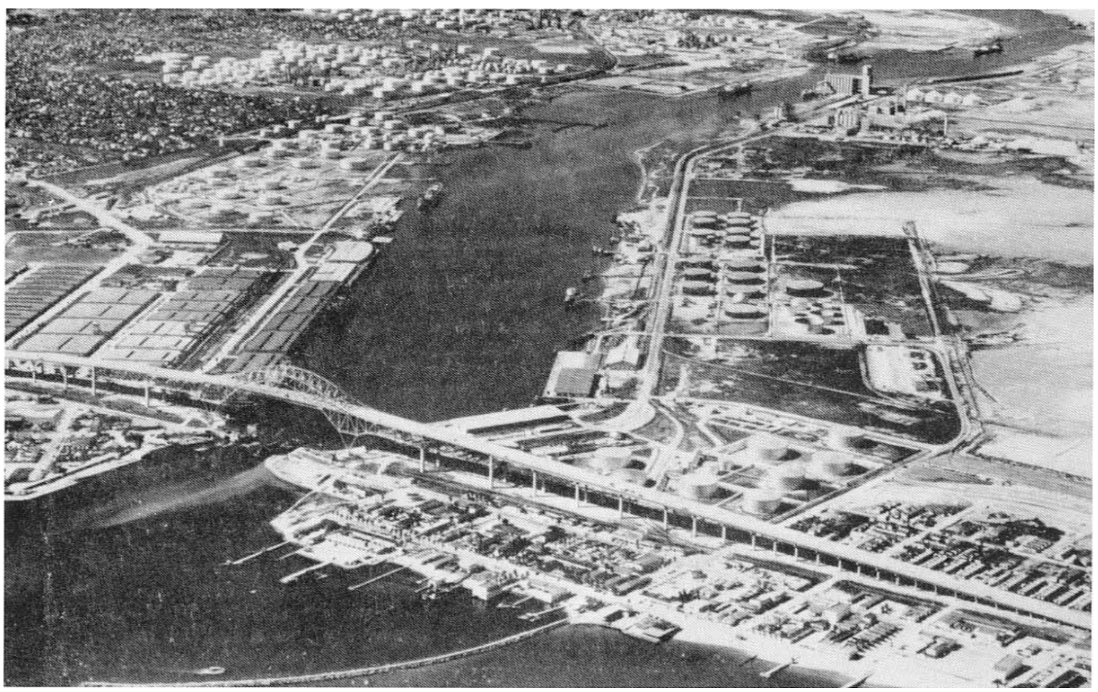
SOIL SURVEY

Nueces County, Texas



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station

HOW TO USE THE SOIL SURVEY REPORT

THIS SURVEY of Nueces County will serve several groups of readers, particularly farmers and ranchers who want information to help them plan the kind of management that will protect their soils and provide good yields. The survey describes the soils, shows their location on a map, and tells what they will do under different kinds of management.

Locating the soils

To find what kinds of soils you have on your farm, first locate the general area of your farm on the *index to map sheets*, which is near the back of the report. A numbered rectangle on the index will tell you what sheet of the large soil map your farm is on. After you turn to the map sheet that shows your farm, you will find that the soils have been outlined and that there is a symbol for each kind of soil. Use the soil legend to find the names of the soils on your farm. Then turn to the “Guide to Mapping Units” near the back of the report to find pages where your soils are described in detail.

Suppose, for example, an area located on the map has the symbol VcA. The legend of the detailed map shows that this is the symbol for Victoria clay, 0 to 1 percent slopes. This soil is described in the section “Descriptions of the Soils,” beginning on the page listed in the “Guide to Mapping Units.” The guide also tells you that this soil is in capability unit IIs-1 and gives the page where that unit is discussed. A capability unit is a group of soils that are suitable for about the same uses, that produce about the same yields, and that respond to similar management in about the same way.

Finding information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers and those who work with farmers will want to learn about the soils in the section “Descriptions of the Soils,” and then turn to the subsection “Management of Soils for Agriculture.” In this way, they learn about the soils, how they can be managed, and what yields can be expected. All the soils and many of the land types in the county are grouped by capability units. Table 2 tells how much a farmer can expect to harvest from each soil in the county under two levels of management.

Soil scientists and others interested in the scientific aspects of soils will find information about how the soils were formed and how they are classified in the section “Formation and Classification of Soils.”

Engineers and builders will want to refer to the subsection “Engineering Applications.” Tables in that section show characteristics of the soils that affect engineering.

Planners of urban developments will find information in the subsection “Urban and Suburban Uses of Soils.”

Students, teachers, and other users can learn about the soils and their management in various parts of this report, depending on their particular interests.

Newcomers in Nueces County will be especially interested in the section “General Soil Map,” where broad pattern of soils are described. They may also be interested in the sections “General Nature of the County” and “Additional Facts About the County.”

This soil survey was made as a part of the technical assistance furnished by the Soil Conservation Service to the San Diego-Agua Dulce Soil Conservation District. Help in farm planning can be obtained from members of the Soil Conservation Service in the district, the county agricultural agent, or the staff of the State agricultural experiment station. Fieldwork for this survey was completed in 1960. Unless otherwise indicated, statements in this report refer to the conditions in the county at the time the survey was in progress.

Cover picture: Harbor of Corpus Christi, looking west, 1959.
Most of the county lies between 15 and 150 feet above the sea
and is nearly level or gently sloping.

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SOIL SURVEY OF NUECES COUNTY, TEXAS

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

NUECES COUNTY is in the southern part of Texas, bordering the Gulf of Mexico (fig. 1). It has a land area of 536,360 acres. The county extends 25 miles from north to south and about 50 miles from the western boundary to the eastern shore of Mustang Island. Corpus Christi, the county seat and largest town, is on Corpus Christi Bay. It is a seaport and has a deep channel leading to the Gulf of Mexico.

Physiographically, the county consists mainly of a nearly level coastal terrace. Its eastern edge lies along the gulf on Mustang and Padre Islands, which are called barrier beaches. The climate is intermediate between that of the humid, subtropical areas to the northeast along the coast and that of the semiarid region to the west and southwest. Maximum temperatures range from the 80's to high in the 90's. Almost constant sea breezes moderate the summer heat. Temperatures below 32° F are infrequent.

About 73 percent of the land area in the county is cultivated, and about 13 percent is used for range. The rest is mostly urban land, dunes, and beaches. The principal crops are cotton and grain sorghum, but some flax and vegetables, mainly onions, are grown. The coast of Nueces County, with its bays, lagoons, and barrier islands, is a mecca for tourists, fishermen, hunters, birdwatchers, and others.

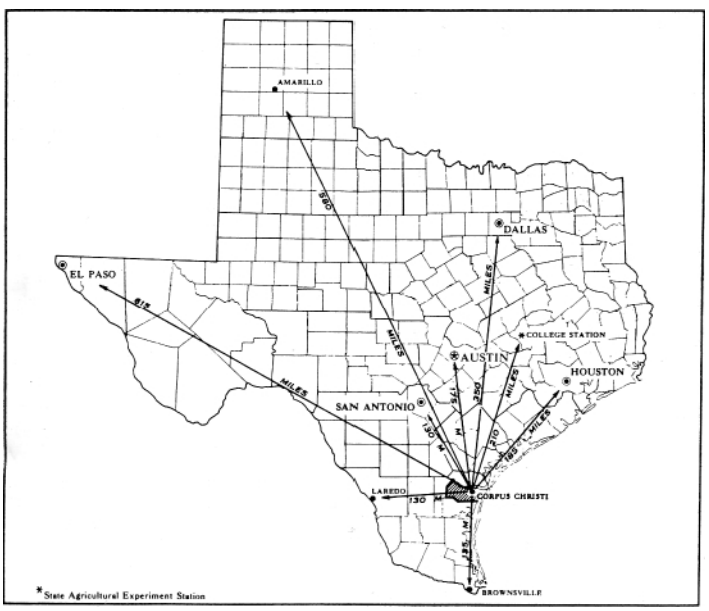

***Figure* 1.—Location of Nueces County in Texas.**

General Nature of the County

This section of the report gives a short summary of the physiography and climate of the county and tells how they affect agriculture.

Physiography, Relief, and Drainage

Nueces County is one of several counties that form an almost uniform curve on the western coast of the Gulf of Mexico. This curve is known locally as the Coastal Bend of Texas. Nueces County is in about the center of this curve. Its mainland is part of a nearly level coastal plain that is about 40 miles wide and is made up mainly of heavy, blackland soils.

The Nueces River flows along the northern boundary of the county and empties into Nueces Bay, which opens into Corpus Christi Bay. Both of these bays lie within the boundaries of the county. Corpus Christi Bay covers an area of 152 square miles and is 10 to 13 feet deep in most places. Nueces Bay is smaller and shallower; its area is only 29 square miles.

In the offshore waters of the county are about 5 miles of Padre Island and all of Mustang Island. These islands are strips of sand called barrier islands or beaches. They lie about 4 miles from the southeastern shore of the mainland and extend across the mouth of Corpus Christi Bay. The lagoon between Padre Island and the mainland is less than 5 feet deep. Boat channels have been dug in the offshore waters. These channels are 12 feet deep or more, but Corpus Christi Channel, which crosses the bay, is 36 feet deep.

The offshore islands and tidal lands make up less than 10 percent of the land area of the county. About three-fourths of the land area consists of a nearly level, fairly smooth coastal terrace that, on the average, falls about 3 feet in a mile. Only about 17 percent of the county drains northward into the Nueces River and Nueces Bay. Drainage is mainly to the southeast through the shallow, narrow channels of Agua Dulce, Pintas, and Petronila Creeks. These creeks cross Kleberg County and empty into Baffin Bay. Oso Creek drains the northeastern quarter of the county and enters Corpus Christi Bay at a point southeast of Corpus Christi.

Matamoros Swale is a drainageway that extends through the southwestern part of the county. This drainageway does not have a continuous, well-defined channel but is mainly a course that is followed by floodwaters. These floodwaters spill over the banks of San Fernando Creek into Jim Wells County and spread over large areas of nearly level soils in Nueces County.

Climate

Climate is a major factor in the farming activity of Nueces County and in the diverse economy of Corpus Christi. Although the county is on the Gulf of Mexico, the climate is intermediate between that of the humid, subtropical coastal area to the northeast and that of the semiarid area to the west and southwest. The amount and distribution of rainfall have much to do with the success or failure of crops, but the heavy, nearly level soils generally are well suited to the varied rainfall if they are properly managed. The average rainfall ranges from about 25 inches in the southwestern part of the county to about 28 inches near the coast. Normally, the distribution of rainfall fits well with the growing season and with the time the crops are seeded, cultivated, and harvested (fig. 2).

The average monthly temperatures in Nueces County are fairly high throughout the year; they also fit well with the rainfall and with seeding, cultivating, and harvesting. These temperatures are shown in figure 3.

