.
11–25	100	100	100	85–100	0.63–2.0	0.15–0.22	7.9–8.4	0–2	Moderate	High	Low.
11–20	100	100	100	70–99	0.63–2.0	0.14–0.24	7.9–8.4	1–4	Moderate	High	Low.
11–20	100	100	90–100	85–100	0.63–2.0	0.01–0.18	7.9–8.4	4–30	Moderate	Very high	Low.
11–20	100	100	90–100	70–95	0.63–2.0	0.01–0.11	7.9–8.4	8–30	Low	Very high	Low.
11–20	100	100	90–100	85–100	0.63–2.0	0.01–0.11	7.9–8.4	8–30	Moderate	Very high	Low.
11–20	100	100	90–100	70–99	0.63–2.0	0.01–0.11	7.9–8.4	8–30	Low	Very high	Low.
12–18	100	100	90–100	51–70	0.63–2.0	0.00–0.01	7.4–7.8	30–70	Low	Very high	Moderate.
15–22	100	100	90–100	51–70	0.06–0.20	0.00–0.01	7.9–8.4	30–70	Low	Very high	Moderate.
45–58	100	100	100	95–100	<0.06	0.00–0.01	7.9–8.4	20–50	Very high	Very high	Moderate.
20–32	100	100	100	85–95	0.20–0.63	0.00–0.01	7.9–8.4	30–50	Moderate	Very high	Moderate.
11–20	100	100	100	51–70	0.63–2.0	0.00–0.01	7.9–8.4	30–50	Low	Very high	Moderate.
4–10	100	100	100	36–50	2.0–6.3	0.10–0.15	6.6–7.8	0–2	Low	High	Low.
15–25	100	100	100	51–70	0.20–0.63	0.09–0.17	6.6–7.8	1–4	Moderate	High	Low.
15–25	100	90–100	90–100	51–70	0.63–2.0	0.06–0.17	7.9–8.4	1–8	Moderate	High	Low.
11–20	100	100	100	51–70	0.63–2.0	0.10–0.17	6.6–7.8	0–2	Moderate	Very high	Low.
15–25	100	100	100	51–70	0.63–2.0	0.09–0.17	6.6–8.4	1–4	Moderate	Very high	Low.
15–25	95–100	95–100	95–100	51–70	0.63–2.0	0.06–0.17	6.6–8.4	1–8	Moderate	Very high	Low.
30–40	100	100	100	95–100	0.06–0.20	0.12–0.18	7.9–8.4	0–2	Very high	High	Low.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Flood hazard		Depth to seasonal high water table	Hydrologic soil group	Depth from surface [1]	USDA texture	Classification		Liquid limit
	Frequency	Duration					Unified	AASHO	
			Inches		*Inches*				*Percent*
Mercedes:									
MEA, MEB, MM—Properties of Urban land in MM are too variable to be rated.	None	None	60–120	D	0–18	Clay	CH	A–7–6	60–80
					18–47	Clay	CH	A–7–6	60–80
					47–74	Clay	CH	A–7–6	60–80
MGC	None	None	(2)	D	0–19	Clay	CH	A–7–6	60–80
					19–31	Clay	CH	A–7–6	60–80
					31–60	Clay	CH	A–7–6	60–80
					60–72	Silt loam, very fine sandy loam.	CL, CL-ML	A–4, A–6	20–35
Mustang:									
MS	Very frequent.	Very brief	6–40	A	0–50	Fine sand	SP-SM	A–3	
MU	Very frequent.	Very brief	6–24	A	0–36	Fine sand	SP-SM	A–3	
Olmito: OM, ON—Properties of Urban land in ON are too variable to be estimated.	None	None	(3)	D	0–23	Silty clay	CH	A–7–6	51–70
					23–34	Silty clay	CH	A–7–6	51–70
					34–63	Silty clay	CH	A–7–6	51–70
Orelia variant: OR	Frequent	Brief	12–48	D	0–8	Clay loam	CL	A–6, A–7–6	35–45
					8–48	Sandy clay	CH, CL	A–7–6	41–55
					48–63	Sandy clay loam	CL	A–6, A–7–6	30–45
Point Isabel: PO, PU—Properties of Urban land in PU are too variable to be estimated.	None	None	(2)	C	0–8	Clay loam	CL	A–7–6	41–50
					8–19	Clay	CH	A–7–6	51–70
					19–22	Clay loam	CL	A–7–6	41–50
					22–65	Clay	CH	A–7–6	51–70
Racombes: RA, RDX—Properties of Urban land in RDX are too variable to be estimated.	Frequent	Very brief	(3)	B	0–13	Sandy clay loam	CL, SC	A–6	27–35
					13–74	Sandy clay loom	CL, SC	A–6, A–7–6	30–45
Raymondville:									
RE, RM—Properties of Urban land in RM are too variable to be estimated.	None	None	(3)	D	0–14	Clay loam	CL	A–6, A–7–6	37–50
					14–25	Clay loam	CL	A–6, A–7–6	37–50
					25–78	Clay	CL	A–6, A–7–6	37–50
RG	None	None	36–72	D	0–15	Clay loam	CL	A–6, A–7–6	37–50
					15–63	Clay	CL	A–6, A–7–6	37–50
Reynosa—Mapped only in a complex with Laredo soils.	None	None	(3)	B	0–37	Silt loam	CL	A–6	30–40
					37–55	Silty clay loam, silt loam.	CL	A–6	30–40
					55–71	Very fine sandy loam.	CL-ML, ML	A–4, A–6	20–35
Rio: RO	Frequent	Brief	36–72	D	0–10	Clay loam	CL	A–6, A–7–6	35–45
					10–37	Clay	CH, CL	A–7–6	41–55
					37–63	Clay loam, sandy clay loam.	CL	A–6, A–7–6	35–50

See footnotes at end of table.

significant in engineering—Continued

Plasticity index	Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity to—	
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						Uncoated steel	Concrete
					Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos per cm*			
35-50	100	100	90-100	75-90	< 0.06	0.09-0.18	7.9-8.4	0-4	Very high	Very high	Low.
35-50	100	100	90-100	75-90	< 0.06	0.06-0.18	7.9-8.4	1-8	Very high	Very high	Low.
35-50	100	100	90-100	75-90	< 0.06	0.03-0.15	7.9-8.4	3-12	Very high	Very high	Low.
35-50	100	100	90-100	75-90	< 0.06	0.09-0.18	7.9-8.4	0-4	Very high	Very high	Low.
35-50	100	100	90-100	75-90	< 0.06	0.06-0.18	7.9-8.4	1-8	Very high	Very high	Low.
35-50	100	100	90-100	75-90	< 0.06	0.03-0.15	7.9-8.4	3-12	Very high	Very high	Low.
4-16	100	100	95-100	70-95	0.63-2.0	0.03-0.15	7.9-8.4	3-12	Low	Very high	Low.
NP	100	95-100	65-80	5-10	6.3-20	0.01-0.05	6.6-8.4	0-2	Very low	High	Moderate.
NP	100	95-100	65-80	5-10	6.3-20	0.00-0.01	7.4-8.4	60-200	Very low	Very high	High.
30-45	100	100	100	90-100	0.06-0.20	0.10-0.18	7.9-8.4	0-4	Very high	Very high	Low.
30-45	100	100	100	90-100	0.06-0.20	0.10-0.18	7.9-8.4	0-4	Very high	Very high	Low.
30-45	100	100	100	90-100	0.06-0.20	0.10-0.18	7.9-8.4	2-16	Very high	Very high	Low.
15-25	100	100	95-100	70-80	0.20-0.63	0.01-0.15	6.6-7.8	4-30	Moderate	High	Moderate.
20-37	100	100	90-100	75-95	0.06-0.20	0.01-0.09	6.6-8.4	8-30	Moderate	High	Moderate.
15-25	100	100	85-95	55-80	0.20-0.63	0.01-0.09	7.9-8.4	8-30	Moderate	High	Moderate.
20-30	100	100	100	80-90	0.20-0.63	0.03-0.16	7.9-8.4	2-14	Moderate	Very high	Moderate.
30-45	100	100	100	85-95	0.06-0.20	0.03-0.16	7.9-8.4	2-14	High	Very high	Moderate.
20-30	100	100	100	80-90	0.06-0.20	0.01-0.12	7.9-8.4	4-20	Moderate	Very high	Moderate.
30-45	100	100	100	85-95	0.06-0.20	0.01-0.09	7.9-8.4	8-30	High	Very high	Moderate.
12-24	100	100	95-100	45-65	0.63-2.0	0.15-0.20	6.6-7.8	0-2	Low	High	Low.
15-30	98-100	97-100	95-100	45-75	0.63-2.0	0.12-0.20	6.6-8.4	1-4	Low	High	Low.
22-35	100	100	100	80-90	0.20-0.63	0.11-0.18	7.9-8.4	0-4	Very high	Very high	Low.
22-35	100	100	100	80-90	0.06-0.20	0.11-0.18	7.9-8.4	1-4	Very high	Very high	Low.
22-35	100	100	95-100	80-90	0.06-0.20	0.06-0.18	7.9-8.4	2-10	Very high	Very high	Low.
22-35	100	100	100	80-90	0.06-0.20	0.01-0.15	7.9-8.4	4-30	Very high	Very high	Moderate.
22-35	100	100	95-100	80-90	0.06-0.20	0.01-0.10	7.9-8.4	8-30	Very high	Very high	Moderate.
11-20	100	100	95-100	80-95	0.63-2.0	0.16-0.24	7.9-8.4	0-2	Low	High	Low.
11-20	100	100	95-100	85-95	0.63-2.0	0.09-0.24	7.9-8.4	1-8	Moderate	High	Low.
2-12	100	100	95-100	70-95	0.63-2.0	0.06-0.20	7.9-8.4	1-8	Very low	High	Low.
15-22	100	100	95-100	70-80	0.63-2.0	0.11-0.20	6.6-7.8	0-4	Moderate	High	Low.
20-30	100	100	90-100	75-95	0.06-0.20	0.09-0.18	7.4-8.4	1-4	Moderate	High	Low.
15-27	100	100	85-95	55-80	0.20-0.63	0.05-0.18	7.9-8.4	1-12	Moderate	High	Low.