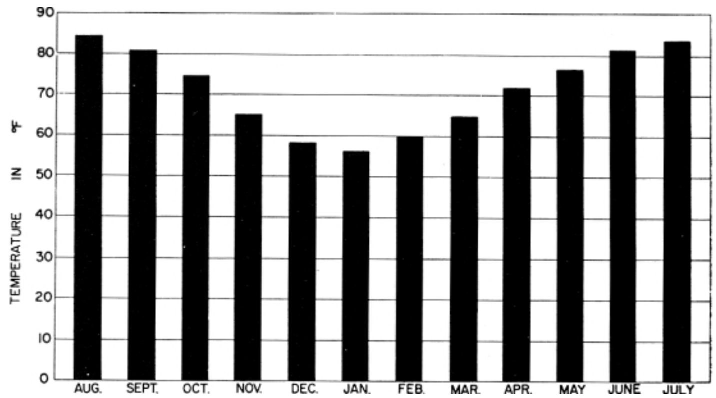

***Figure* 2.—-Average monthly rainfall at Corpus Christi for a 55- year period from 1905 through 1959.**

Humidity is high during most of the year because the prevailing southeasterly winds bring in moist air from the gulf. This high humidity lessens the amount of soil moisture that normally would be lost through evaporation induced by high temperatures. However, some moisture needed for plant growth is lost in winter and early in spring when dry winds from the north or other directions speed up evaporation. Much moisture is lost in summer because the county receives more than 80 percent of the sunshine possible to receive.

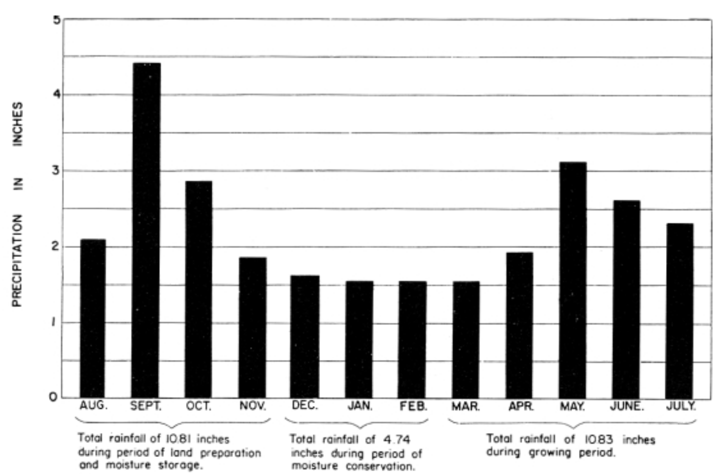

***Figure* 3.—Average monthly temperatures at Corpus Christi for a 55-year period from 1905 through 1959.**

Severe tropical storms occur about once in every 10 years, and less severe storms occur about once in 5 years. When storms strike the coast 100 miles to the east or south, Nueces County receives beneficial rains and there is little wind. Hurricanes strike chiefly in August and September, though tropical storms have occurred as early as June and as late as October.

The county rises gradually from the sea to the northwestern part of the county, where the highest point is 146 feet above sea level. Because little or no cropland is less than 15 feet above sea level, crops are not damaged by salt water at high tides during storms. Some crops, however, may be damaged shortly before harvesting by winds and torrential rain. Hail strikes small areas about once a year, and its damage depends on the stage of crop growth. If young crops are damaged by hail, they may partly recover.

The average length of the growing season ranges from 335 days near the coast to 288 days in the western part of the county. At Corpus Christi, the average date of the first killing frost is December 27 and that of the last is January 26. In the western part of the county, the average date of the first killing frost is December 6 and that of the last is February 21.

Since 1887, there has been a trace or more of snow at Corpus Christi on only 24 days. From four to six times a year, the temperature falls to 32° F or lower, but this low temperature seldom comes early in spring, and crops generally are not damaged. Spring planting normally begins about March 1 or shortly thereafter.

According to an analysis of records kept for 70 years at Corpus Christi and for 43 years at Alice (*13*), *(1)* more than 20 inches of rain can be expected annually in about 75 percent of the years. Alice is 10 miles west of the county. The average annual rainfall was 25 inches at Alice and 26 inches at Corpus Christi. The records indicate that more than 30 inches can be expected in the county in about 22 percent of the years. On the other hand, only 10 to 20 inches fall in 14 percent of the years at Corpus Christi and in 28 percent of the years at Alice.

Of the droughts that occur periodically, the most severe one extended from 1907 to 1911. During this period the average annual rainfall was 18.6 inches, or 72 percent of normal. Between 1951 and 1955 in another 5-year period of drought, rainfall was about 81 percent of normal. During 1951, 1953, and 1955, crops failed completely on many farms, but in 1952 and 1954 yields were above average.

The climate determines the kind of farming and the timing of the practices used. Normally, only one crop is grown in a field each year. Immediately after this crop is harvested, the soils are prepared so that they can conserve moisture from the rains late in summer, in fall, and in winter. Flax is harvested in May, grain sorghum in July, and cotton late in July. Crop residues are disked so that a mulch covers the surface. Except in fields that are to be planted to flax, the soil is bedded and rebedded. It remains fallow until planting time. Because flax is drilled, the soil is not bedded. During winter, moisture is conserved by controlling weeds, by maintaining a surface mulch, and by disturbing the seedbed as little as possible. Planting normally begins about March 1.

The frost-free growing season is long enough to permit two crops to mature on the same field, but there may not be enough moisture in the soil to supply the second crop. Consequently, growing only one crop on a field is generally more profitable.

Before March enough moisture should be in the soil for the germination of seeds because little rain falls in that month, and often the winds are dry. The rainfall normally increases in April and replaces the moisture lost. Crops reach their maximum growth and need the most moisture in May. Fortunately, rainfall is heavy in that month. It decreases in June, and crops begin to mature.

The highest yields of cotton are generally produced when rainfall is high, but yields have not always been highest in years of highest rainfall. The control of insects may be ineffective in years of high rainfall, or most of the rain may come late in the growing season. Also, the crop may be reduced by excessive rainfall. In 1954 the yield of cotton was 432 pounds per acre, and in 1958 it was 434 pounds. In those years of high yields, much moisture must have been in the soil at the beginning of the growing season because the rain that fell during the growing season was below average. Because of this low rainfall, effective control of insects was possible. In addition, all of the cotton bolls matured and opened, and a large crop was harvested.

In 1951 only 51 pounds of cotton was harvested per acre. In that year rain fell in places where rainfall was recorded, but cotton fields did not receive enough rain for the seeds to germinate. The main reason, however, that yields were so low is that not enough moisture was stored in the subsoil in the fall of 1950 and early in 1951. If the rainfall from December through July is less than 15 inches, yields of cotton generally are less than 120 pounds per acre.

How Soils Are Mapped and Classified

Soil scientists made this survey to learn what kinds of soils are in Nueces County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

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. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

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. Miguel and Victoria, 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 go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Miguel fine sandy loam and Miguel loamy fine sand are two soil types in the Miguel series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Miguel fine sandy loam, 0 to 1 percent slopes, is one of several phases of Miguel fine sandy loam, a soil type that ranges from nearly level to sloping.

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 greatly help in drawing boundaries accurately. The soil map at the back of this report, 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 management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. 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 type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed and so small in size, that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit, for example, Galveston and Mustang fine sands. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Gullied land or Tidal flats, and are called land types rather than soils.

While a soil survey is in progress, samples of soils after a guide for classifying and naming the soils had for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. Based on the yield and practice tables and other data, the soil scientists set up trial groups, and test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists 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 present methods of use and management.

General Soil Map

In describing the soils of Nueces County, it is well to start with large areas such as those that can be seen from an airplane. From a plane flying high over Nueces County, one can see different patterns of soils and vegetation and also roads, farmhouses, and other manmade objects. From the air, some large areas appear dark and smooth; others appear gray and depressional. In some places there are narrow, meandering strips clotted with a few, small, pondlike depressions. Other parts of the county are irregular and grayish brown.

By drawing lines around the different patterns of soils on a small map, one can make a map of general soil areas, or soil associations. This map gives a general idea of the various patterns of soils. Each soil association, or distinct soil pattern, is made up mainly of soils of two or three soil series. Generally, the association also contains small areas of soils in other series.

A map showing soil associations is useful to those who want a general idea of the soil patterns; who want to compare different parts of the county; or who want to locate large areas suitable for some particular kind of farming or other land use. The colored map at the back of this report shows the eight general soil areas, or kinds of soil patterns, in Nueces County. As that map shows, the Victoria soil association covers most of the county. That association is by far the most important one in the county from an agricultural standpoint. The other general soil areas are omparatively small, but each has a distinct pattern of soils and in each, the differences among the soils are important to farming and other land use.

For those readers who are interested in reading about them, the soil associations are discussed in the following pages. If the reader wishes to see the soil associations for himself so that he can recognize and understand them better, he can view them from paved roads by following the directions given at the beginning of each description of the soil associations.

1. Miguel-Willacy association: Soils on the valley slopes of the Nueces River

To reach a part of this soil association from Corpus Christi, drive out Leopard Street to Up River Road and on to the Corpus Christi Golf and Country Club. The Miguel-Willacy association is the sloping land above the flood plain, a band from one-half mile to 3 miles wide.

This association consists of deep, loamy and sandy soils on the more sloping parts of the coastal terrace that lies along the Nueces River and near Nueces Bay. The association extends from the Corpus Christi Golf and Country Club along both sides of the Up River Road as far as Calallen, and then along Farm Road 624 to the western county line. The landscape consists of gently sloping to strongly sloping, low spur ridges and of short, shallow valleys. Small, narrow creeks carry local water and runoff from the higher lying soil associations on the main part of the coastal terrace. This association occupies about 6.5 percent of the county.

The soils in this association are moderately well drained and are slowly to moderately permeable. Their surface soils are neutral to alkaline. Their subsoils are alkaline and are underlain by calcareous substrata.

The Miguel soils have a thin to moderately thick surface soil of dark grayish-brown fine sandy loam or loamy fine sand. Their subsoil is grayish-brown, blocky sandy clay with fine reddish mottles. The very pale brown parent material is clayey and contains hard and soft lumps of lime. Miguel soils make up about 32 percent of this association.

The Willacy soils have a fairly thick, grayish-brown surface layer that is underlain by a slightly browner, crumbly sandy clay loam subsoil. Their substratum is light-colored, strongly calcareous clay loam that contains many soft lumps of lime. Willacy soils cover about 20 percent of this association.

Also in the association is Sandy sloping land. This land resembles the Hidalgo soils, but its soil material is so variable that the land cannot be placed in a soil series. About 80 percent of Sandy sloping land has a calcareous, grayish-brown fine sandy loam surface soil. The subsoil ranges from light-gray fine sandy loam to sandy clay that is brownish and very firm. The substratum is light-gray fine sandy loam to sandy clay and contains many lumps of lime. About 20 percent of this land has a thick, dark grayish-brown loamy fine sand surface soil. The subsoil is brownish, noncalcareous loamy fine sand that extends to a depth of 5 or 6 feet. Sandy sloping land makes up about 18 percent of the association.

Smaller acreages of other soils occur in the Miguel-Willacy association. Soils of the Clareville complexes account for about 16 percent, and the Victoria and Hidalgo soils account for about 14 percent.

Near Corpus Christi and along Up River Road, more and more of this soil association is being used for suburban and industrial development. Most of the soils are probably better suited to these uses than to agriculture. Some of the less sloping areas of the loamy Willacy, Hidalgo, and Miguel soils are still cultivated, but large farm equipment generally cannot be used so well on those parts as it can on some of the more level soils in the county.

The sloping Miguel soils have a claypan subsoil and are subject to erosion if they are cultivated. However, they are suitable for landscape gardening because they have good drainage and are fertile. West of Calallen, along Farm Road 624, areas of Miguel soils are more sandy, less sloping, and better suited to cultivation than other areas of Miguel soils. A greater part of these less sloping areas are in watermelons, other crops, and improved grasses that are grazed.

2. Lomalta association: Semimarshy saline soils

To see part of this association, turn north from Up River Road onto a road that is 3 miles west of Midway and travel to a point near the Nueces River.

This soil association consists of dark soils formed in clayey sediments that floodwaters have washed from local and inland areas. These sediments have accumulated along the coast in shallow tidal waters. When the waters of high storm tides carved Nueces Bay out of the mainland, clayey knolls were left where small remnants of coastal terraces resisted wave action. During dry periods, windblown, saline, clayey deposits helped to build up these knolls.

The Lomalta soils have a calcareous, clayey, somewhat salty surface layer that is about 20 inches thick and is underlain by a slightly lighter colored heavy clay subsoil. The substratum occurs at a depth of 30 to 40 inches and consists of salty, gray clay containing lumps of lime. The Lomalta soils make up more than 95 percent of the association.

Also in this association, on the clayey knolls or mounds, are the Point Isabel soils. These soils have a gray clay surface soil, about 6 inches thick, that is underlain by a subsoil of light grayish-brown clay. The subsoil is salty, crumbly, and limy. The substratum is a gray, salty clay that, in some places, is in thin, wind-deposited layers. Less than 150 acres of Point Isabel soils occur in this association, but they are important because of their location and their potential use.

This soil association makes up only about 0.5 percent of the county, but its nearness to Corpus Christi makes it important. Most of the association is less than 5 feet above sea level and is nearly level, depressional, saline, and in places, semimarshy. Along Tule Lake and near Calallen are a few moundlike areas of Point Isabel soils that are 5 to 10 feet higher than the surrounding Lomalta soils. The association is flooded occasionally. It may be flooded by water from the bay when storm tides are high, or by floodwaters from the river.

Most of this association is thickly covered with gulf cordgrass that is grazed by beef cattle. In this soil association are the Corpus Christi Ship Channel, the Missouri Pacific Railroad, and other industrial facilities. The soils in the association are not suitable for cultivation.

3. Trinity-Frio-Zavala association: Soils on the flood plain of the Nueces River

This soil association can be seen from a distance by looking north toward the lowlands along the Nueces River while traveling along Farm Road 624 in the northwestern corner of the county. It can be reached by turning north on Farm Road 666 near Bluntzer School.

This association covers about 2.6 percent of the county and consists of soils formed in alluvium along the Nueces River. During the past few thousand years, this alluvium has been carried from the upper reaches of the river and its tributaries and has been deposited by floodwaters. On the higher lying coastal terrace that makes up the rest of Nueces County, in contrast, the soils were formed from sediments deposited in ancient lagoons and bays many thousands of years ago.

Trinity soils, which cover about 70 percent of this association, are along the Nueces River in low-lying backwater areas on the flood plain. They are flooded occasionally and, in most places, remain flooded longer than the Zavala soils. Trinity soils have a very dark colored, crumbly surface layer of calcareous clay about 18 inches thick. It is underlain by a calcareous clay subsoil that is lighter colored with increasing depth. Below 60 inches is a light-gray, limy substratum.

The Frio soils have a dark clay loam surface layer about 18 inches thick. Normally, the Frio soils are calcareous throughout. In this county, however, there is a variant of the Frio soils in which the surface soil and subsoil are alkaline but not calcareous. In most places the subsoil of the Frio soils is grayish-brown clay loam, but in a few places it is a gray clay loam. The substratum is a light-gray, strongly calcareous clay loam that contains many lumps of lime. Frio soils occupy about 20 percent of this soil association.

In position, texture, and permeability, the Frio soils are intermediate between the Trinity clays and the Zavala fine sandy loams. Frio soils are flooded less frequently than the Trinity soils.

The Zavala soils are mainly in one large area along the Nueces River in the northwestern part of the county. They occupy low knolls and ridges. Their surface layer is a dark-gray, noncalcareous fine sandy loam about 30 inches thick. The subsoil is a gray, noncalcareous fine sandy loam that extends to a depth of more than 60 inches. Zavala soils account for about 10 percent of this association.

Most of this soil association is range in native grasses, but some of the soils that are flooded only occasionally are cultivated successfully. The finer textured Trinity and Frio soils are better suited to locally grown crops than are the coarser textured Zavala soils, but introduced grasses grow exceptionally well on all of these soils.

4. Clareville-Orelia association: Soils on loamy knolls and nearly level soils with a hardpan

You can reach the northern tip of this soil association by driving west on Farm Road 624 to a point about 1½ miles from the county line.

This is a nearly level soil association marked by scattered low mounds and ridges. A few small, very shallow creeks drain the almost level valley floors.

The deep, loamy soils of this association cover only about 2.2 percent of the county. They are poorly drained to moderately well drained. Their surface soil is neutral to alkaline, and their subsoil and substratum are mildly alkaline to strongly calcareous.

Soils of the Clareville complexes are dominant and occupy most of the higher areas in this association. They have a dark-gray clay loam surface soil about 7 inches thick. Their subsoil is crumbly clay loam that ranges from gray to very dark gray within a distance of 10 to 20 feet. The substratum occurs at a depth of about 36 inches and is crumbly, light-gray clay loam that contains lumps of lime. The Clareville complexes make up about 42 percent of the association.

The Orelia soils are in the nearly level valleys. These soils have a thin, crusty fine sandy loam and clay loam surface soil that is 5 to 8 inches thick; it is underlain by a hard, blocky sandy clay loam subsoil. A gray substratum containing lumps of lime is normally at a depth of about 2 feet. The Orelia soils occupy about 38 percent of this association.

Also in this association are Victoria soils. These soils are along the east and south sides of this association. They are better drained than the Orelia soils. Victoria soils have a dark-colored, calcareous, crumbly clay surface layer about 3 feet thick. Their subsoil consists of gray, subangular blocky clay intermingled with a dark-gray clay. Very pale brown, limy clay makes up the substratum. Victoria soils amount to about 13 percent of this soil association.

Smaller acreages of other soils, mainly the Willacy and Miguel, occupy some slopes and the summits of the high knolls and account for about 7 percent of the association.

Nearly all of this association is cultivated. Although many of the farms are slightly smaller than the average-sized farm in the county, the trend is for these farms to become parts of larger units. Farmhouses or other structures occupy many of the knolls.

5. Willacy-Clareville-Orelia association: Nearly level, loamy and moderately sandy soils

You can reach this association by traveling south on Farm Road 70 about 5 miles from Agua Dulce. The boundary of the association is only a few hundred yards south of the intersection of Farm Roads 70 and 665.

This association consists of moderately to very slowly permeable soils on the coastal terrace. These soils developed in sandy materials that were deposited by an ancient stream and were later shifted by the wind. In some areas these soils are slightly elevated and nearly level, but their surface is slightly wavy. Only the main body of this association is shown on the general soil map. It accounts for about 4.7 percent of the county. A few outlying, discontinuous strips extend as far as Bishop, but these are too narrow to be shown on the map.

The Willacy soils have a thick, grayish-brown fine sandy loam surface soil that is free of lime and is neutral to slightly acid. Their subsoil is moderately permeable and slightly alkaline. Light-colored clay loam and fine lumps of lime make up the substratum. Willacy soils occupy about 30 percent of this soil association.

In about 56 percent, of the acreage occupied by Clareville soils, the surface layer is a dark-gray loam that is free of lime. The surface soil grades to a subsoil of very dark gray, crumbly, lime-free clay loam at a depth of 8 inches. The remaining 44 percent of the acreage in Clareville soils occurs in complexes with calcareous soils and, as a result of cultivation, has a calcareous surface soil. The Clareville soils make up 15 percent of the association.

The Orelia soils occupy low, meandering, almost flat strips in this association. These soils have a. thin, dark-gray, crusty fine sandy loam surface soil that is free of lime and abruptly overlies a subsoil of dark-gray, hard, blocky sandy clay loam. The subsoil is free of lime in the upper part but is limy and lighter colored in the lower part. The substratum is light-gray loamy clay containing lumps of lime. The Orelia soils account for about 14 percent of this association.

Also in this association are fingerlike areas of Victoria soils that extend from the adjoining Victoria soil association and are surrounded by Willacy, Clareville, or Orelia soils. The Victoria soils have a surface layer of heavy, dark-gray, calcareous clay that is about 3 feet thick. This surface layer is underlain by about 18 inches of light-gray and dark-gray clay. This 18-inch layer is underlain by a substratum of pale-brown, calcareous clay that contains a few fine lumps of lime. Victoria soils make up about 31 percent of this association.

About 10 percent of the association is made up of small areas and narrow strips of other soils, mainly the Hidalgo, the Trinity, and the depressional Banquete soils.

Cotton and grain sorghum are the principal crops grown, but yields normally are not so high on soils in this association as they are on the more clayey soils of the county. Proportionately, however, more flax is grown on these soils than on the other soils.

6. Victoria association: Blackland soils of the Coastal Plain

The northern edge of this association can be seen by driving westward along Farm Road 624 from its intersection with U.S. Highway No. 77. Farm Road 70 crosses the southern part of the association.

This association covers approximately 66 percent of the county and is almost twice as large as all the other soil associations combined. About 88 percent of its area consists of nearly level Victoria soils, called blackland.

Only a few shallow, natural drainageways break the uniformity of this nearly level land. During periods of high rainfall in counties to the west, Agua Dulce and Pintas Creeks, together with San Fernando Creek along the southwestern corner of the county, overflow their channels and flood thousands of acres of this association. Flooding has been complicated by the many roads built in recent years to improve access to all parts of the county. Some of the roads confine water to low places or divert it to bridge openings. This causes concentrations of floodwaters that erode the soils and cut channels across fields.

Victoria soils, which make up most of this association, have a surface layer of dark-gray, calcareous heavy clay. This clay is about 3 feet thick and is underlain by a layer of light-gray and dark-gray clay that is 18 inches thick. The substratum is pale-brown, calcareous clay containing a few fine lumps of lime.