TABLE 5.—*Estimated soil properties*

Soil series and map symbols	Flood hazard		Depth to seasonal high water table	Hydrologic soil group	Depth from surface [1]	USDA texture	Classification		Liquid limit
	Frequency	Duration					Unified	AASHO	
			Inches		*Inches*				*Percent*
*Rio Grande:									
RR, RU, RZ	Infrequent	Brief	(2)	B	0–9	Silt loam	CL, CL-ML	A–4, A–6	20–35
					9–63	Silt loam, very fine sandy loam.	CL, CL-ML	A–4, A–6	20–35
For the Zalla part of RZ, see the Zalla series. Properties of Urban land in RU are too variable to be estimated.									
RT	Infrequent	Brief	(2)	B	0–17	Silty clay loam	CL	A–6, A–7	35–50
					17–63	Silt loam, very fine sandy loam.	CL, CL-ML	A–4, A–6	20–35
Sejita: SE, SU	Frequent	Brief	20–48	D	0–40	Silty clay loam	CL	A–6	30–40
Properties of Urban land in SU are too variable to be estimated.									
Tiocano: TC	Frequent	Long	(2)	D	0–74	Clay	CH	A–7–6	55–75
Urban land. Mapped only in complexes with Benito, Harlingen, Hidalgo, Laredo, Lomalta, Mercedes, Olmito, Point Isabel, Raymondville, Rio Grande, and Sejita soils and in an undifferentiated unit with Racombes soils. Properties are too variable to be estimated.									
Ustifluvents, clayey: USX.	Infrequent	Extremely brief.	(2)	D	0–60	Clay, clay loam	CH, CL	A–6, A–7	30–70
Willacy: WAA, WAB	None	None	(2)	B	0–14	Fine sandy loam	SC, SM-SC	A–4, A–2–4	20–30
					14–74	Fine sandy loam, sandy clay loam.	CL, SC	A–4, A–6	25–35
Willamar: WM	None	None	36–72	D	0–5	Fine sandy loam, sandy clay loam.	CL-ML, ML, SM, SM-SC	A–4	20–35
					5–30	Clay loam	CL	A–6	30–40
					30–60	Sandy clay loam	CL	A–6	30–40
Zalla: ZA	Frequent	Brief	(2)	A	0–63	Loamy fine sand	SM, SM-SP	A–2–4	-------

[1] See representative profile for each series in the section "Descriptions of the Soils" for more specific depths of horizons.
[2] Water table is below observed depths.

significant in engineering—Continued

Plasticity index	Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity to—	
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)						Uncoated steel	Concrete
					Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos per cm*			
4–16	100	100	95–100	70–95	0.63–2.0	0.16–0.24	7.9–8.4	0–2	Low	Moderate	Low.
4–16	100	100	95–100	70–95	0.63–2.0	0.12–0.24	7.9–8.4	0–4	Low	Moderate	Low.
15–30	100	100	100	80–95	0.63–2.0	0.18–0.22	7.9–8.4	0–2	Moderate	Moderate	Low.
4–16	100	100	95–100	70–95	0.63–2.0	0.12–0.24	7.9–8.4	0–4	Low	Moderate	Low.
11–18	100	100	100	85–100	0.20–0.63	0.00–0.01	7.4–9.0	35–70	Low	Very high	Moderate.
35–50	100	100	100	95–100	<0.06	0.09–0.18	6.6–8.4	0–4	Very high	Very high	Low.
11–45	95–100	90–100	85–100	80–90	<0.06	0.00–0.01	7.9–9.0	30–200	High	Very high	High.
5–10	100	100	95–100	30–45	2.0–6.3	0.14–0.18	6.6–7.8	0–2	Low	Moderate	Low.
8–16	98–100	97–100	95–100	36–55	0.63–2.0	0.10–0.18	7.4–8.4	0–4	Low	Moderate	Low.
1–7	100	100	100	36–70	0.63–2.0	0.10–0.18	6.6–8.4	0–4	Low	Very high	Moderate.
11–20	100	100	100	51–70	<0.06	0.01–0.09	7.4–9.0	8–30	Moderate	Very high	Moderate.
11–20	100	100	100	51–70	0.06–0.20	0.00–0.04	7.9–9.0	15–40	Moderate	Very high	Moderate.
NP	100	100	70–85	10–25	6.3–20.0	0.05–0.10	7.9–8.4	0–2	Very low	Very low	Low.

[3] In some irrigated fields, the water table may be at depths of 36 to 120 inches.
[4] NP means nonplastic.

TABLE 6.—*Interpretations of engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. series as indicated in the first column of this table. Soil characteristics in this table are expressed in computer- page 92, for definition of "percs slowly" and

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields [1]	Sewage lagoons	Shallow excavations [1]	Dwellings	Sanitary landfill [1, 2] (trench)	Local roads and streets
Barrada: BA	Severe: floods; percs slowly; wet.	Severe: floods; wet.	Severe: floods; too clayey; wet.	Severe: floods; shrink-swell; wet.	Severe: floods; too clayey; wet.	Severe: floods; low strength; shrink-swell; wet.
Benito: BE, BU. Properties of Urban land in BU are too variable for interpretations to be made.	Severe: percs slowly; wet.	Slight	Severe: floods; too clayey; wet.	Severe: floods; shrink-swell; wet.	Severe: floods; too clayey; wet.	Severe: low strength; shrink-swell; wet.
Camargo: CA, CC	Moderate: floods.	Moderate: seepage.	Severe: floods	Severe: floods	Severe: floods	Moderate: floods; low strength; shrink-swell.
Cameron:						
CE	Slight	Severe: seepage.	Moderate: wet.	Severe: shrink-swell.	Severe: too clayey.	Severe: low strength; shrink-swell.
CF	Moderate: wet.	Severe: seepage.	Severe: wet	Severe: shrink-swell.	Severe: too clayey; wet.	Severe: low strength; shrink-swell.
Chargo: CH	Severe: percs slowly.	Moderate: wet.	Severe: too clayey; wet.	Severe: shrink-swell.	Severe: too clayey; wet.	Severe: low strength; shrink-swell.
Coastal beach: CO. Properties are too variable for interpretations to be made.						
Coastal dunes: CU. Properties are too variable for interpretations to be made.						
Delfina: DE	Severe: percs slowly.	Slight	Slight	Moderate: shrink-swell.	Slight	Moderate: low strength; shrink-swell.
Galveston: GA	Severe: floods	Severe: seepage.	Severe: too sandy.	Severe: floods	Severe: floods; too sandy.	Moderate: floods.
Grulla: GR	Severe: floods; percs slowly.	Severe: floods	Severe: floods; too clayey; wet.	Severe: floods; shrink-swell; wet.	Severe: floods; too clayey; wet.	Severe: low strength; shrink-swell; wet.
Harlingen:						
HA, HE. Properties of Urban land in HE are too variable for interpretations to be made.	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: low strength; shrink-swell.
HC	Severe: shrink-swell.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: low strength; shrink-swell.

See footnotes at end of table.

properties of the soils

The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to refer to other adapted terms that differ from those in the Soil Survey Manual. Refer to "Computer-Adapted Terms," other terms that describe soil characteristics]

Degree and kind of limitation for—Continued			Suitability as a source of—		Soil features affecting—	
Light industry	Pond reservoir areas	Pond embankments	Road fill	Topsoil	Drainage of crops and pasture	Irrigation
Severe: floods; shrink-swell; wet.	Severe: floods	Moderate: compressible; low strength; unstable fill.	Poor: low strength; shrink-swell; wet.	Poor: excess salt; too clayey; wet.	Excess salt; floods; percs slowly.	Excess salt; floods; wet.
Severe: floods; shrink-swell; wet.	Moderate: seepage.	Moderate: compressible; low strength; unstable fill.	Poor: low strength; shrink-swell; wet.	Poor: excess salt; too clayey; wet.	Floods: percs slowly; wet.	Excess salt; floods; slow intake; wet.
Severe: floods	Severe: seepage	Moderate: compressible; piping.	Fair: low strength; shrink-swell.	Fair: excess lime; too clayey.	All features favorable.	All features favorable.
Severe: shrink-swell.	Severe: seepage	Moderate: compressible; piping.	Poor: low strength; shrink-swell.	Poor: too clayey.	Percs slowly	Slow intake.
Severe: shrink-swell.	Severe: seepage	Moderate: compressible; piping.	Poor: low strength; shrink-swell.	Poor: excess salt; too clayey.	Percs slowly	Excess salt; slow intake
Severe: shrink-swell.	Moderate: seepage.	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: excess salt; too clayey.	Percs slowly	Excess salt; slow intake.
Moderate: shrink-swell.	Moderate: seepage.	Slight	Fair: low strength; shrink-swell.	Fair: thin layer.	All features favorable.	Seasonal High water table.
Severe: floods	Severe: seepage	Severe: seepage; piping; unstable fill.	Good	Poor: too sandy.	Cutbanks cave	Droughty; erodes easily; rapid intake.
Severe: floods; shrink-swell; wet.	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: too clayey.	Percs slowly; wet.	Slow intake; wet.
Severe: shrink-swell.	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: too clayey.	Percs slowly	Slow intake.
Severe: shrink-swell.	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: excess salt; too clayey.	Percs slowly	Excess salt; slow intake.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields [1]	Sewage lagoons	Shallow excavations [1]	Dwellings	Sanitary landfill [1, 2] (trench)	Local roads and streets
Hidalgo:						
HGA, HGB	Slight	Moderate: seepage.	Slight	Moderate: shrink-swell.	Slight	Moderate: low strength; shrink-swell.
HO, HU. Properties of Urban land in HU are too variable for interpretations to be made.	Slight	Moderate: seepage.	Slight	Moderate: shrink-swell.	Slight	Moderate: low strength; shrink-swell.
*Laredo:						
LAA, LAB, LD, LEA, LEB, LG. For the Olmito part of LD and the Reynosa part of LEA and LEB, see the Olmito and Reynosa series. Properties of Urban land in LG are too variable for interpretations to be made.	Moderate: percs slowly.	Moderate: seepage.	Slight	Moderate: shrink-swell.	Slight	Moderate: low strength; shrink-swell.
LC	Moderate: percs slowly; wet.	Moderate: seepage.	Severe: wet	Moderate: shrink-swell; wet.	Severe: wet	Moderate: low strength; shrink-swell; wet.
Latina: LK	Severe: percs slowly; wet.	Severe: floods; wet.	Severe: wet	Severe: floods; wet.	Severe: wet	Moderate: low strength.
Lomalta: LM, LO. Properties of Urban land in LO are too variable for interpretations to be made.	Severe: percs slowly.	Severe: floods; wet.	Severe: floods; too clayey; wet.	Severe: floods; shrink-swell; wet.	Severe: floods; too clayey; wet.	Severe: low strength; shrink-swell; wet.
Lozano: LR	Severe: percs slowly.	Moderate: wet.	Moderate: wet.	Moderate: shrink-swell.	Severe: wet	Moderate: low strength; shrink-swell.
Lyford: LY	Moderate: percs slowly; wet.	Moderate: wet.	Moderate: wet.	Moderate: shrink-swell.	Severe: wet	Moderate: low strength; shrink-swell.
*Matamoros: MA, MC. For the Rio Grande part of MC, see the Rio Grande series.	Severe: floods; percs slowly.	Severe: floods.	Severe: floods; too clayey.	Severe: floods; shrink-swell.	Severe: floods; too clayey.	Severe: floods; low strength; shrink-swell.
Mercedes:						
MEA, MEB, MM. Properties of Urban land in MM are too variable for interpretations to be made.	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: low strength; shrink-swell.
MGC	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: low strength; shrink-swell.