If the Victoria soils are plowed at the proper moisture content, they crumble easily to a mass of small granules that form a mellow, easily worked seedbed. If plowed when wet, however, their surface layer puddles, their subsoil compacts, and they dry out hard and cloddy.

Victoria soils, locally called good blackland, are more desirable for farming than soils of the Clareville complexes, Orelia soils, and Banquete soils, all of which occur in this association. Soils of the Clareville complexes make up about 6 percent of this association. The Orelia soils and the Banquete soils together make up an additional 6 percent.

Clareville soils have a dark-gray clay loam surface soil 7 inches thick. Their subsoil is crumbly clay loam that ranges from gray to very dark gray. A light-gray clay loam substratum is at a 8 depth of about 36 inches. Many areas of Clareville soils are complexes that contain areas of a calcareous soil. The Orelia soils are hard and crusty; the Banquete soils occur in depressions.

This soil association is suited to use of heavy farm equipment and to large-scale farming. The topography is fairly uniform, with a slope that falls less than 3 feet to the mile. Most of the association is only slightly subject to erosion, but much of it is farmed on the contour. Under contour farming, the distribution of water is improved and more moisture is absorbed where the intake rate is slow or when rains are heavy.

Some of the highest crop yields in the county are produced on these soils. Cotton and grain sorghum are the principal crops, but large acreages of vegetables, principally onions, are grown when favorable prices and weather are predicted.

7. Orelia-Banquete association: Crusty and depressional soils of ancient lagoons and bays

One strip of this soil association extends northwestward as a nearly continuous belt from a point on the southern boundary of the county to a point near the Nueces River. This strip appears to be the course of an ancient stream. A broader strip of the association extends from a point near Nueces Bay, through the southern part of Corpus Christi, and then to Laguna Larga. Instead of forming in ancient streambeds, some of the soils in the association may have formed in ancient lagoons that were along old shorelines.

This association occupies about 6.5 percent of the county. In most places it lies about 2 feet lower than the bordering soil associations. It is nearly level; the slope averages less than 2 feet of fall per mile.

This association consists largely of the crusty Orelia soils that have a hardpan and of the depressional, imperfectly drained Banquete soils. Mainly along outer edges of the association are clay loams of the Clareville complexes.

The Orelia soils in this association are even more crusty than those in the Willacy-Clareville-Orelia association. The Banquete soils occupy slightly depressional, shallow, platterlike areas. Although these areas are generally irregular in shape, in some places they are oval. They vary from less than 1 acre to several acres in size, and they are few in some parts of the association but are numerous in other parts. Locally, these depressions are called swale land.

The Orelia soils in this association have a thin, crusty surface layer of dark-gray fine sandy loam that is free of lime. The surface layer is abruptly underlain, at a depth of 6 to 8 inches, by a dark-gray, hard, blocky subsoil, which is lighter colored and calcareous below a depth of 2 feet. The substratum is light gray and limy. Orelia soils make up about 50 percent of this association.

Banquete soils have a dark-gray, clayey surface layer that is free of lime, crusty, and about 18 inches thick. Their subsoil is gray, hard clay that is neutral in reaction. It is underlain by a substratum of light-gray, noncalcareous, alkaline clay containing a few lumps of lime. Banquete soils account for about 23 percent of the association.

Other soils, and their percentage of the association, are as follows: Clareville complexes, about 10 percent; Victoria clay, about 9 percent; and Victoria clay, low, about 8 percent. Victoria clay, low, like the Banquete soils, has very slow or slightly impeded surface drainage, but its surface soil is crumbly and calcareous.

Most of this soil association lies 30 to 40 feet above sea level. A drainage system consisting of large ditches removes most floodwaters during heavy rains. Cotton is better suited to the soils in this association than are other crops. During dry years crop yields may exceed those from higher, better drained areas.

8. Galveston-Mustang-Tidal flats association: Coastal sands generally above water, and low flats that are flooded daily

This soil association consists of deep, loose soils that developed in wave-deposited sands from the Gulf of Mexico. They are on Tidal flats — low level coastal areas flooded daily by normal tides. The association is made up of a broad area on the mainland and of Padre and Mustang Islands. In the broad area the sandy soils were first deposited as a barrier reef, which was left behind when the gulf receded to its present position. When the gulf receded, Mustang and Padre Islands were also formed. This association accounts for about 11 percent of the county.

The Galveston soils have a surface layer of light-gray fine sand that contains a small amount of humus and is about 1 foot thick. The subsoil, also light-gray fine sand, is normally moist and is about 3 to 4 feet thick. The parent material is fine sand that is almost white and is saturated much of the time. The hummocky surface of Galveston soils and the thick cover of small live oak, sweetbay, and many perennial grasses suggest that these soils have not been flooded by high tides for a long period of time. In most places Galveston soils are more than 5 feet above sea level. They account for about 30 percent of this association.

Mustang soils have a light-gray surface soil 6 inches thick. They are young soils that contain only a small amount of humus. Their subsoil is about 2 feet thick and consists of fine sand that is almost white. The substratum is normally saturated with salty or brackish water, but in other respects it is similar to the subsoil. Mustang soils are almost level and probably will remain so because backwater from their leeward side floods them occasionally when the lagoons and bays are filled during high storm tides. The Mustang soils lie above the level of normal daily tides but are generally only about 5 feet above sea level. They amount to about 32 percent of the association. Large areas of Mustang soils occur on the islands.

The soil material of Tidal flats ranges from fine sand and shell fragments to clay. Layers vary in texture and in their arrangement in the profile. Tidal flats make up about 32 percent of the association. Since the flats are covered with water, the acreage is not included in the acreage reported for the county by the U.S. Census of Agriculture.

The Nueces soils, which are on the mainland, occupy 5 percent of the soil association. These soils are light-gray fine sands that have a mottled, clayey subsoil. Coastal dunes, in high ridges and mounds, are mainly along the eastern side of the islands. They account for slightly more than 1 percent of the association. Coastal beach makes up less than 0.1 percent, but it is valuable for recreation.

None of the soils in this association are cultivated. They are used, on the mainland and on the islands, only as range for the grazing of beef cattle. This association, however, is probably one of the most important in the county from the standpoint of diversified use and its present and potential productivity. It is valuable for commerce and recreation because it lies in and along the Gulf of Mexico, the bays, and the lagoons. The association contributes greatly to the economy of Corpus Christi and of the whole Coastal Bend area. It provides transportation and marine resources, as well as fishing, hunting, and other activities.

Descriptions of the Soils

This section describes, in nontechnical language, the soil series (groups of soils) and single soils (mapping units) of Nueces County. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is first to describe the soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section “How Soils Are Mapped and Classified,” not all mapping units are members of a soil series. Gullied land and Tidal flats are miscellaneous land types and do not belong to a soil series but, nevertheless, are listed in alphabetic order along with the soil series.

Following the name of each mapping unit, there 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. The page on which each capability unit is described can be found readily by referring to the “Guide to Mapping Units” at the back of the report.

Soil scientists, engineers, students, and others who want detailed descriptions of soil series should turn to the section “Formation and Classification of Soils.” Many terms used in the soil descriptions and other sections of the report are defined in the Glossary.

Banquete Series

The Banquete series consists of gray, clayey soils that are imperfectly drained in most places. These soils are in depressions that are generally shallow. They occur in all parts of the county but are mostly in the eastern part.

The surface layer is dark gray, free of lime, and about 18 inches thick. It is crusty after rains and breaks into hard, irregular clods if it is plowed. The subsoil, about 16 inches thick, is gray, tight clay of weak structure. It is penetrated very slowly by roots, air, and water. Lime has not accumulated in this layer. The substratum is light gray. It is somewhat less clayey than the subsoil and is more granular in structure. Although it is generally not calcareous, it contains a few small lumps of lime.

The surface layer is darker colored in some places than it is in others. The texture of the surface layer and of the subsoil is light clay or heavy clay.

Typically, Banquete soils are imperfectly drained; surface and internal drainage are very slow. In years when rainfall is normal or high, these soils remain wet for longer periods than the surrounding soils. Some areas occupy deep basins and remain ponded for long periods.

These soils are similar to the Orelia soils but are more clayey and less well drained.

Most areas of these soils are small and can be cultivated along with the better drained adjoining soils. Normally, they can be drained easily by field ditches. Cotton is a better suited crop than grain sorghum or flax.

Banquete clay (0 to 1 percent slopes) (Ba) is a nearly level soil that is a few inches to a foot or more lower than the surrounding soils. It is moderately fertile, but if planting, tilling, or harvesting is delayed by wetness, yields are sometimes decreased. During dry years, however, yields on this soil may be higher than those on better drained soils.

Included with this soil are small areas of Orelia sandy loam. (Capability unit IIIw-1)

Banquete clay, low (0 to 1 percent slopes) (Bn) is similar to Banquete clay but is in lower areas. It is 2 to 5 feet lower than the surrounding soils. Some of the depressions are shallow and platterlike, but others are deeper, more concave, and basinlike. Because drainage in most places is not economical, the soil is not suitable for cultivation. Its native vegetation consists of sennabean, retama, huisache, and grasses that grow in swales. The grasses can be used for grazing. (Capability unit Vw-1)

Clareville Series

The Clareville series consists of deep, dark-colored, loamy soils in the western and northern parts of the county. These soils are nearly level or gently sloping.

The surface layer is very dark gray, free of lime, easily worked, and about 10 inches thick. It is granular in structure and slightly sticky when wet. The subsoil is about 30 inches thick. It contains slightly more clay than the surface layer and, as depth increases, gradually becomes less crumbly, harder, and more blocky. The parent material is light-gray, crumbly clay loam that contains many hard and soft lumps of lime.

The surface layer ranges from 6 to 14 inches in thickness and from dark gray to very dark brown in color. The subsoil is dominantly clay loam, but it ranges from sandy clay loam to sandy clay. The gently sloping Clareville soils tend to be slightly lighter colored than the nearly level ones.

Typically, Clareville soils have slow surface drainage and moderately slow internal drainage. They are moderately high in natural fertility and are easily penetrated by roots, air, and water.

Clareville soils are less clayey throughout than the Victoria soils, and the surface layer and upper subsoil are not calcareous as they are in the Hidalgo soils. Clareville soils take in water more rapidly than the crusty Orelia soils and are more easily worked.

Nearly all the acreage of Clareville soils is cultivated. These soils are well suited to cotton, grain sorghum, and flax, which are the crops generally grown in this area.

Clareville loam, 0 to 1 percent slopes (CaA) occurs mainly in the southwestern part of the county. This soil lies at a slightly lower level than the Willacy soils, the Hidalgo soils, and Clareville complex, 0 to 1 percent slopes. Consequently, it receives runoff water from those soils as well as from the higher lying Victoria soils. Surface drainage and internal drainage are slow, even after the soil is wet.

Included with this soil are a few small areas of Hidalgo fine sandy loam, 0 to 1 percent slopes; of Orelia clay loam; and of a Willacy soil that is not mapped separately in this county. (Capability unit IIc-2)

Clareville loam, 1 to 3 percent slopes (CaB) occurs mainly on the valley slopes of the Nueces River, in the northern part of the county. Surface runoff is slightly greater than on Clareville loam, 0 to 1 percent slopes. The areas are small and scattered.

The surface layer is about 8 inches thick. In places it is calcareous and slightly coarser textured than the surface layer of the slightly less eroded Clareville loam on 0 to 1 percent slopes. The subsoil is about 20 inches thick, and in most places the parent material occurs at a depth of less than 30 inches.

Included with this soil are a few small areas of Hidalgo fine sandy loam, 1 to 3 percent slopes, and of Clareville complex, 1 to 3 percent slopes. (Capability unit IIe-2)

Clareville Complexes

The Clareville complexes consist of dark Clareville loams and of a light-colored calcareous soil. Clareville soils make up 20 to 40 percent of the complex, and the calcareous soil, 60 to 80 percent. The Clareville soils are much like the loams described for the Clareville series. The calcareous soil has a limy surface layer that ranges from 6 to 15 inches in thickness, from sandy clay loam to heavy clay loam in texture, and from gray to very dark gray in color. Its subsoil, to a depth of 38 inches, is very firm, gray, calcareous clay containing small pockets or tongues of brownish gray or dark-gray clay. The underlying material is light-gray clay containing a few fine lumps of lime.

The two kinds of soil are so intermingled that it is not feasible to show them separately on the soil map. On the surface, the complexes are marked by light-gray and dark-gray spots. These spots are easily seen where the soils are not disturbed. They are not so distinct in areas that have been plowed, smoothed, and cultivated. Actually, in some cultivated areas, the dark surface layer of the Clareville soils has been mixed with that of the calcareous soil, and the resulting surface layer is dark-gray, limy clay loam 10 to 14 inches thick. It is plowing to a depth of 10 to 14 inches that turns up the dark-colored material that spots some fields (fig. 4). This spotting disappears after the field has been smoothed and cultivated.

Soils of the Clareville complexes are well suited to all locally grown crops and are moderately productive.

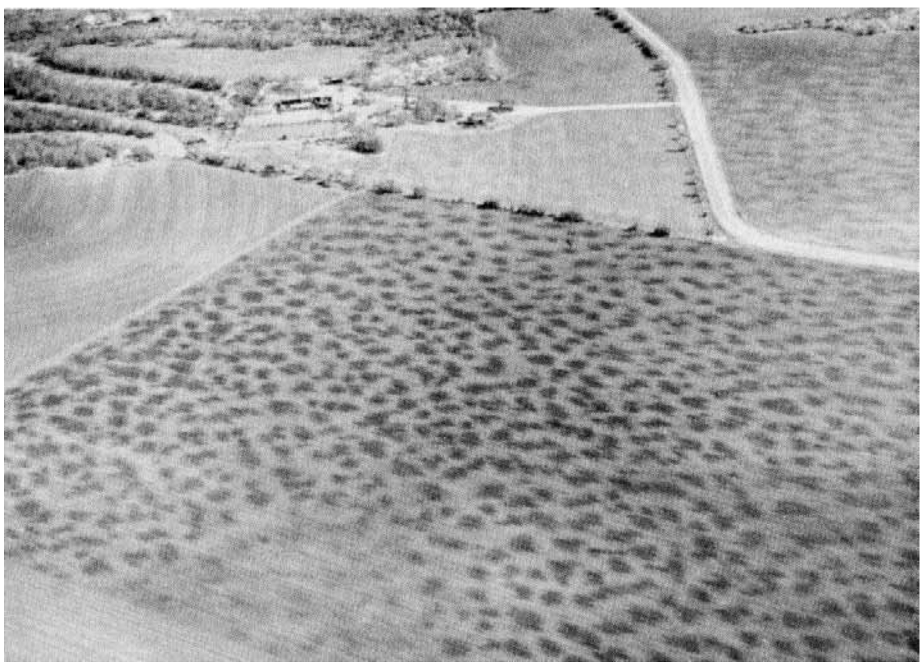

Figure 4.— Spotted field of Clareville complex in which dark-colored material from the subsoil has been turned up by flat breaking the land to a depth of 12 inches. Area on left and in left foreground has not been plowed so deep and has uniform color.

Clareville complex, 0 to 1 percent slopes (CcA) occurs in small and moderately large areas in most of the nearly level parts of the mainland. In places the surface is slightly convex, but the slope is normally less than one-half percent.

Included in this complex are small areas of Hidalgo fine sandy loam, 0 to 1 percent slopes, and of Victoria clay, 0 to 1 percent slopes. (Capability unit IIc-2)

Clareville complex, 1 to 3 percent slopes (CcB) occurs as narrow, gently sloping bands near small drainageways in the nearly level parts of the mainland and in the northern part of the county. It is similar to Clareville complex, 0 to 1 percent slopes.

Included in this complex are small areas of Victoria clay, 1 to 3 percent slopes, and of Hidalgo fine sandy loam, 1 to 3 percent slopes. (Capability unit IIe-2)

Clareville complex, 3 to 5 percent slopes (CcC) occurs as narrow, moderately sloping bands in the northern part of the county. It is subject to moderate erosion and is marked by a few shallow gullies.

Included in this complex are a few small areas of Victoria clay, eroded, and of Miguel fine sandy loam, 3 to 5 percent slopes. (Capability unit IIIe-4)

Clayey Alluvial Land (Cd)

This land occurs in and along the narrow, shallow channels of natural waterways that cross and drain the coastal terrace in Nueces County. It consists of alluvium that generally is stratified. The alluvium varies widely in texture but is normally clayey. It was recently deposited and is shallow to deep. In some places the alluvium is over eroded AC horizons of soils from which the creeks washed away the surface layer. These drainageways cut mainly into areas of Victoria and Orelia soils.

Nearly all Clayey alluvial land is frequently flooded during periods when rainfall in the contributing watersheds is above average or is prolonged. Most of the land is not cultivated, either because flooding damages the land or crops or because the banks of the drainageways are steep or gullied.

The soil materials vary greatly in texture and in arrangement of their soil layers. In most places in this county, Clayey alluvial land consists of very dark gray clay or sandy clay that is underlain by gray or brownish-gray sandy clay or fine sandy loam. Bars and strips of freshly deposited, loamy and sandy material occur in places.

Nearly all of this land is in native vegetation, mainly mesquite trees and thorny shrubs. Much of it is used as range, but some that has not been fenced provides cover for wildlife. (Capability unit Vw-2)

Coastal Beach (Co)

Coastal beach consists of shores that have been washed and rewashed by waves. It is partly or completely covered by water at high tides during storms. The soil material is fine sand that is almost white. The sand washed from the Gulf of Mexico to the eastern shore of Padre and Mustang Islands. It lies in a narrow band, 100 to 300 feet wide, that adjoins Coastal dunes. From the eastern base of these dunes to the water's edge, the slopes of Coastal beach range from 2 to 3 percent. Its surface is generally smooth. The water from the occasionally 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 for a distance of more than 20 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 Padre Island since a causeway was built to the island. A large part of the island, including that in Nueces County, has recently been declared a national seashore or park. Coastal beach has not been placed in a capability unit.

Coastal Dunes (Cs)

Coastal dunes are made up of sand dunes that are partly stable and partly active. The dunes are a series of steep-sided, ridges of fine sand that has washed from the Gulf of Mexico and has been shifted by wind. The ridges are mainly along the eastern side of Mustang and Padre Islands, but in places they extend to the western side.

The surface layer is light-gray, loose fine sand about 4 feet thick. The subsoil is loose fine sand that is almost white and is 1 to several feet thick. The tops of the dunes are 5 to 30 feet or more above sea level. The prevailing breeze from the sea is shifting the bare dunes northwestward.

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

These dunes furnish a small amount of grazing for cattle, and because they adjoin Coastal beach, they are useful for recreation and for scenery. (Capability unit VIIe-1)

Frio Series

The Frio series consists of deep, loamy, calcareous soils in alluvium on the flood plain of the Nueces River.

The surface layer of these soils is about 20 inches thick and is loamy, high in lime, and easily worked. To a depth of 6 inches it is gray in color and granular in structure, but below that depth it is dark gray and subangular blocky. The subsoil, about 1 foot thick, is gray and has about the same texture and structure as the lower part of the surface layer. The parent material is light gray, contains a few soft lumps of lime, and has about the same texture and structure as the layers above.

The surface layer ranges from loam to clay loam in texture and from very dark gray to gray in color. In places the subsoil consists of thin, alternating layers of sandy and loamy material that ranges from light gray to grayish brown.

The Frio soils are moderately well drained. Surface drainage is slow because slopes are nearly level. Permeability and fertility are moderate. Every 2 or 3 years these soils are flooded to a depth of 1 to 5 feet.

Frio soils are less clayey than the Trinity soils hut are more clayey and contain more lime than the Zavala soils.

The Frio soils produce moderate yields of most locally grown crops. These crops are occasionally damaged by floods.

Frio clay loam (0 to 1 percent slopes) (Fe) occurs mainly as crescent-shaped strips along the inside edge of curves in old stream channels. The strips were once streambanks, but they have been leveled so much that their slope is now less than one-half percent.

The surface layer, about 20 inches thick, is calcareous. It ranges from light-colored loam on slight ridges to heavy clay loam in filled channels. The subsoil is calcareous, gray silty clay loam about 1 foot thick, and the parent material is light-gray, subangular blocky, limy silty clay loam.

Included with this soil are a few small areas of noncalcareous, slightly finer textured soils and a few small areas of Trinity clay. (Capability unit IIw-1)

Galveston Series

The Galveston series consists of deep, hummocky, light-colored, loose sands on the coast of the mainland and on the offshore islands. These soils are more than 5 feet above mean sea level.

The surface layer, normally less than 1 foot thick, contains a little humus and normally is light gray. It is underlain by light-gray fine sand that is 3 or 4 feet thick and is moist most of the time. Parent material of nearly white fine sand lies at a depth of 4 to 10 feet and is usually saturated.

The surface layer ranges from nearly white to grayish brown. It is slightly salty on the side of the islands facing the Gulf of Mexico but is slightly acid farther from the shore.

Runoff is very slow because practically all rain enters and moves through these soils rapidly. The soils remain moist in their lower layers most of the time and support a thick growth of small live oak trees, bay trees, and tall bunchgrass.

Galveston soils occur with the Mustang and Nueces soils. They are hummocky and better drained than the lower lying Mustang soils and are not susceptible to flooding at high storm tide. Although similar to the Galveston soils, the Nueces soils are clayey at a depth of less than 5 feet, and their water table is not permanently high.

Galveston and Mustang fine sands (0 to 8 percent slopes) (Gm) are along coastal strips of the mainland and are in a few areas of the offshore islands. These soils and many small areas of Nueces fine sand, and of other soils, are mapped as one unit because it is not practical to map the soils separately. They are mainly in nearly level areas on which there are many low dunes. On the mainland the dunes are seldom more than 3 feet high, but on the islands they are as much as 10 feet high.