properties of the soils—Continued

Degree and kind of limitation for—Continued			Suitability as a source of—		Soil features affecting—	
Light industry	Pond reservoir areas	Pond embankments	Road fill	Topsoil	Drainage of crops and pasture	Irrigation
Moderate: shrink-swell.	Moderate: seepage.	Moderate: compressible.	Fair: low strength; shrink-swell.	Good	All features favorable.	All features favorable.
Moderate: shrink-swell.	Moderate: seepage.	Moderate: compressible.	Fair: low strength; shrink-swell.	Fair: too clayey.	All features favorable.	All features favorable.
Moderate: shrink-swell.	Severe: seepage	Moderate: compressible.	Fair: low strength; shrink-swell.	Fair: too clayey.	All features favorable.	All features favorable.
Moderate: shrink-swell; wet.	Severe: seepage	Moderate: compressible.	Fair: low strength; shrink-swell.	Poor: excess salt.	All features favorable.	Excess salt.
Severe: floods; wet.	Slight	Moderate: compressible; piping.	Fair: low strength; wet.	Poor: excess salt; too clayey.	Excess salt; floods.	Excess salt; wet.
Severe: floods; shrink-swell; wet.	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell; wet.	Poor: excess salt; too clayey; wet.	Excess salt; floods.	Excess salt; floods; slow intake; wet.
Moderate: shrink-swell.	Moderate: seepage.	Moderate: compressible.	Fair: low strength; shrink-swell.	Fair: thin layer.	All features favorable.	Seasonal high water table.
Severe: shrink-swell.	Moderate: seepage.	Moderate: compressible.	Fair: low strength; shrink-swell.	Fair: too clayey.	All features favorable.	Seasonal high water table.
Severe: floods; shrink-swell.	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: too clayey.	Percs slowly	Slow intake.
Severe: shrink-swell.	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: too clayey.	Percs slowly	Slow intake.
Severe: shrink-swell.	Slight	Moderate: compressible; unstable fill.	Poor: low strength: shrink-swell.	Poor: too clayey.	Percs slowly	Slope: slow intake.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields [1]	Sewage lagoons	Shallow excavations [1]	Dwellings	Sanitary landfill [1, 2] (trench)	Local roads and streets
Mustang:						
MS	Severe: floods; wet.	Severe: floods; wet; seepage.	Severe: floods; too sandy; wet.	Severe: floods; wet.	Severe: floods; too sandy; wet.	Severe: wet
MU	Severe: floods; wet.	Severe: floods; wet; seepage.	Severe: floods; too sandy; wet.	Severe: floods; wet.	Severe: floods; too sandy; wet.	Severe: wet
Olmito: OM, ON. Properties of Urban land in ON are too variable for interpretations to be made.	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: low strength; shrink-swell.
Orelia variant: OR	Severe: floods; percs slowly; wet.	Severe: floods; wet.	Severe: floods; too clayey; wet.	Severe: floods; wet.	Severe: floods; too clayey; wet.	Moderate: low strength; shrink-swell; wet.
Point Isabel: PO, PU. Properties of Urban land in PU are too variable for interpretations to be made.	Severe: percs slowly.	Severe: slope	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: low strength; shrink-swell.
Racombes: RA, RDX. Properties of Urban land in RDX are too variable for interpretations to be made.	Severe: floods	Moderate: seepage.	Slight	Severe: floods	Severe: floods	Severe: floods
Raymondville:						
RE, RM. Properties of Urban land in RM are too variable for interpretations to be made.	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: shrink-swell.
RG	Severe: percs slowly.	Slight	Severe: too clayey.	Severe: shrink-swell.	Severe: too clayey.	Severe: shrink-swell.
Reynosa. Mapped only in a complex with Laredo soils.	Moderate: percs slowly.	Moderate: seepage.	Slight	Moderate: shrink-swell.	Slight	Moderate: low strength; shrink-swell.
Rio: RO	Severe: floods; percs slowly.	Severe: floods	Severe: floods; too clayey; wet.	Severe: floods; wet.	Severe: floods; too clayey; wet.	Severe: floods
*Rio Grande:						
RR, RU, RZ. For the Zalla part of RZ, see the Zalla series. Properties of Urban land in RU are too variable for interpretations to be made.	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods
RT	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods	Severe: floods

properties of the soils—Continued

Degree and kind of limitation for—Continued			Suitability as a source of—		Soil features affecting—	
Light industry	Pond reservoir areas	Pond embankments	Road fill	Topsoil	Drainage of crops and pasture	Irrigation
Severe: floods; wet.	Severe: seepage	Severe: seepage; piping; unstable fill.	Poor: wet	Poor: too sandy; wet.	Cutbanks cave: floods; wet.	Rapid intake; wet.
Severe: floods; wet.	Severe: seepage	Severe: seepage; piping; unstable fill.	Poor: wet	Poor: excess salt; too sandy; wet.	Wet areas lower than available outlets.	Excess salt; rapid intake; wet.
Severe: shrink-swell.	Moderate: seepage.	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: too clayey.	Percs slowly	Slow intake.
Severe: floods; shrink-swell; wet.	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink swell.	Poor: excess salt.	Slowly permeable.	Excess salt; slow intake.
Severe: shrink-swell; slope.	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: excess salt; too clayey.	Percs slowly; slope.	Excess salt; slope; slow intake.
Severe: floods	Moderate: seepage.	Slight	Fair: low strength.	Fair: too clayey.	All features favorable.	All features favorable.
Severe: shrink-swell.	Slight	Moderate: compressible.	Poor: shrink-swell.	Fair: too clayey.	Percs slowly	Slow intake.
Severe: shrink-swell.	Slight	Moderate: compressible.	Poor: shrink-swell.	Poor: excess salt.	Percs slowly	Excess salt; slow intake.
Moderate: shrink-swell.	Moderate: seepage.	Moderate: compressible.	Fair: low strength; shrink-swell.	Good	All features favorable.	All features favorable.
Severe: floods; wet.	Slight	Moderate: compressible.	Fair: low strength; shrink-swell; wet.	Fair: too clayey.	All features favorable.	Slow intake.
Severe: floods	Severe: seepage	Moderate: compressible; unstable fill.	Fair: low strength.	Good	All features favorable.	All features favorable.
Severe: floods	Severe: seepage	Moderate: compressible; unstable fill.	Fair: low strength.	Fair: too clayey.	All features favorable.	All features favorable.

TABLE 6.—*Interpretations of engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields [1]	Sewage lagoons	Shallow excavations [1]	Dwellings	Sanitary landfill [1, 2] (trench)	Local roads and streets
Sejita: SE, SU---- Properties of Urban land in SU, are too variable for interpretations to be made.	Severe: floods; wet.	Severe: floods; wet.	Severe: floods; wet.	Severe: floods; wet..	Severe: floods; wet.	Severe: floods; wet.
Tiocano: TC----	Severe: floods; percs slowly.	Severe: floods--	Severe: floods; too clayey; wet.	Severe: floods; shrink-swell; wet.	Severe: floods; too clayey; wet.	Severe: floods; low strength; shrink-swell.
Urban land. Mapped only in complexes with Benito, Harlingen, Hidalgo, Laredo, Lomalta, Mercedes, Olmito, Point Isabel, Raymondville, Rio Grande, and Sejita soils and in an undifferentiated unit with Racombes soil. Properties are too variable for interpretations to be made.						
Ustifluvents, clayey: USX.	Severe: percs slowly.	Severe: floods--	Severe: too clayey.	Severe: floods--	Severe: too clayey.	Severe: low strength; shrink-swell.
Willacy: WAA, WAB----	Slight----	Moderate: seepage.	Slight----	Slight----	Slight----	Moderate: low strength.
Willamar: WM----	Severe: percs slowly.	Slight----	Severe: wet----	Moderate: shrink-swell; wet.	Severe: wet----	Severe: low strength; shrink-swell.
Zalla: ZA----	Severe: floods--	Severe: floods; seepage.	Severe: floods; too sandy.	Severe: floods--	Severe: floods; seepage.	Severe: floods--

[1] Water table is at a depth of 3 to 10 feet in some irrigated areas. Field observations may determine that some soils rated slight may have moderate or severe limitations.

contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning in soil science. The Glossary defines many of these terms.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified Soil Classification System[4] used by the SCS engineers, Department of Defense, and others, and the AASHTO system[5] adopted by the American Association of State Highway and Transportation Officials.

In the Unified Soil Classification System soils are classified according to particle size distribution, plasticity, liquid limit, and organic matter. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL–ML.

[4] UNITED STATES DEPARTMENT OF DEFENSE. Unified soil classification system for roads, airfields, embankments and foundations. MIL–STD–619B, 30 pp., illus. 1968.

[5] AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 v., illus. 1970.

properties of the soils—Continued

Degree and kind of limitation for—Continued			Suitability as a source of—		Soil features affecting—	
Light industry	Pond reservoir areas	Pond embankments	Road fill	Topsoil	Drainage of crops and pasture	Irrigation
Severe: floods; wet.	Slight	Moderate: compressible.	Poor: wet	Poor: excess salt; wet.	Excess salt; floods; wet.	Excess salt; floods; wet.
Severe: floods; shrink-swell; wet.	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: too clayey.	Floods: percs slowly; wet.	Floods: slow intake; wet.
Severe: floods	Slight	Moderate: compressible; unstable fill.	Poor: low strength; shrink-swell.	Poor: excess salt.	Excess salt; percs slowly.	Excess salt; slow intake.
Slight	Moderate: seepage.	Slight	Fair: low strength.	Fair: thin layer.	All features favorable.	All features favorable.
Moderate: shrink-swell; wet.	Slight	Moderate: compressible.	Poor: low strength; shrink-swell.	Poor: excess salt; thin layer.	Excess salt; percs slowly.	Excess salt; slow intake.
Severe: floods	Severe: seepage	Severe: piping; unstable fill.	Good	Poor: too sandy.	Cutbanks cave	Rapid intake.

[2] Onsite deep studies of the underlying strata, water table, and hazards of aquifer pollution and drainage into ground water need to be made for landfills deeper than 5 or 6 feet.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided 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.

Estimated engineering properties of the soils

Several estimated soil properties significant in engineering are given in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observation made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 5.

Flood hazard is described in terms of the frequency of occurrence and the duration of flooding. Frequency and duration classes are defined in the Glossary.

The depth of the seasonl high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

The depth to bedrock is the distance from the surface of the soil to the upper surface of the rock

TABLE 7.—*Engineering*

[Tests performed by the Texas

Soil name and location	Parent material	Report No.	Depth	Shrinkage limit	Linear shrinkage
			Inches	*Percent*	*Percent*
Harlingen clay:					
1120 feet east and 40 feet north of NW. corner, Block 155, San Benito Land and Water Company Subdivision; 4 miles southwest of San Benito. (Modal).	Calcareous alluvial sediments.	95–R	23–35	13	21.9
Laredo silty clay loam:					
0.9 mile south of Rangerville school on Farm Road 1479 and 200 feet west in a cultivated field; 8.0 miles southwest of Harlingen.	Calcareous alluvial sediments.	88–R 89–R	8–18 18–46	16 18	11.2 8.0
Lomalta clay:					
1.6 miles south on Farm Road 1847 from its intersection with State Highway 100 in Los Fresnos, Texas; 780 feet east of right-of-way. (Modal)	Calcareous saline alluvial or lagoonal deposits.	74–R 75–R	13–29 29–39	13 12	21.9 22.6
Racombes sandy clay loam:					
240 feet south and 60 feet west of NE. corner, Block 87, Hodges Subdivision; 4.5 miles southeast of Santa Rosa. (Modal)	Deltaic or marine terraces.	78–R 79–R	17–31 44–75	14 12	10.7 9.8
800 feet east and 120 feet south of NW. corner, Block 8, David and Stevenson Subdivision; 0.9 mile east of Combes (Less clayey than modal profile)	Deltaic or marine terraces.	76–R 77–R	18–39 47–63	14 12	13.2 10.5
2.9 miles south of Farm Road 107 on Tamm Lane Road then 70 feet east of right-of-way; 1.75 miles southwest of Primera. (Less clayey than modal profile)	Deltaic or marine terraces.	80–R 81–R	16–25 41–89	15 11	8.9 12.9
Raymondville clay loam:					
260 feet east and 85 feet south of NW. corner, Block 8, Agua Dulce Farms Subdivison; 4 miles northeast of Combes. (Modal)	Old calcareous alluvium.	84–R 85–R	25–43 60–78	13 11	15.8 17.6
250 feet west and 180 feet north of SE. corner, Block 5, B. F. Clark Subdivison; 1.0 mile north of Combes. (Less clayey than modal profile)	Old calcareous alluvium.	82–R 83–R	29–41 50–72	15 11	11.2 14.8
1200 feet south and 80 feet east of NE. corner, Block 15, B. F. Clark Subdivision; 1.5 miles northeast of Combes. (Less clayey than modal profile)	Old calcareous alluvium.	86–R [2] 87–R	23–39 46–70	11 10	15.4 17.5
Willacy fine sandy loam:					
135 feet north and 215 feet west of SE. corner, Block 16, Combes Subdivision; 1.5 miles southeast of Sebastian. (Modal)	Deltaic or marine terraces.	65–70–R 71–R 72–R 73–R	5–14 19–33 38–52 52–74	18 17 16 17	4.6 5.2 6.4 5.8

[1] Mechanical analyses according to AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICALS, standard specifications for highway materials and methods of sampling and testing, Ed. 8, 2v., illus. 1961. AASHO Designation T 88. Results by this procedure frequently may differ from results that would have been obtained by the soil survey procedure of the Soil Conservation Service(SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses

layer. Depth to bedrock is not given in table 5 because the depth to bedrock is more than 10 feet in all the soils of Cameron County.

In the column headed "Hydrologic soil group," the soils are placed in one of four groups according to their ability to restrain runoff from a heavy storm after they have been thoroughly wetted. The groups range from tight clays (highest runoff potential—Group D) to open sands (lowest runoff potential—Group A).

Soils in group A have a high infiltration rate, even when they are thoroughly wetted. They have a high rate of water transmission and low runoff potential. The soils of this group are deep, are well drained or excessively drained, and consist chiefly of sand, gravel, or both.

Soils in group B have a moderate infiltration rate when they are thoroughly wetted. Their rate of water transmission and their runoff potential are moderate. These soils are moderately deep or deep, moderately well drained or well drained, and fine textured to moderately coarse textured.

test data

Highway Department except as noted]

Shrinkage ratio	Mechanical analysis [1]							Liquid limit	Plasticity index	Classification [2]	
	Percentage passing sieve—				Percentage smaller than—					AASHO [3]	Unified [4]
	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.005 mm	0.0002 mm				
1.92	----------	----------	----------	99	99	84	68	71	50	A-7-6	CH
1.79	----------	100	99	99	96	41	33	40	20	A-6	CL
1.74	----------	----------	----------	99	99	42	35	34	14	A-6	CL
1.91	----------	----------	----------	99	98	81	67	73	52	A-7-6	CH
1.93	----------	----------	----------	99	99	82	53	73	51	A-7-6	CH
1.85	----------	100	99	61	57	40	35	36	23	A-6	CL
1.93	99	97	97	62	58	37	32	31	19	A-6	CL
1.86	----------	----------	100	61	57	39	34	42	28	A-7-6	CL
1.91	100	99	98	58	51	35	28	33	21	A-6	CL
1.82	----------	100	99	50	45	32	29	33	20	A-6	SC
2.00	100	99	99	71	70	51	40	36	24	A-6	CL
1.96	----------	100	96	82	79	57	47	48	33	A-7-6	CL
2.00	----------	----------	----------	87	83	61	49	50	35	A-7-6	CL or CH
1.80	----------	100	98	80	74	51	42	38	22	A-6	CL
2.00	----------	100	99	89	86	56	43	42	29	A-7-6	CL
1.97	----------	100	96	81	77	52	44	45	30	A-7-6	CL
2.02	----------	100	97	87	82	57	49	49	35	A-7-6	CL
1.72	----------	----------	100	42	33	19	16	27	8	A-4	SC
1.76	----------	----------	100	46	36	33	20	27	9	A-4	SC
1.82	99	98	97	50	45	28	25	28	15	A-6	SC
1.78	98	97	97	48	38	24	21	28	12	A-6	SC

used in this table are not suitable for use in naming textural classes for soil.

[2] Unified and AASHO classification made by the Soil Conservation Service.

[3] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-49.

[4] Based on the Unified Classification System, UNITED STATES DEPARTMENT OF DEFENSE, unified soil classification system for roads, airfields, embankments and foundations. MIL-STD-619B, 30 pp. 1968.

Soils in group C have a slow infiltration rate when they are thoroughly wetted. Their rate of water transmission is slow, and their potential runoff is high. These soils have a layer that impedes the downward movement of water, or they are moderately fine textured or fine textured and they have a slow infiltration rate.

Soils in group D have a slow infiltration rate when they are thoroughly wetted. Their rate of water transmission is very slow, and their runoff potential is very high. In this group are (1) clay soils that have high shrink-swell potential, (2) soils that have a permanent high water table, (3) soils that have a claypan or clay layer at or near the surface, and (4) soils that are shallow over nearly impervious material.

Soil texture is described in table 5 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. "Sand,"

"silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey. There are no gravelly or stony soils in Cameron County.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a solid to a semisolid. If the moisture content is further increased, the material changes from a semisolid to a plastic and finally to a liquid. The plastic limit is the moisture content at which the soil material changes from semisolid to plastic, and the liquid limit, from a plastic to a 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. Liquid limit and plasticity index are estimated in table 5, but in table 7 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 6 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the amount of water a soil can hold and make available for use by most plants. It is the numerical difference between the amount of water at field capacity and the amount at the wilting point of most crop plants. The rate is expressed as inches of water per inch of soil depth.

Reaction is the degree of acidity of alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its corrosiveness to metals and concrete.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Corrosivity, as used in table 5, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Engineering interpretations

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in this survey area and in others nearby or adjoining, and on the experience that engineers and soil scientists have with the soils of Cameron County. In table 6, ratings are used to summarize limitations or suitability of the soils for all listed purposes other than for drainage of crops and pasture and irrigation. For these particular uses, table 6 lists those soil features not be overlooked in planning, installation, and maintenance.

Following are explanations of most of the columns in table 6.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 18 inches to 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet, long enough for bacteria to decompose the solids. A lagoon has a nearly level floor, and sides, or embankments of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries.

Dwellings, as rated in table 6, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Unless otherwise stated, the ratings in table 6 apply only to a depth of about 6 feet, and therefore limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. For some soils reliable predictions can be made to a depth of 10 or 15 feet, but regardless of this, every site should be investigated before it is selected.

Local roads and streets, as rated in table 6, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, shells, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly

asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Ratings for light industry are for the undisturbed soils that are used to support building foundations. Emphasis is on foundations, ease of excavation for underground utilities, and corrosion potential of uncoated steel pipe. The undisturbed soil is rated for spread footing foundations for buildings less than three stories high or foundation loads not in excess of that weight.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage.

Pond embankments are raised structures of soil material constructed across drainageways in order to impound water. These embankments are generally less than 20 feet high, are constructed of "homogeneous" soil material, and compacted to medium density. Embankments having core and shell type construction are not rated in this table. Embankment foundation, reservoir area, and slope are assumed to be suitable for pond construction. Soil properties are considered that affect the embankment and the availability of borrow material.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage, and (2) the relative ease of excavating the material at borrow areas.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or its response of plants when fertilizer is applied, and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties are generally favorable for the rated use, or in other words, limitations are minor and easily overcome or modified by special planning and design. *Moderate* means soil properties are moderately favorable for the rated use. Limitations can be overcome or modified with special planning, design, or maintenance. Some of the limitations can be tolerated. *Severe* means soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms *good, fair,* and *poor,* which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Soil characteristics in table 6 are expressed in computer-adapted terms that differ from those in the Soil Survey Manual. Refer to Computer-Adapted Terms, page 92, for the definitions of terms that describe soil characteristics.

Engineering test data

Table 7 contains engineering test data for some of the major soil series in Cameron County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Shrinkage limit is the percentage of moisture at which shrinkage of the soil material stops.

Linear shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the given value of the shrinkage limit.

Shrinkage ratio is the relation of change in volume of the soil material to the water content of the soil material when at the shrinkage limit. The change in volume is expressed as a percentage of the air-dry volume of the soil material, and the water content is expressed as a percentage of the weight of the soil material when ovendry.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 5.

Use of the Soils for Recreational Development

Many areas of Cameron County have a medium potential to high potential for the development of various types of recreation enterprises. The county has many scenic, natural, and historical areas that are of special interest to the outdoor recreationist. The county contains about 30 miles of coastal beaches along the Gulf of Mexico. Abundant and unique fishing is available in the warm waters of the Gulf of Mexico and Laguna Madre. Cameron County is a winter resort area and a major gateway to Mexico. The mild winters provide for year-round outdoor activities.

Knowledge of soils is necessary in planning, developing, and maintaining areas used for recreation. In table 8 the soils of Cameron County are rated according to limitations that affect their suitability for camp areas, playgrounds, picnic areas, and paths and trails.