These soils are not suitable for locally grown cultivated crops and are used mainly for range. Permanent structures, including those of Flour Bluff and Port Aransas, are located on this soil. (Capability unit VIe-5)

Gullied Land

Recently, this land has been cut so much by gullies that it cannot be cultivated. It is dominantly steep and consists of many kinds of soils along streams. Some areas are loamy, but most are clayey.

The surface soil remains only in small islandlike areas that are surrounded by gullies. The gullies range from 1 to several feet in depth and are, on the average, less than 100 feet apart. The surface layer is dark-gray, crumbly clay that is less than 14 inches thick in most places. The subsoil is slightly lighter colored and a little less crumbly than the surface soil. It is underlain by a hard, light-gray substratum of limy clay that is salty in many places.

The surface layer ranges from 2 to 20 inches in thickness. On 25 to 75 percent of this land, the subsoil and parent material are exposed in the gullies. Slopes range from 1 to 20 percent but are dominantly about 12 percent.

Gullied land is generally steeper than Victoria clay, eroded, and has lost more of its surface soil. Gullies are deeper and more numerous on this land. Gullied land is generally darker colored and less salty than Gullied land, saline.

Gullied land (0 to 20 percent slopes) (Gu) occurs as gently sloping to steep, narrow bands. It is mainly along Petronila and Oso Creeks and near the community of Calallen on valley slopes of the Nueces River (fig. 5).

Included with Gullied land are areas of Gullied land, saline; of Victoria clay, eroded; and of some soils that have a loamy surface soil and subsoil. (Capability unit VIIe-2)

Gullied Land, Saline

This land is eroded, dominantly steep, and too salty for the normal growth of most plants. It occurs along the coast on the short slopes of creeks that empty into small bays, which spray it with salt water at high tide during storms.

The surface layer is mainly dark-gray, crumbly clay that is less than 14 inches thick. Salt and erosion have given the surface a light-gray appearance. The subsoil is gray, crumbly, salty clay about 1 foot thick. The substratum is hard, light-gray clay that is limy and strongly salty.

The surface layer ranges from 2 to 20 inches in thickness and from dark gray to gray in color. On 25 to 75 percent of this land the subsoil and parent material are exposed in washes and gullies. Slopes range from 1 to 20 percent but are dominantly about 12 percent.

This land is generally steeper than Victoria clay, eroded, and has lost more of its surface soil. It has deeper and more numerous gullies than Gullied land and is lighter colored and more salty.

Gullied land, saline (0 to 20 percent slopes) (Gv) occupies gently sloping to steep, narrow bands on Cayo del Oso and, on the mainland, near the mouth of Oso Creek.

This land is not suited to cultivation, for it is salty, generally steep, and eroded. Native plants are scattered and stunted. (Capability unit VIIe-3)

***Figure* 5.—Gullied land, west of Calallen. Areas of nearly level Victoria clay are in upper left background. The Nueces River is at the foot of the slope.**

Hidalgo Series

Soils of the Hidalgo series are deep, grayish, and moderately well drained. They contain much lime and are sometimes called ashy soils. They occur mainly in gently sloping or moderately sloping areas in the northern part of the county but also are scattered in small, nearly level areas in the southwestern part.

The surface layer is about 1 foot thick and is grayish brown, high in lime, and loamy. This layer is normally granular in structure and is easily worked, but excessive cultivation powders the soil and makes it subject to wind erosion in dry periods. The subsoil, about 18 inches thick, is light brownish-gray sandy clay loam that is high in lime. It is porous and breaks to granular structure that permits roots to develop and air and water to move freely. The parent material is porous, pale-brown, limy sandy clay loam that contains lumps of lime.

The surface layer ranges from 8 to 16 inches in thickness, from dark gray to grayish brown in color, and from fine sandy loam to sandy clay loam in texture.

These soils have moderate to slow surface drainage and moderate internal drainage.

Except that Hidalgo soils contain much lime in the surface soil and subsoil, they are similar to the lime-free Willacy soils. Hidalgo soils have a less clayey, more porous subsoil than the Clareville complexes.

The Hidalgo soils are fertile and produce moderately high yields of most, crops grown locally.

Hidalgo fine sandy loam, 0 to 1 percent slopes (HaA) occurs as small, scattered, slightly convex areas, mainly in the southwestern part of the county, where it is closely associated with the Willacy soils.

Grain sorghum on this soil is damaged by chlorosis (yellowing), but most other crops do well.

Included with this soil are small areas of Clareville complex, 0 to 1 percent slopes, and of Willacy fine sandy loam, 0 to 1 percent slopes. (Capability unit IIc-3)

Hidalgo fine sandy loam, 1 to 3 percent slopes (HaB) occupies a few small, gently sloping areas in the northern part of the county. (Capability unit IIe-3)

Hidalgo fine sandy loam, 3 to 5 percent slopes (HaC) occupies short, moderately sloping spur ridges and shallow valleys that lead to the Nueces River in the northern part of the county. This soil is slightly thinner and more brownish in the surface layer than Hidalgo fine sandy loam, 0 to 1 percent slopes, and is more susceptible to erosion.

Included with this soil are small areas of Willacy soils, and of a soil that has a sandy clay loam surface layer. (Capability unit IIIe-8)

Lomalta Series

The Lomalta series consists of deep, dark-colored clays that are marshy and saline. These soils are mainly on the nearly level lowlands near the mouth of the Nueces River, between Calallen and Nueces Bay.

The very dark gray surface layer is calcareous, salty, and about 20 inches thick. It is crumbly and has granular structure. A thin, white film of salt can be seen on the surface in places where this soil is dry. The subsoil, about 10 inches thick, is slightly lighter gray than the surface layer. Although the subsoil has weak, granular structure, this layer is wet and sticky most of the time and does not crumble as easily as the surface layer. The parent material is gray, limy clay that is strongly saline and contains a few small, hard, white lumps of lime.

The surface layer of the Lomalta soils ranges from dark gray to black in color and from sandy clay to clay in texture. This layer is slightly saline in some places and is strongly saline in others. The subsoil is moderately to strongly saline. During long droughty periods these soils dry and crack on the surface.

Lomalta soils are likely to be flooded by the Nueces River (fig. 6). Flooding occurs two or three times each year and may last for several days to several weeks. During some tropical storms salt water floods these soils at high tide. Sea level is less than 5 feet below these soils, and the water table is permanently between depths of 2 and 6 feet. Except during dry periods the soils are marshy or semimarshy for long periods during most years.

Lomalta soils support a thick growth of salt-tolerant and water-loving plants, mainly gulf cordgrass, which is a coarse perennial bunchgrass that remains green throughout the year and is grazed by cattle. Some of the higher, less salty areas of these soils have been planted to perennial grasses suitable for improved pasture. These soils are used mainly as range because they are too wet and saline for crops.

Lomalta clay (0 to 1 percent slopes) (Lo) is the only Lomalta soil mapped in this county. Although this soil is nearly level, it is ponded for long periods in the shallow troughs of the undulations.

Included with this soil are small areas of Point Isabel clay and areas covered by moderately sandy and loamy overwash. (Capability unit VIIs-1)

***Figure* 6.—Semimarshy Lomalta clay near the mouth of the Nueces River.**

Made Land (Ma)

This land consists of piles of sand, mud, and shells that have been excavated from the floor of lagoons and bays. Although some of this land is waste material from the excavation of ship and boat channels, much of it, for example, that in the Padre Island Causeway, was pumped or dug and then placed and shaped for a special purpose.

In some parts of the lagoons and bays, the excavated clay is similar to, or is the same as, the geological material from which most of the soils on the mainland formed. Because the excavated material was saturated with sea water when it was excavated, it contains salt and is not normally suitable for useful plants unless it is covered with a layer of good topsoil. Made land has not been placed in a capability unit.

Miguel Series

The Miguel series consists of deep, dark grayish-brown, loamy and sandy soils that contain a mottled claypan. These soils occur in the northern part of the county and are nearly level to sloping.

The dark grayish-brown surface layer is about 10 inches thick. It is free of lime and slightly hard when dry, but it is easily worked when moist. This layer is abruptly underlain by a dark grayish-brown subsoil that is about 20 inches thick and consists of hard clay with fine, reddish mottles. Plant roots normally follow cracks between the blocks that make up the blocky structure of the subsoil.

The very pale brown parent material is less clayey than the subsoil. It contains hard and soft lumps of lime.

The surface layer is loamy to sandy. It generally ranges from 8 to 24 inches in thickness, but in a few small areas it is as much as 30 inches thick. The subsoil ranges from dark gray to gray or pale brown.

Internal drainage is very slow in the Miguel soils. Surface drainage is slow in nearly level areas and medium to rapid in gently sloping or moderately sloping areas. Much water is lost in runoff, and the intake of water is very slow. Consequently, these soils tend to be droughty.

Miguel soils are slightly thicker and less crusty in the surface layer than the Orelia soils and, unlike those soils, are mottled in the subsoil.

The Miguel soils produce only moderate to low yields of crops that mature in summer. They are better suited to crops that mature early or to crops grown during the cooler part of the year.

Miguel fine sandy loam, 0 to 1 percent slopes (MgA) is mainly in the northwestern part of the county. As much as 10 percent of any mapped area may be Orelia fine sandy loam. Also included are a few small areas of Miguel loamy fine sand.

This soil produces higher yields of cotton and grain sorghum than do the more sloping Miguel soils, but it is probably better suited to flax or vegetables. (Capability unit IIIs-1)

Miguel fine sandy loam, 1 to 3 percent slopes (MgB) has convex slopes that are slightly more than 2 percent in most places. This soil is slightly thinner in the surface layer than Miguel fine sandy loam, 0 to 1 percent slopes. Included in slightly depressional drainageways are small, narrow strips of Orelia fine sandy loam and a few small areas of Banquete soils. These inclusions make up less than 15 percent of any area mapped. (Capability unit IIIe-1)

Miguel fine sandy loam, 3 to 5 percent slopes (MgC) occupies short, convex slopes that normally border very shallow drainageways in the northern part of the county. Although the slope of this soil is more than 4 percent in only a few places, the surface layer is only 6 or 8 inches thick and the risk of erosion is high. The soil is, therefore, better suited to close-growing crops or to grass than to clean-tilled crops. (Capability unit IVe-3)

Miguel loamy fine sand (0 to 3 percent slopes) (Mf) is slightly billowy or wavy. It is in the northern part of the county.

The surface layer ranges from 12 to 30 inches in thickness but is normally about 2 feet thick. Cultivated areas are sandy and somewhat loose. The subsoil, about 20 inches thick, is blocky, gray to pale-brown sandy clay that is mottled with yellow and red. The parent material is pale brown and contains lumps of lime.