In table 8 of the soil limitations for the specified uses are expressed as slight, moderate, or severe. It is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, intense management, or a combination of these, is required.

Soil characteristics in table 8 are expressed in computer-adapted terms that differ from those in the Soil Survey Manual. Refer to Computer-Adapted Terms, page 92, for the definitions of terms that describe soil characteristics.

TABLE 8.—*Limitations of the soils for recreational development*

[Soil characteristics in this table are expressed in computer-adapted terms that differ from those in the Soil Survey Manual. Refer to "Computer-adapted terms," page 92, for the definition of "percs slowly" and other terms that describe soil characteristics]

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Barrada: BA	Severe: floods; percs slowly; wet.	Severe: floods; too clayey; wet.	Severe: floods; percs slowly; wet.	Severe: floods; too clayey; wet.
Benito: BE, BU Ratings are for Benito soils only in these mapping units. Urban land in BU is too variable to be rated.	Severe: percs slowly; wet.	Severe: too clayey; wet.	Severe: percs slowly; too clayey; wet.	Severe: too clayey; wet.
Camargo:				
CA	Slight	Slight	Slight	Slight.
CC	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey.
Cameron: CE, CF	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Chargo: CH	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Coastal beach: CO. Too variable to be rated.				
Coastal dunes: CU. Too variable to be rated.				
Delfina: DE	Slight	Slight	Slight	Slight.
Galveston: GA	Severe: too sandy	Severe: too sandy	Severe: too sandy	Severe: too sandy.
Grulla: GR	Severe: floods; percs slowly; wet.	Severe: floods; too clayey; wet.	Severe: floods; percs slowly; wet.	Severe: floods; too clayey; wet.
Harlingen: HA, HC, HE Ratings are for Harlingen soils only in these mapping units. Urban land in HE is too variable to be rated.	Severe: percs slowly; too clayey.	Severe: too clayey	Severe: percs slowly; too clayey.	Severe: too clayey.
Hidalgo:				
HGA	Slight	Slight	Slight	Slight.
HGB	Slight	Slight	Moderate: slope	Slight.
HO, HU Ratings are for Hidalgo soils only in these mapping units. Urban land in HU is too variable to be rated.	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey.
Laredo:				
LAA, LC, LD, LEA, LG Ratings are for Laredo soils only in these mapping units. For the Olmito part of LD and the Reynosa part of LEA, see the Olmito and Reynosa series. Urban land in LG is too variable to be rated.	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey.
LAB, LEB For the Reynosa part of LeB, see Reynosa series.	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey; slope.	Moderate: too clayey.

TABLE 8.—*Limitations of the soils for recreational development—Continued*

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Latina: LK	Severe: wet	Moderate: too clayey; wet.	Severe: wet	Moderate: too clayey; wet.
Lomalta: LM, LO. Ratings are for Lomalta soils only in these mapping units. Urban land part of LO is too variable to be rated.	Severe: percs slowly; too clayey; wet.	Severe: too clayey; wet.	Severe: percs slowly; too clayey; wet.	Severe: too clayey; wet.
Lozano: LR	Moderate: percs slowly	Slight	Moderate: percs slowly	Slight.
Lyford: LY	Moderate: too clayey; wet.	Moderate: too clayey; wet.	Moderate: too clayey; wet.	Moderate: too clayey.
Matamoros: MA, MC. Ratings are for Matamoros soils only in these mapping units. For the Rio Grande part of MC, see the Rio Grande series.	Severe: floods; too clayey.	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Mercedes: MEA, MEB, MGC, MM. Ratings are for Mercedes soils only in these mapping units. Urban land in MM is too variable to be rated.	Severe: percs slowly; too clayey.	Severe: too clayey	Severe: percs slowly; too clayey.	Severe: too clayey.
Mustang: MS, MU	Severe: too sandy; wet	Severe: too sandy; wet	Severe: too sandy; wet	Severe: too sandy; wet.
Olmito: OM, ON. Ratings are for Olmito soils only in these units. Urban land in ON is too variable to be rated.	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Orelia variant: OR	Severe: wet	Moderate: too clayey	Severe: wet	Moderate: too clayey.
Point Isabel: PO, PU. Ratings are for Point Isabel soils only in these mapping units. Urban land in PU is too variable to be rated.	Moderate: too clayey	Moderate: too clayey	Severe: slope	Moderate: too clayey.
Racombes: RA, RDX. Ratings are for Racombes soils only in these mapping units. Urban land in RDX is too variable to be rated.	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey	Moderate: too clayey
Raymondville: RE, RG, RM. Ratings are for Raymondville soils only in these mapping units. Urban land in RM is too variable to be rated.	Moderate: percs slowly; too clayey.	Moderate: too clayey	Moderate: percs slowly; too clayey.	Moderate: too clayey.
Reynosa. Mapped only in a complex with Laredo soils.	Slight	Slight	Slight	Slight.

TABLE 8.—*Limitations of the soils for recreational development—Continued*

Rio: RO	Severe: wet	Moderate: too clayey; wet.	Moderate: percs slowly; too clayey; wet.	Moderate: too clayey; wet.
Rio Grande: RR, RU, RZ. Ratings are for Rio Grande soils only in these mapping units. For the Zalla part of RZ, see the Zalla series. Urban land in RU is too variable to be rated.	Severe: floods	Slight	Moderate: floods	Slight.
RT	Severe: floods	Moderate: too clayey	Moderate: floods; too clayey.	Moderate: too clayey.
Sejita: SE, SU. Ratings are for Sejita soils only in these mapping units. Urban land part of SU is too variable to be rated.	Severe: wet	Severe: wet	Severe: wet	Severe: wet.
Tiocano: TC	Severe: percs slowly; too clayey; wet.	Severe: too clayey; wet.	Severe: percs slowly; too clayey; wet.	Severe: too clayey; wet.
Urban land. Mapped only in complexes with Benito, Harlingen, Hidalgo, Laredo, Lomalta, Mercedes, Olmito, Point Isabel, Raymondville, Rio Grande, and Sejita soils and in an undifferentiated unit with Racombes soils. Too variable to be rated.				
Ustifluvents, clayey: USX	Severe: too clayey	Severe: too clayey	Severe: too clayey	Severe: too clayey.
Willacy: WAA, WAB	Slight	Slight	Slight	Slight.
Willamar: WM	Severe: percs slowly	Moderate: wet	Severe: percs slowly	Moderate: wet.
Zalla: ZA	Severe: floods	Moderate: floods; too sandy.	Moderate: floods; too sandy.	Moderate: too sandy.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Picnic areas are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are free of flooding during the season of use, do not have slopes that greatly increase cost of leveling sites or of building access roads.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

Paths and trails are used for local and cross country travel by foot or horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, and have slopes of less than 15 percent.

Formation and Classification of the Soils

This section explains how soils form and discusses the factors that affected the formation of soils in Cameron County. It describes briefly the current system of soil classification and classifies the soil series represented in the county by higher categories.

Factors of Soil Formation

Soil is the product of the interaction of the five major factors of soil formation. These factors are climate, living organisms (especially vegetation), parent material, relief, and time. The kind of soil that forms in one area differs from the kind of soil in another area if there has been a difference between the two areas in one or more of the major factors.

Climate

Rainfall, temperature, humidity, and wind have been important in the formation of soils in Cameron County. The wet climate of past geologic ages influenced the deposition of parent materials. Later, rainfall was limited as it is today, and it seldom wets the soil below the root zone. As a result, horizons of calcium carbonate formed in many of the soils. Most of the soils have lime throughout the profile because not enough rainwater has moved downward to leach out the lime.

Wind has definitely affected the formation of soils in this county. The soil materials that made up the offshore barrier islands—Padre and Boca Chica—were deposited by waves and currents and later reworked by wind into complex dunes. Soil blowing from intermittently dry depressions along the Gulf Coast resulted in the formation of clay dunes occupied by soils of the Point Isabel series. The poorly defined, northwest-tending grain of the topography north of the Arroyo Colorado indicates that eolian activity has affected the formation of the soils.

Living organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. The gains in content of organic matter and supply of nitrogen in the soil, gains or losses in other plant nutrients, and changes in structure and porosity are among the changes caused by living organisms.

Vegetation, dominantly grass, has affected soil formation in Cameron County more than any other living organism. Mid and tall grasses contributed a large amount of organic matter to the soil. The network of roots has left tubes and pores that provide passageways for air and water.

Earthworms and other animals have mixed soil materials and have helped in the downward movement of air, water, and plant roots in the soil.

The influence of man has considerably affected the soils of this county. Man plowed the soils and planted crops. By tillage and using heavy machinery, he compacted the soil material and reduced aeration and infiltration of water and consequently the growth of plant roots. Many soil areas have been considerably altered by land leveling, and in some areas the natural formations have been completely destroyed. Man has changed the moisture supply by irrigation and, in some places, drainage.

Parent material

The soils of Cameron County formed in geologic materials of Pleistocene age or younger. Most of the soils formed in fluviatile deposits. The older deposits in the northern part of the county have probably been reworked by wind. The geology of the parent material is discussed in more detail in the section, "Surface Geology."

Relief

Cameron County is on a nearly level coastal plain where slopes generally are less than 1 percent. The fluviatile deposition of the parent materials determined relief in the county.

Relief has influenced soil formation in this County through its effect on drainage and runoff. The degree of development of a soil profile depends on the amount of water that enters a soil provided other factors of soil formation are equal. For example, Willacy soils, which are higher and better drained, absorb less moisture and have less well-developed profiles than Racombes soils, which are in weakly concave depressions that receive extra water.

Time

The characteristics of a soil are determined mainly by the length of time that the soil-forming factors have been active. A long time is generally required for the formation of well-defined, genetically related horizons. Geologically, the soils of Cameron County are very young. There are differences in the age of these soils, however, that can be noted from the appearance of the profile. For example, in the soils of the Rio Grande, Zalla, Camargo, Matamoros, and Grulla series on the active flood plain, recent sediments were stratified as they were laid down in each successive flooding. Soils of the Delfina, Racombes, and Willacy series, which formed in sediment of Pleistocene age, have been in place long enough to develop some genetic profile characteristics. They have lost free lime from the upper part of the profile, and clay particles have moved down and accumulated in the subsoil.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 and is called the Soil Taxonomy.[6]

The soil taxonomy has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system, the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen so that the soils of similar genesis or mode of origin are grouped.

In table 9, the soil series of Cameron County are classified by higher categories. These categories are briefly defined in the following paragraphs.

ORDER.—Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The three exceptions to this are the Entisols, Inceptisols, and Histosols that occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol).