Included with this soil are a few small areas of Miguel fine sandy loam, 0 to 1 percent slopes, and of Orelia fine sandy loam. Peas, watermelons, and peanuts grow well on this soil. (Capability unit, IIIe-16)

Mustang Series

The Mustang series consists of nearly level, deep, sandy soils that are wet and, in some places, salty. These soils occupy low areas along the coast, mainly on Padre and Mustang Islands, and are occasionally flooded at high tide. They are generally less than 5 feet above sea level.

The light-gray surface layer is about 6 inches thick. Because these soils are very young, this layer contains only a small amount of humus. The subsoil is almost white and is about 2 feet thick. It is nearly always moist and has a few, faint, yellowish-brown mottles. Generally, in much of this soil a water table stands at a depth of about 3 or 4 feet. The parent material is similar to the subsoil, but it is more salty and is normally saturated with water.

The surface layer ranges from light brownish gray to white. In some places the subsoil is mottled, and in other places it contains thin layers of dark-gray loamy sand. After these soils have been flooded, they are much saltier than normal, but during long storm-free periods much of the salt is washed through the subsoil. During heavy rains, the water table rises close to the surface. In some places these soils are marshy.

Mustang fine sand (0 to 1 percent slopes) (Mu) is the only Mustang soil mapped in this county. A few low areas of this nearly level soil are marshy most of the time.

Native plants are more abundant on this soil than on other soils of the offshore ads. Plants tolerant of excess salt grow well, including many nutritious grasses that are grazed by livestock. Because this soil is low and wet, it is not suited to cultivation. It is used as range for beef cattle. (Capability unit VIw-1)

Nueces Series

The Nueces series consists of deep, light-colored soils that have a loose, sandy surface soil and a sandy clay loam subsoil. These soils occur with the Galveston soils in the southeastern part of the county.

The sandy surface layer is about 3 feet thick. To a depth of 1 foot it is light brownish gray and contains fine roots and a small amount of humus, but its lower part is lighter colored and has a few, fine, yellowish-brown mottles. The subsoil of gray sandy clay loam is mottled with yellow and brown and is about 1 foot thick. The coarse blocks and columns of its structure are very hard when dry. The parent material is light-gray, hard sandy clay loam.

The surface layer ranges from 15 to 40 inches in thickness. It tends to be slightly more loamy where it is 15 to 30 inches thick than where it is thicker.

Runoff from these soils seldom occurs because the surface layer takes in water rapidly. The subsoil, however, takes in water slowly, and the thin surface layer remains saturated for a short time after heavy rains.

Nueces soils have a thinner, less moist surface layer than the Galveston soils and a lighter colored, sandier surface layer and subsoil than the Miguel soils. Nueces soils are not used for most locally grown crops, because they are low in natural fertility and are susceptible to wind erosion.

Nueces fine sand (0 to 3 percent slopes) (Nu) lies at the western edge of the strip of coastal sand in the southeastern part of the county. The surface layer is 15 to 40 inches thick, but the average thickness is about 36 inches.

On the slightly wavy surface are a few dunes. Although most of the soil is nearly level, slopes are as much as 3 percent in a few places. (Capability unit IVe-11)

Oil-Waste Land (Oa)

This land has been damaged by oil, salt water, mud, or other byproducts of oilfields to such an extent that its productivity has been seriously reduced or destroyed. Most of the damage was done when the oil industry was first started in the county. For more than 25 years, some of this land has been covered by sterile mud, slush, salt water, and oil to a depth of 1 to 4 feet, and it is still bare of vegetation. Other areas that were severely to moderately damaged have been gradually improved, and parts of them are put back into agricultural production each year. Little land is now being damaged because techniques and equipment have been improved and regulations enforced. Oil-waste land has not been placed in a capability unit.

Orelia Series

The Orelia series consists of deep, dark-colored, crusty soils that contain a hardpan and are locally called hardpan soils. The largest areas of these soils are nearly level and occur in the eastern part of the county, but many small areas are scattered throughout most of the mainland.

The surface layer is dark gray, free of lime, and about 6 inches thick. As these soils dry, this layer normally hardens to a crust before the subsoil is dry enough for plowing. The subsoil consists of sandy clay loam 2 to 3 feet thick. It is dark gray, hard, dense, and blocky. The upper part of the subsoil is free of lime and darker colored than the limy lower part. The parent material is light-gray loamy clay that contains hard and soft lumps of lime.

The surface layer ranges from 5 to 8 inches in thickness and from gray to dark grayish brown in color. The soils are less crusty in the western part of the county than they are near the coastline. The subsoil ranges from gray to grayish brown and, in some places, is strongly limy at a depth of 18 inches.

Because their subsoil is dense, these soils take in water very slowly. Although surface drainage is slow, tillage is not delayed by wetness.

Orelia soils are similar to the Miguel soils but are not mottled in the subsoil. They are better drained than the Banquete soils. The surface soil and subsoil of Orelia soils are less crumbly than those of the Victoria and Clareville soils.

Orelia fine sandy loam (0 to 1 percent slopes) (Of) is mainly in the eastern part of the county. Although the surface layer is moderately sandy, it is hard and cloddy where the content of organic matter is low. This soil is lower in natural fertility than Orelia clay loam.

Included with this soil are small areas of Banquete clay and of Banquete clay, low. (Capability unit IIIs-1)

Orelia clay loam (0 to 1 percent slopes) (Oc) occupies shallow valleys of small creeks in the county, mainly those of Quinta, Aqua Dulce, and Pintas Creeks in the western part. Because the channels of these creeks are shallow and narrow, this nearly level soil is flooded when rains are heavy locally or in the counties to the west.

This soil is more productive than Orelia fine sandy loam, but occasional floods delay tillage or damage crops. Included with this soil are small areas of Banquete clay and of Banquete clay, low. (Capability unit IIIw-1)

Orelia-slickspot complex (0 to 1 percent slopes) (Os) consists of deep, gray, crusty, salty soils that in small areas have had their surface soil removed and their clayey subsoil exposed. These small areas are called slickspots. The slickspots are intermingled with the Orelia soils to such an extent that it is not practical to map them separately. This complex is in the southeastern part of the county, in beds of old lagoons that are now 15 feet above sea level.

The surface layer of this complex is gray, free of lime, moderately to strongly salty, and about 7 inches thick. This layer is hard and crusty and, if broken, has angular blocky structure. The subsoil, about 2½ feet thick, is lighter colored than the surface layer. It is blocky sandy clay that is salty and contains lime. The parent material is light-gray, strongly salty, crumbly clay loam that contains lumps of lime.

The surface layer ranges from fine sandy loam to clay loam in texture and from light gray to dark gray in color. Within short distances the subsoil ranges from sandy clay loam to sandy clay. Because of excess salt, Orelia soils have not developed so evenly throughout this complex as they have elsewhere in the county. Included in this complex are small pockets of Banquete clay, low.

Native plants consist mainly of stunted thorny shrubs, some desirable grasses, and many other plants that are tolerant of salt. Range is the only suitable use. (Capability unit VIs-1)

Pits (Ps)

This mapping unit is made up of pits from which gravel, sand, and other material are excavated for use in construction. Some of the pits are borrow pits that supply fill material for roads. Most of the pits are in use, but some have been abandoned.

Some of the pits that supply sand and fill material are in areas south of Flour Bluff and south of Corpus Christi, but most of those that supply sand and gravel are in the northwestern part of the county. Pits have not been placed in a capability unit.

Point Isabel Series

In the Point Isabel series are deep, light-colored, saline clays that make up stable dunes and eroded knolls near the coast. The dunes and knolls are small and convex. These soils are scattered between Calallen and Nueces Bay in the semimarshy lowlands that lie along the Nueces River.

The surface layer is gray, slightly saline clay about 6 inches thick. It is crumbly and granular in structure and contains some lime. The subsoil is about 8 inches thick. It is light grayish-brown, limy, moderately salty clay that has fine, granular structure. The parent material consists of thin layers of salty, gray loam and clay that have little or no structure.

The surface layer ranges from dark gray to gray in color and from sandy clay to clay in texture. In some places washing has exposed the subsoil, and in others thin layers of windblown sand cover the surface.

Point Isabel soils are lighter colored and more sloping than Lomalta soils and have better surface drainage. They also have better surface drainage than Orelia-slickspot complex and are smoother and more clayey.

Point Isabel clay (1 to 3 percent slopes) (Pt) occupies gently sloping knolls in the lowlands northwest of Corpus Christi, where it occurs with the semimarshy Lomalta soils.

Because it is saline, this soil is not suitable for cultivation. It is used as range, which can be improved by good management. (Capability unit VIs-1)

Sandy Sloping Land (Sa)

This land is made up mainly of steep, sandy soils that are so variable that they cannot be placed in a soil series, although they resemble the Willacy soils in some respects. Slopes range from 5 to 12 percent. About 80 percent of the acreage consists of calcareous fine sandy loams, and 20 percent, of noncalcareous loamy fine sands. The subsoil ranges from fine sandy loam to sandy clay. In about one-third of the acreage that has a calcareous fine sandy loam surface layer, the soils are similar to the Hidalgo soils, but, areas are so small, discontinuous, or variable that it is not practical to show them on a map of the scale used in this survey. In the rest of their acreage, the calcareous fine sandy loams are sloping and have a light-gray or light brownish-gray surface layer of varying thickness. The subsoil is brownish-gray fine sandy loam that is coarser textured than that of Hidalgo soils, or it is dense, brownish, very firm sandy clay that is finer textured than the subsoil of the Hidalgo soils.

The loamy fine sands of this land have a dark grayish-brown surface layer that is 2 to 3 feet thick. The subsoil, about 2 feet thick, ranges from grayish brown to reddish brown. The substratum is light-brown sandy clay loam.

Watermelons, grain sorghum, and other crops have been grown in areas of Sandy sloping land, generally those with slopes of not more than 8 percent. These areas are now in perennial grasses and are better suited to that use. (Capability unit IVe-6)

Spoil Banks (Sb)

Spoil banks consist of sand, clay, and shells that were excavated from the floor of lagoons and bays and dumped in unsmoothed mounds and ridges near channels dug for ships and boats. Many of these ridges and mounds are along channels in Laguna Madre and Corpus Christi and Redfish Bays. Spoil banks have not been placed in a capability unit.

Tidal Flats (Ta)

Tidal flats are mainly barren, nearly level areas that are above salt water at low tide but are flooded at normal high tide. Slopes range from 0 to 1 percent. At low tide the flats can be seen along parts of the mainland shore, along the edge of islands, and protruding above the water in shallow bays and lagoons.

Layers of sand, shells, and clay make up Tidal flats, but these layers are not consistent in texture, in thickness, or in their arrangement. In some places gray clay occurs that is similar to, or is the same as, the parent material of many soils on the mainland.

A sparse growth of grasses and weeds tolerant of salt water borders the edges of these flats that are above water most often. Tidal flats have not been placed in a capability unit.

Trinity Series

The Trinity series consists of almost black, nearly level, clayey alluvial soils on the flood plain of the Nueces River.