SUBORDER.—Each order is divided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Fluvent* (*Fluv*, meaning fluviatile, and *ent*, from Entisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movements of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding the prefix to the name of the suborder. An example is *Ustifluvents* (*Usti*, meaning dry climates, *fluv*, for fluviatile, and *ent*, from Entisols).

SUBGROUP. Great groups are divided into subgroups, one representing the central (typic) segment of the group and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is *Typic Ustifluvents* (a typical Ustifluvent).

[6] Unpublished working document used in the Soil Conservation Service: "Soil Taxonomy of the National Cooperative Soil Survey." Copy available in the SCS State Office.

TABLE 9.—*Soil series classified by higher categories*

Series	Family	Subgroup	Order
Barrada	Fine, mixed (calcareous), hyperthermic	Typic Hydraquents	Entisols.
Benito	Very-fine, montmorillonitic, hyperthermic	Udorthentic Pellusterts	Vertisols.
Camargo	Fine-silty, mixed (calcareous), hyperthermic	Typic Ustifluvents	Entisols.
Cameron	Clayey over loamy, mixed, hyperthermic	Vertic Haplustolls	Mollisols.
Chargo	Fine, mixed, hyperthermic	Vertic Ustochrepts	Inceptisols.
Delfina	Fine-loamy, mixed, hyperthermic	Aquic Haplustalfs	Alfisols.
Galveston	Mixed, hyperthermic	Typic Udipsamments	Entisols.
Grulla	Fine, mixed (calcareous), hyperthermic	Vertic Fluvaquents	Entisols.
Harlingen	Very-fine, montmorillonitic, hyperthermic	Entic Chromusterts	Vertisols.
Hidalgo	Fine-loamy, mixed, hyperthermic	Typic Calciustolls	Mollisols.
Laredo	Fine-silty, mixed, hyperthermic	Fluventic Haplustolls	Mollisols.
Latina	Fine-loamy, mixed, hyperthermic	Aquollic Salorthids	Aridisols.
Lomalta	Very-fine, montmorillonitic, hyperthermic	Udrothentic Pellusterts	Vertisols.
Lozano	Fine-loamy, mixed, hyperthermic	Aquic Haplustalfs	Alfisols.
Lyford	Fine-loamy, mixed, hyperthermic	Aquic Haplustalfs	Alfisols.
Matamoros	Fine, mixed (calcareous), hyperthermic	Vertic Ustifluvents	Entisols.
Mercedes	Fine, montmorillonitic, hyperthermic	Udorthentic Pellusterts	Vertisols.
Mustang	Mixed, hyperthermic	Typic Psammaquents	Entisols.
Olmito	Fine, montmorillonitic, hyperthermic	Vertic Calciustolls	Mollisols.
Orelia, variant	Fine, mixed, hyperthermic	Typic Ochraqualfs	Alfisols.
Point Isabel	Fine, mixed, hyperthermic	Ustollic Camborthids	Aridisols.
Racombes	Fine-loamy, mixed, hyperthermic	Pachic Argiustolls	Mollisols.
Raymondville	Fine, mixed, hyperthermic	Vertic Calciustolls	Mollisols.
Reynosa	Fine-silty, mixed, hyperthermic	Fluventic Ustochrepts	Inceptisols.
Rio	Fine, mixed, hyperthermic	Typic Argiaquolls	Mollisols.
Rio Grande	Coarse-silty, mixed (calcareous), hyperthermic	Typic Ustifluvents	Entisols.
Sejita	Fine-silty, mixed, hyperthermic	Typic Salorthids	Aridisols.
Tiocano	Fine, montmorillonitic, hyperthermic	Udic Pellusterts	Vertisols.
Ustifluvents, clayey	Clayey, hyperthermic	Ustifluvents	Entisols.
Willacy	Fine-loamy, mixed, hyperthermic	Udic Argiustolls	Mollisols.
Willamar	Fine-loamy, mixed, hyperthermic	Typic Natraqualfs	Alfisols.
Zalla	Sandy, mixed, hyperthermic	Typic Ustifluvents	Entisols.

FAMILY.—Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used to differentiate families. An example is the fine-silty, mixed (calcareous) hyperthermic family of Typic Ustifluvents.

Additional Facts About the County

The first settlers in what is now Cameron County were mainly wealthy Spanish cattle owners who controlled large Spanish land grants. Cameron County, formed from part of Nueces County, was organized in 1848. Later, parts of it were used to form two other counties: Hidalgo County in 1852 and Willacy County in 1912. In 1846, Fort Brown was built, and shortly afterward the town of Brownsville was established. The first courthouse was erected in Brownsville in 1886.

Irrigation was begun about 1876, and the first irrigation systems were established about 1905. These systems were built by large land and irrigation companies that also cleared the land, divided it, and sold it to new settlers. By 1914, most of these companies were bankrupt. The irrigated acreage was greatly expanded in the 1920's and early 1930's when farmers organized the irrigation districts.

The first farming enterprise of any importance was begun in 1890 when sugarcane, an irrigated crop, was processed at a small factory erected for that purpose. The sugarcane soon gave way to citrus, vegetables, cotton, and grain sorghum because competition from foreign countries was severe and insect infestations were a problem. In 1902, rice was grown for processing at a mill, but this enterprise was short lived. Rice was not grown after 1905 because large amounts of salts had accumulated in the soils where it was grown.

The real beginning of farming in Cameron County came in 1904 when the first railroad was built.

Cameron County is one of the most intensively farmed areas in the nation. Cotton is the major crop, but grain sorghum, many cool-season vegetables, and citrus are important crops. The trend is toward the growing of grain sorghum and improved pasture because the cost of producing cotton is high, insect infestation is heavy, and shortages of water are frequent. More than 200 kinds of cool-season vegetables are grown commercially and in sufficient amounts to ship to other markets. Carrots, onions, peppers, cabbage, lettuce, and sweet corn are the most dependable vegetable crops. Citrus was first grown in the county in 1910, and the acreage of this crop continued to expand until 1951 when a severe freeze killed almost all the orchards. At present the citrus acreage is again expanding and is expected to continue expanding because protection from freezing temperatures has been improved.

The raising of livestock is a farming enterprise that is becoming increasingly important. In 1964 the livestock numbered 28,422 cattle and calves, 2,040 hogs and pigs, 203 sheep and lambs, and 68,969 chickens.

The population of Cameron County was 14,959 in 1880, and it more than doubled in the next 40 years. According to the census, it was 151,098 in 1960, and according to the preliminary census, it had declined slightly to 137,506 in 1970. Approximately 90 percent of the population is urban, and of this, almost 80 percent is in Brownsville, Harlingen, and San Benito.

Among the major transportation facilities in Cameron County are three U.S. highways, two major railroads, three ocean ports, and two major airports. There is also an extensive network of state highways and farm roads within the county. Several county roads are paved. Two international bridges at Brownsville serve as a gateway to Mexico. The Matamoros Bridge crosses the Rio Grande and connects with a major highway route to the interior of Mexico.

Among the industries of economic importance to the county are the shrimp industry and several plants for freezing and processing seafood. The area made up of Port Isabel and Port Brownsville is considered the shrimp capital of the world. Among the other industries are cotton gins, grain-storage facilities, fertilizer and chemical plants, and garment factories. Oil and gas development as well as the tourist trade, especially the winter tourist trade, are also important to the economy of the county.

Climate[7]

Cameron County has a warm temperature, subtropical climate, characterized by dry winters and hot humid summers. Although largely dominated by tropical maritime air masses from the Gulf of Mexico, Cameron County does not possess a truly maritime climate, but rather more of a continental climate. Tropical maritime air masses are dominant throughout spring, summer, and fall, but modified polar air masses frequently affect the area in winter.

Table 10 gives temperature and precipitation data. These data are based on records at Harlingen.

In most of the county, the average annual rainfall is about 26 inches, but it decreases slightly along the extreme western boundary. Most of it falls as thundershowers and consequently is unevenly distributed, both geographically and seasonally. Large variations occur over relatively small areas. Because the few tropical cyclones that occur late in summer bring heavy rains, the average monthly rainfall is highest in September. The next highest rainfall occurs late in May and early in June when squall-line thunderstorms occur. The most persistent rains are associated generally with warm fronts and stationary fronts in winter and with tropical lows late in summer and early in fall. March is usually the driest month. Snow or sleet falls in January, but the amount is too small to be measured.

The moisture-laden air from the Gulf of Mexico has a moderating effect on temperature. In general, summer temperatures are highest and winter temperatures lowest as the distance from the Gulf of Mexico increases.

Low temperatures of 32° F or below do not occur every year in Cameron County. They are less fre-

[7] By ROBERT B. ORTON, climatologist for Texas, National Weather Service, U.S. Department of Commerce.

TABLE 10.—*Temperature*

[All data from Harlingen, Texas, elevation (ground) 38 feet,

Month	Temperature [1]				Precipitation		
	Average daily maximum	Average monthly highest temperature	Average daily minimum	Average monthly lowest temperature	Average total [1]	Probability of receiving—	
						0 or trace	0.5 inch or more
	°F	°F	°F	°F		*Percent*	*Percent*
January	70.9	85.8	49.8	31.4	1.43	5	70
February	74.5	89.0	52.3	34.8	1.22	2	70
March	79.0	92.7	57.2	39.4	.95	<1	68
April	85.9	97.0	64.5	49.4	1.47	1	68
May	90.0	97.3	69.3	58.5	3.18	<1	88
June	93.7	99.4	72.9	66.2	2.49	<1	80
July	96.0	101.1	73.8	69.5	1.71	1	70
August	96.7	102.1	73.6	68.9	3.04	1	81
September	92.3	99.2	71.0	62.1	4.80	<1	96
October	87.1	95.0	64.2	51.4	2.56	1	90
November	78.9	90.1	56.4	39.9	1.43	1	70
December	73.0	86.1	51.2	34.0	1.57	1	65
Year	84.8	----------	63.0	----------	25.85	----------	----------

[1] Average length of record is 39 years.
[2] Average length of record is 14 years.

quent near the coast but occur more often as distance from the western boundary of the county decreases. At Harlingen, on the average, the last date when the temperature is 32° F or below in spring is February 4, and the first date in fall, December 12. These dates have been adjusted to take into account the years when no freezing temperatures occur. The average length of the warm season at Harlingen is 341 days. Severe freezes that caused heavy losses of citrus as well as of vegetables occurred in January of 1949, January and February of 1951, and January of 1962.

Cameron County receives approximately 50 percent of the total possible sunshine in winter, 60 percent in spring, 76 percent in summer, and 65 percent in fall.

Relative humidity decreases slightly from east to west as the distance from the Gulf increases. At noon, Central Standard Time, the east-to-west variation in relative humidity is estimated at 70 to 67 percent in January, 65 to 59 percent in April, 55 to 52 percent in July, and 63 to 60 percent in October.

In an average year, free-water (lake) evaporation exceeds precipitation by 32 to 36 inches, the higher value being near the coast.

The prevailing winds are southeasterly to south-southeasterly throughout the year, but in December are north-northwesterly.

The largest and most destructive storms in Cameron County are tropical cyclones. These storms have sustained windspeeds of 64 knots, or 74 miles per hour, or more, and are called hurricanes. They are a threat to the area late in summer or early in fall, but major storms are rare. Flooding from the torrential rains accompanying these storms is the most likely cause of property damage. Before Hurricane Beulah, which occurred in September 1967, the most recent major hurricane to strike Cameron County directly occurred in September 1933.

Surface Geology[8]

Cameron County is on the Coastal Plain of Texas. The geologic formations in the county are not lithified. They dip gently toward the Gulf of Mexico and are of Pleistocene age or younger. Only two geologic formations are exposed: the Beaumont Formation[9] of Pleistocene age and the overlying sediments of Holocene (Recent) age.

Among the features of the landscape in Cameron County are depressions, tidal flats, levees, point bars, backswamps, meander belts, barrier islands, and an old subdelta of the Rio Grande. Some of the older meander belts are those of Resaca de Rancho Viejo and Resaca de la Palma. Also, among the features are the isolated and partly submerged clay dunes and their adjacent source basins and flats, now permanently inundated, that contribute much to the raggedness of the western shoreline of Laguna Madre.

The younger deposits in the county are of Holocene age and the older deposits are the materials of the Beaumont Formation. The younger deposits are separated from the older ones by a well-defined low scarp in the area of Sweeney and Cross Lakes and, west of Harlingen, by the Arroyo Colorado that flows along the Holocene-Pleistocene contact. Sweeney and Cross Lakes are in the relict backswamp areas of the Resaca de los Fresnos, which is an abandoned channel of the Rio Grande. In other areas, clear-cut topographic features that separate the younger from the older are lacking.

[8] By SAUL ARONOW, Department of Geology, Lamar State College of Technology, Beaumont, Tex. (currently compiling the Geologic Atlas of Texas).

[9] Beaumont Formation as shown on Beaumont sheet (1968) in unpublished Geologic Atlas of Texas. Not to be confused with Beaumont clay shown on earlier Geologic Map of Texas (Darton and others, 1937) farther north on Coastal Plain of Texas.

and precipitation

for the period 1931–1969. The symbol < means less than]

Precipitation—Continued								
Probability of receiving—Continued						Average number of days with [2]—		
1 inch or more	2 inches or more	3 inches or more	4 inches or more	5 inches or more	6 inches or more	0.1 inch or more	0.5 inch or more	1 inch or more
Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*			
50	25	15	7	3	1	3	1	([3])
50	20	10	5	1	1	3	1	([3])
40	18	5	3	<1	<1	2	([3])	([3])
50	30	17	10	5	3	2	1	1
69	49	30	18	12	7	3	2	1
65	44	30	20	12	10	4	2	1
54	30	18	12	7	3	2	1	([3])
70	50	35	24	14	12	3	1	1
90	70	60	50	34	30	6	3	1
90	60	40	30	20	10	5	2	1
50	20	10	3	1	<1	3	1	1
50	30	18	10	5	5	3	1	1
						39	16	8

[3] Less than one-half day.

Geologic history

The deposition of the materials of the Beaumont Formation that are of Pleistocene age and of the more recent materials that are of Holocene age is related to the rise and fall of the sea during and after the last major advance of the continental glaciers in North America. During periods when water was abstracted from the ocean to form the glaciers, the sea fell, perhaps as much as 450 feet below its present level, and the major streams deepened their channels, flowed across the Continental Shelf, and discharged into the Gulf many miles beyond the present shoreline. During interglacial periods when water from the melting glaciers flowed back into the ocean, the sea rose, the deepened valleys were backfilled, and the coalescing deposits formed a broad delta plain along the margins of the Gulf of Mexico.

The materials of the Beaumont Formation were deposited during the last of the interglacial periods. They may have been deposited during a mid-Wisconsin interglacial interval or during the Sangamon Stage, an interval between the Wisconsin and Illinoisan glaciers.[10] The Sangamon Stage is currently estimated as taking place about 70,000 years ago. According to the results of radiocarbon dating of wood and shell from the Beaumont clay, this deposit is more than 40,000 years old, but all the material was "dead" and beyond the range of accurate analysis. After the materials of the Beaumont Formation had been deposited, the sea level fell again, but about 20,000 years ago, it started to rise and, about 5,000 to 3,000 years ago, reached its present level.

All the deposits of Holocene age along the Rio Grande as well as those of the barrier island are less than 5,000 years old.[10] The materials making up the three Holocene subdeltas are exposed at the surface on Padre Island, a barrier island. They were probably deposited when the sea was at about its present level.

Geology related to soil associations

In the following paragraphs the surface geology of the county is discussed in relation to the soil associations of the county. The younger deposits can be divided roughly into deposits of beach sand, fluviatile deposits, and modified fluviatile deposits. Some of the beach sand has been reworked into dunes. The fluviatile deposits have been modified by subsidence, differential compaction, and the action of wind and waves. The soil associations are described under the heading "General Soil Map."

Deposits of beach sand.—The soils of the Mustang-Coastal dunes association are the only ones that formed in deposits of beach sand. This association occurs only on the barrier islands where the sand has been deposited by waves and currents and then reworked by wind into complex dunes. These dunes have substantially increased the altitude of the islands.

Fluviatile deposits.—The soils of the Rio Grande-Matamoros association formed in the youngest fluviatile sediments in the county. They formed in the deposits on levees and point bars and in backswamps. Locally, some formed in the lacustrine fillings of meander cutoffs and in segments of an abandoned channel. These deposits make up the youngest meander belt of the Rio Grande where the sedimentary bedding is still preserved.

The soils of the Laredo-Olmito association, Harlingen association, and Harlingen-Benito association formed in older fluviatile deposits. The soils of the

[10] BERNARD, HUGH A., and LEBLANC, RUFUS J. Resume of the Quaternary geology of the northwestern Gulf of Mexico province. Quaternary of the U.S. Princeton Univ. Press: 146, 1965.

Laredo-Olmito association formed on older meander belts where the sedimentary bedding has largely been destroyed, but those of the other two associations formed in backswamp and lacustrine deposits, mainly in intermeander belt depressions. These deposits make up the next to the youngest meander belt of the Rio Grande.

The soils of the Laredo-Olmito association and the Laredo-Lomalta association formed in areas where meander belts flank the Resaca de los Cuates, Resaca de los Fresnos, and Resaca de la Gringa. The higher parts of the meander belts are within the Laredo-Olmito association and the lower parts within the other association. These resacas are former channels of the Rio Grande and formed after the sea had risen to about its present level. These are the oldest unmodified fluviatile deposits.

Modified fluviatile deposits.—The Sejita-Lomalta-Barrada association and the Laredo-Lomalta association are on the old subdelta in intermittently dry depressions and on tidal flats where soil blowing has been accompanied by the formation of clay dunes. These dunes are common in southern Texas and are perhaps best developed and most numerous in Cameron County. These are areas of the old Rio Grande subdelta that in many places are temporarily filled or covered by sea water in times of high tide as well as in periods of heavy rainfall. When these areas dry out, pellets that are made up of clay- to sand-size particles form as the surface crust breaks up. These pellets are blown into adjacent higher areas, where successive accumulations of pellets are disaggregated and homogenized by rainwater and later stabilized by vegetation. Most of the soils on the clay dunes are in the Point Isabel series.

In the areas of the subdelta on which the Sejita-Lomalta-Barrada association occurs, several processes have modified the parent material. One of these is differential compaction of the clayey sediment in the depressions of the intermeander belt, resulting in local enhancement of differences in relief. Also among these processes are regional subsidence and tilting that have resulted in lowering the level of the topographic surface. The original parent material was clayey and, for the most part, probably filled backswamp and intermeander-belt depressions, and lacustrine deposits similar to the ones of those unmodified fluviatile deposits associated with the parent material of the Harlingen association and the Harlingen-Benito association. These materials have been reworked by the action of tidal currents and shallow-water waves. Erosion and reworking of sediment also take place in depressions that are intermittently filled with rainwater and where the water table is at the surface.

Beaumont Formation.—Among the soils that formed in materials of the Beaumont Formation are those of the Willamar association, Willacy-Racombes association, Lyford-Raymondville-Lozano association, Hidalgo-Raymondville association, Willacy-Raymondville association, Raymondville association, and Mercedes association, which are associations 3, 6, 7, 8, 9, 10, and 13, respectively. Nearly all the older soils formed in materials of the Beaumont Formation, which is at the surface. In areas of these soils are many relict channels and isolated meanders in patterns that indicate the parent materials are fluviatile in origin. Around Harlingen, the origin of parent materials for soils of the Mercedes association is ambiguous. The lack of surface pattern and the generally clayey soils suggest that the deposits are backswamp of overflow floodway in origin. In the rest of the county the soils formed in fluviatile deposits that were reworked by wind before and during their formation.

The areas that have meandering stream patterns in parts of associations 6 and 9 are northwest of Combes, north of Farm Road 508, and west of the Arroyo Colorado. They are within the parts of association 7 that are on the eastern side of Arroyo Colorado and north and east of Farm Road 106. The soils in all of these associations extend across areas of several relict fluviatile features. In a few places, clay loams of the Raymondville, Rio, and Tiocano series formed in deposits that fill the well-defined, narrow, sinuous, relict meanders.

Except for the Mercedes association, the topography of most of the remaining areas has a poorly defined, northwest-trending grain. These areas occur in most parts of associations 6 and 10 that are west of U.S. Highway 77 and in association 8, which is entirely west of U.S. Highway 77 and north of the Arroyo Colorado. The topography in the area of association 7 that is north and west of Farm Road 106 and in almost all of association 3 is similar to that of the foregoing associations but it has a more diffuse grain. It is undoubtedly that of a relict, longitudinal dune.

Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity. The amount of water a soil can hold and make available to common plants. It is the numerical difference between the percentage of water at field capacity and the percentage of water at the time plants wilt. The rate is expressed as inches of water per inch of soil depth.

Class	*Available Water in Upper 40 Inches of Soil*
Very high	More than 8 inches
High	6 to 8 inches
Medium	4 to 6 inches
Low	2 to 4 inches
Very low	Less than 2 inches

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Bedding planes. The plane or surface separating the individual laminae or beds of sediments.

Calcareous. A soil containing enough calcium carbonate to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium car-

bonate and iron oxide are examples of material commonly found in concretions.

Delta. An alluvial deposit formed where a stream or river drops its sediment load on entering a body of more quiet water.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Exchangeable sodium percentage. The degree of saturation of the soil exchange complex with sodium. It may be calculated by the formula:

$$ESP = \frac{\text{Exchangeable sodium}}{\text{Cation exchange capacity}} \times 100$$

See Alkali soil.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Flood hazard. Water from stream overflow, runoff or seepage that stands or flows above the soil surface. Commonly expressed by frequency and duration classes as listed below.

Frequency	
None	Less than once in 50 years
Very infrequent	Once in 20 to 50 years
Infrequent	Once in 5 to 20 years
Frequent	Once in 1 to 5 years
Very frequent	More often than once every year
Duration	
Extremely brief	Shorter than 2 days
Very brief	2 to 7 days
Brief	7 days to 1 month
Long	1 month to 6 months
Very long	Longer than 6 months

Gilgai. Typically, the microrelief of Vertisols—clayey soils that have a high coefficient of expansion and contraction with changes in moisture; usually a succession of microbasins and microknolls, in nearly level areas, or of microvalleys and microridges that run with the slope.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

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 relatively level plots 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, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements 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.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	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

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Only the upper part of this, modified by organisms and other soil-building forces, is regarded by soil scientists as soil. Most American engineers speak of the whole regolith, even to great depths, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Resaca. A Spanish term for an abandoned river channel.

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium. Soil salinity is commonly expressed in millimhos per centimeter of a saturated extract ($ECe \times 10^3$) defined in classes thus:

Class	Millimhos per centimeter ($ECe \times 10^3$)
None	0—2
Low	2—4
Moderate	4—8
High	8—16
Very high	Above 16

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stone line. A concentration of coarse rock fragments in soils that generally represents an old weathering surface. In a cross section, the line may be one stone or more thick. The line generally overlies material that weathered in place, and it is ordinarily overlain by sediment of variable thickness.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

Computer-Adapted Terms

Soil characteristics in tables 6 and 8 are expressed in computer-adapted terms that differ from those in the Soil Survey Manual. Following are definitions of the terms used to describe soil characteristics.

Compressible. Decrease in soil volume is excessive under load.
Cutbanks cave. Walls of cuts not stable.
Droughty. Soils cannot hold enough water for plants during dry periods.
Erodes easily. Water erodes soil easily.
Excess lime. Carbonates restrict plant growth.
Excess salt. Soluble salts restrict plant growth.
Floods. Soil floods by stream overflow, runoff, or high tides.
Low strength. Not enough strength to adequately support the load.
Percs slowly. Water moves through the soil too slowly.
Piping. Water may form tunnels or pipelike cavities.
Rapid intake. Water infiltrates rapidly.
Shrink-swell. Soil expands significantly on wetting and shrinks on drying.
Slope. Slope is too great.
Slow intake. Water infiltration restricted.
Thin layer. Inadequate thickness of suitable soil.
Too clayey. Soil slippery and sticky when wet and slow to dry.
Too sandy. Soil soft and loose; droughty and low in fertility.
Unstable fill. Banks of fills likely to cave or slough.
Wet. Soil wet during periods of use.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1977--230-853/44

GUIDE TO MAPPING UNITS

For complete information about a mapping unit, read the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or other interpretative group, read the introduction to the section for general information about management. Yard and garden suitability groups are discussed on pages 47-51, orchard suitability groups on pages 51-52, pasture and hay suitability groups on pages 52-54, and range sites on pages 55-56. Dashes in a column mean that the mapping unit was not placed in that particular grouping. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Predicted yields, table 2, page 44.
Suitability for yard and garden plants, table 3, page 47.
Suitability for wildlife habitat, table 4, page 58.
Engineering uses of the soils, tables 5, 6, and 7, pages 62 through 79.
Recreational development, table 8, page 82.

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Capability unit: Irrigated Symbol	Irrigated Page	Yard and garden suitability group Symbol	Orchard suitability group Symbol	Pasture and hay suitability group Symbol	Range site Name
BA	Barrada clay	8	VIIIs-2	44	-----	--	6	---	--	----------
BE	Benito clay	8	VIs-1	43	IVw-1	42	6	---	7F	Salty
BU	Benito-Urban land complex	8	-----	--	-----	--	6	---	--	----------
CA	Camargo silt loam	9	-----	--	I-1	37	2	C	2A	----------
CC	Camargo silty clay loam	9	-----	--	I-2	37	2	C	1C	----------
CE	Cameron silty clay	10	IIs-1	40	IIs-1	40	3	F	7C	----------
CF	Cameron silty clay, saline	10	IVs-3	43	IIIs-4	42	6	I	7F	----------
CH	Chargo silty clay	11	IVs-3	43	IIIs-4	42	6	I	7F	Salty
CO	Coastal beach	11	VIIIs-2	44	-----	--	---	---	--	----------
CU	Coastal dunes	11	VIIIs-1	44	-----	--	---	---	--	----------
DE	Delfina fine sandy loam	12	IIw-1	39	IIw-1	39	1	A	8C	----------
GA	Galveston fine sand, hummocky	12	IVe-1	42	-----	--	5	---	--	Coastal Sand
GR	Grulla clay	13	-----	--	IVw-2	42	4	---	1A	----------
HA	Harlingen clay	14	IIIs-1	41	IIIs-1	41	4	---	7A	----------
HC	Harlingen clay, saline	14	IVs-1	43	IVs-1	43	6	---	7F	----------
HE	Harlingen-Urban land complex	14	-----	--	-----	--	4	---	--	----------
HGA	Hidalgo fine sandy loam, 0 to 1 percent slopes	15	IIc-1	41	I-3	37	2	C	8C	----------
HGB	Hidalgo fine sandy loam, 1 to 3 percent slopes	15	IIe-1	38	IIe-1	38	2	D	8C	----------
HO	Hidalgo sandy clay loam	15	IIc-2	41	I-4	38	2	C	7C	----------
HU	Hidalgo-Urban land complex	15	-----	--	-----	--	2	---	--	----------
LAA	Laredo silty clay loam, 0 to 1 percent slopes	16	IIc-2	41	I-4	38	2	C	7C	----------
LAB	Laredo silty clay loam, 1 to 3 percent slopes	17	IIe-2	38	IIe-3	39	2	D	7C	----------
LC	Laredo silty clay loam, saline	17	IIIs-2	42	IIs-4	40	6	I	7G	Coastal Ridge
LD	Laredo-Olmito complex	17	IIs-3	40	IIs-3	40	2	F	7C	----------
LEA	Laredo-Reynosa complex, 0 to 1 percent slopes	17	IIc-2	41	I-4	38	2	C	7C	----------
LEB	Laredo-Reynosa complex, 1 to 3 percent slopes	17	IIe-2	38	IIe-3	39	2	D	7C	----------
LG	Laredo-Urban land complex	18	-----	--	-----	--	2	---	--	----------
LK	Latina sandy clay loam	18	VIs-2	43	-----	--	6	---	7F	Sandy Coastal Flat
LM	Lomalta clay	19	VIIs-1	44	-----	--	6	---	7F	Salty
LO	Lomalta-Urban land complex	19	-----	--	-----	--	6	---	--	----------

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Capability unit: Irrigated Symbol	Irrigated Page	Yard and garden suitability group Symbol	Orchard suitability group Symbol	Pasture and hay suitability group Symbol	Range site Name
LR	Lozano fine sandy loam--	20	IIw-1	39	IIw-1	39	1	F	8C	Sandy Loam
LY	Lyford sandy clay loam--	21	IIw-2	39	IIw-2	40	1	F	7C	Clay Loam
MA	Matamoros silty clay----	21	-----	--	IIs-1	40	3	I	1C	----------
MC	Matamoros-Rio Grande complex----------	21	-----	--	IIs-3	40	3	I	1C	----------
MEA	Mercedes clay, 0 to 1 percent slopes--------	22	IIIs-1	41	IIIs-1	41	4	---	7A	----------
MEB	Mercedes clay, 1 to 3 percent slopes--------	22	IIIe-1	41	IIIe-1	41	4	---	7A	----------
MGC	Mercedes clay, loamy substratum, 1 to 5 percent slopes--------	22	IVe-2	42	-----	--	4	---	7A	----------
MM	Mercedes-Urban land complex----------	22	-----	--	-----	--	4	---	--	----------
MS	Mustang fine sand-------	23	VIw-1	43	-----	--	5	---	--	Coastal Sand
MU	Mustang fine sand, saline----------	23	VIIIs-2	44	-----	--	6	---	--	----------
OM	Olmito silty clay-------	24	IIs-1	40	IIs-1	40	3	I	7C	----------
ON	Olmito-Urban land complex----------	24	-----	--	-----	--	3	---	--	----------
OR	Orelia clay loam, clayey subsoil variant-------	25	IVs-3	43	-----	--	6	I	7F	Clay Loam
PO	Point Isabel clay loam--	25	VIe-1	43	-----	--	6	---	7G	Coastal Ridge
PU	Point Isabel-Urban land complex----------	26	-----	--	-----	--	6	---	--	----------
RA	Racombes sandy clay loam----------	26	IIc-4	41	I-5	38	1	F	7C	----------
RDX	Racombes soils and Urban land----------	27	-----	--	-----	--	1	---	--	----------
RE	Raymondville clay loam--	27	IIs-1	40	IIs-1	40	3	I	7C	Clay Loam
RG	Raymondville clay loam, saline----------	27	IVs-3	43	IIIs-4	42	6	I	7F	----------
RM	Raymondville-Urban land complex----------	28	-----	--	-----	--	3	---	--	----------
RO	Rio clay loam----------	29	IIs-2	40	IIs-2	40	3	I	7E	----------
RR	Rio Grande silt loam----	30	-----	--	I-1	37	2	C	2A	----------
RT	Rio Grande silty clay loam----------	30	-----	--	I-2	37	2	C	2A	----------
RU	Rio Grande-Urban land complex----------	30	-----	--	-----	--	2	---	--	----------
RZ	Rio Grande-Zalla complex----------	30	-----	--	IIIs-3	42	2	C	2A	----------
SE	Sejita silty clay loam--	31	VIIs-2	44	-----	--	6	---	--	Salt Flat
SU	Sejita-Urban land complex----------	31	-----	--	-----	--	6	---	--	----------
TC	Tiocano clay----------	32	Vw-1	43	-----	--	4	---	7E	----------
USX	Ustifluvents, clayey----	32	VIIIs-3	44	-----	--	6	---	--	----------
WAA	Willacy fine sandy loam, 0 to 1 percent slopes-	33	IIc-3	41	I-6	38	1	A	8C	Sandy Loam
WAB	Willacy fine sandy loam, 1 to 3 percent slopes-	33	IIe-3	39	IIe-2	39	1	B	8C	Sandy Loam
WM	Willamar soils----------	34	IVs-2	43	IIIs-2	42	6	---	7F	Sandy Coastal Flat
ZA	Zalla loamy fine sand---	35	-----	--	IIIs-3	42	5	---	3A	----------

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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.