The surface layer is very dark gray, calcareous, and about 18 inches thick. This layer crumbles if it is plowed when dry, but it is fairly hard to work because it consists of heavy clay. It has fine, subangular structure and is very sticky when wet. The clay subsoil is dark gray to a depth of 50 inches, but below that depth it is lighter colored and contains a few lumps of lime. The subsoil is harder than the surface layer and has a less distinctly angular structure.

The surface layer ranges from dark gray to black and is free of lime in some places. The subsoil ranges from dark gray to gray and from clay to sandy clay.

The Trinity soils are likely to be flooded by the Nueces River. Most areas are moderately well drained, though low areas are somewhat poorly drained. Surface drainage and internal drainage are slow.

Trinity soils are more clayey and less well drained than the Frio and Zavala soils. They dry and crack during most summers.

Most of the Trinity soils can be cultivated, but they are used mainly as range. They are high in fertility, but in some places flooding occasionally damages or destroys crops.

Trinity clay, occasionally flooded (0 to 1 percent slopes) (Tc) extends from Calallen westward to the county line. It is on the flood plain of the Nueces River, in nearly level areas that are flooded two or three times every 5 years. Because the flooding is normally shallow and seldom occurs before May or June, it often benefits crops instead of damaging them. This soil produces moderately high yields of cotton and grain sorghum, the principal crops.

Included with this soil are small areas of Trinity clay, frequently flooded, and of Frio soils. (Capability unit IIw-2)

Trinity clay, frequently flooded (Tf) occupies basins, sloughs, and abandoned channels that are flooded by local runoff and by the Nueces River. Although this soil is fertile, it is used as range because wet periods are frequent and prolonged and tillage is not practical. (Capability unit Vw-2)

Urban Land (Ua)

This land consists of urban areas in which closely spaced buildings and other urban structures have been built. The areas are those into which soil boundaries could not be extended with reasonable accuracy in this type of survey.

In some urban or suburban areas, a soil survey is sometimes made with special procedures, techniques, and equipment. Such a survey is made according to special arrangements between a local government and the Soil Conservation Service.

Urban land has not been placed in a capability unit.

Victoria Series

The Victoria series consists of dark, calcareous, crumbly soils that are called blackland. These soils crack when they dry, and when wet, they swell and take in water slowly. They occur on the mainland and occupy more than 60 percent of the county.

The dark-gray surface layer is heavy clay that contains lime and is about 3 feet thick. The structure of these soils is fine and granular if they are plowed when the moisture content is favorable, but a cloddy seedbed is formed if they are plowed when too wet or too dry. More powerful equipment is required for plowing these soils than is required on more loamy soils.

The subsoil is clay about 18 inches thick. It is gray in the upper part and grades to a lighter color in its lower part. The subsoil contains pockets and seams of dark-gray material that fell from the surface layer when these soils were dry. The parent material is very pale brown, limy clay that contains a few fine lumps of lime.

The surface layer ranges from 15 to 40 inches in thickness and from gray to almost black in color. Most of the Victoria soils are nearly level, but a few small areas near the Nueces River are on slopes of 0 to 5 percent. Some areas that are still in native grasses contain many small hogwallows in which water remains after rains.

Because Victoria soils dry and crack almost every summer, their subsoil can take in and store much water in a short time during heavy rains in fall. Although internal and surface drainage are slow, in most places these soils are drained well enough to permit well-timed tillage.

Victoria soils are more crumbly than the Orelia and Banquete soils and are more permeable in the subsoil. Also, their surface layer is self mulching, and that of the Orelia and Banquete soils is not. Victoria soils are less loamy than the Clareville and Willacy soils but are better drained than the Banquete soils.

Nearly all of the Victoria soils are cultivated and produce moderate to high yields of locally grown crops.

Victoria clay, 0 to 1 percent slopes (VcA) occupies large, smooth areas on the mainland. In this county this soil makes up almost 94 percent of the acreage in Victoria soils. The average slope falls about 4 feet in a mile, or is about 0.1 of 1 percent.

Because the slopes are long, water accumulates in some of the low areas when rainfall is heavy. Large drainage ditches and road ditches remove excess water so that it seldom interferes with cultivation. Skilled management that includes a minimum of well-timed tillage operations is needed to keep this soil in good tilth.

Included with this soil are small areas of Orelia clay loam; of Banquete clay, low; of Victoria clay, low; and of Clareville complexes, but in only a few places do these soils exceed 1 percent of the areas mapped. (Capability unit IIs-1)

Victoria clay, 1 to 3 percent slopes (VcB) is in the northern part of the county. It occupies narrow bands on short gentle slopes along small creeks and the Nueces River.

The surface layer is about 2 feet thick, and the subsoil extends to a depth of about 18 inches. This soil is slightly more susceptible to erosion than Victoria clay, 0 to 1 percent slopes, because it is more sloping and it receives runoff from large areas.

Included with this soil are small areas of Clareville complex, 1 to 3 percent slopes; of Clareville loam, 1 to 3 percent slopes; and of Victoria clay, eroded. (Capability unit IIIe-3)

Victoria clay, eroded (0 to 5 percent slopes) (Vd 2) is along the edge of large areas of Victoria clay, 0 to 1 percent slopes, and along the narrow bands of Victoria clay, 1 to 3 percent slopes, that border creeks and drainageways in this county.

This soil is susceptible to moderately severe erosion, but if it is carefully managed, it can be tilled along with the adjoining soils.

The surface layer of this soil is about 11 inches thick in most places, but the light-colored subsoil is exposed in some places. (Capability unit IIIe-4)

Victoria clay, low (0 to 1 percent slopes) (Vt) is an almost flat, very slowly drained soil. It is normally surrounded by Victoria clay, 0 to 1 percent slopes, and is about 1 foot lower than that soil.

The surface layer of Victoria clay, low, is slightly lighter colored than that of the better drained Victoria soils. In some places tillage is delayed by wetness, but most of the excess water can be removed by simple, easily constructed field ditches.

Included with this soil are small areas of Victoria clay, 0 to 1 percent slopes, that may total as much as 10 percent of any area mapped. (Capability unit IIw-2)

Willacy Series

The Willacy series consists of deep, grayish, moderately loamy soils. These soils occupy long, narrow strips in the southwestern and northern parts of the county.

The surface layer is dark grayish brown, free of lime, and about 16 inches thick. It is easily worked. This layer has weak, granular structure and is friable when moist and slightly hard when dry. The subsoil, about 2 feet thick, is free of lime and contains many fine pores. It is friable and easily penetrated by water and roots. Its structure is subangular blocky. The parent material is white, limy clay loam that contains many soft lumps of lime.

The surface layer ranges from 14 to 26 inches in thickness and from dark gray to grayish brown in color. In many places it contains lime in the lower part. In some places it has about the same color and texture as the surface layer.

Internal drainage is moderate, and surface drainage is medium to slow. Much of the water soaks into these soils.

The Willacy soils, unlike the Hidalgo soils, are free of lime in the surface layer. They are less clayey in the subsoil than the Clareville soils.

Willacy fine sandy loam, 0 to 1 percent slopes (WaA) occupies slightly convex areas in the southwestern part of the county.

Included with this soil are small areas of Hidalgo fine sandy loam, 0 to 1 percent slopes; of Clareville clay loam; and of Orelia clay loam that together may make up as much as 15 percent of any area mapped. Clareville clay loam was not mapped separately in this county.

This soil is better suited to flax than to cotton and grain sorghum, but if it is well managed, it produces moderately high yields of most locally grown crops. (Capability unit IIc-3)

Willacy fine sandy loam, 1 to 4 percent slopes (WaB) occurs mainly in the northern part of the county. Most areas of this soil are small and scattered.

Included with this soil are small areas of Hidalgo fine sandy loam, 1 to 3 percent slopes, that may total as much as 10 percent of any area mapped. Much of this soil is in improved pasture or in forage crops, but some is in flax and grain sorghum. (Capability unit IIe-3)

Zavala Series

The Zavala series consists of gray, moderately sandy alluvial soils on the flood plain of the Nueces River.

The surface layer is dark gray, free of lime, and about 30 inches thick. It is easily worked. It is slightly firm when dry and has granular structure, but when moist, it crumbles easily and forms a mellow seedbed. The subsoil is gray, lime-free fine sandy loam about 3 feet thick. It has no structure or only a weak one, and it is slightly hard when dry and friable when moist.

The surface layer ranges from light sandy clay loam to loamy fine sand but is fine sandy loam in most places. Its color ranges from dark gray to grayish brown. The subsoil is more sandy in some places than it is in others. In most places a few small, rounded pebbles are scattered through these soils.

These soils have moderate internal drainage and slow surface drainage. Although most areas are occasionally flooded by the Nueces River, some are seldom flooded.

The Zavala soils are less clayey than the Frio soils and, unlike them, are free of lime in their surface soil and subsoil. The layers of Zavala soils are less distinct than those of Willacy soils, and the subsoil is more brown. Also, Zavala soils are susceptible to flooding and Willacy soils are not.

Zavala soils are suited to most locally grown crops, but good management, including fertilization, is needed to maintain moderately high yields of cultivated crops.

Zavala fine sandy loam (0 to 1 percent slopes) (Za) occupies low, slightly convex ridges along the Nueces River, mainly near Bluntzer. A few slightly depressional former meanders, or old channels, cross the nearly level surface of this soil. The surface layer in these old channels is loam instead of fine sandy loam.

Included with this soil are a few small areas of loamy fine sand that do not total more than 10 percent of any area mapped. (Capability unit IIw-1)

Use and Management of Soils

This section discusses the use and management of soils for agriculture, in engineering works, and for urban and suburban uses.

Management of Soils for Agriculture

This subsection can be used as a general guide for managing the soils of the county. The first part discusses some general principles of management. The second part explains capability grouping. In the third part, the soils of the county are placed in capability units and the use and management of these units are explained. The fourth part consists of a table that lists estimated yields of cotton, grain sorghum, and flax at two levels of management.

Principles of soil management

By Harold V. Stephens, management agronomist, and Guido E. Franki, soil scientist, Soil Conservation Service

On soils that are used for cultivated crops, management practices are needed to maintain or improve natural fertility and structure of the soils, to protect the soils from erosion, and to keep them in good tilth. Also, soils should be tested so that the amounts and kinds of fertilizer needed can be determined. Your county agricultural agent or local representatives of the Soil Conservation Service can advise you about taking soil samples and applying fertilizer.

Maintaining or improving fertility and structure.—Because the amount of annual rainfall and its distribution are unpredictable, increases in yields, brought about by the use of ideal amounts of fertilizer, are also likely to vary in dryland farming.

The soils of Nueces County contain enough *potash* for dryland farming. If the very sandy soils are irrigated, however, some crops respond to small additions of potash.

Nonirrigated soils on bottom land contain enough *phosphorus* to supply all crops except legumes (*11*), but on uplands additional amounts of this nutrient are needed on the clays, clay loams, and moderately sandy or coarse sandy soils. Little phosphorus is needed on fields of flax and some other crops.

The soils in Nueces County are more likely to be deficient in *nitrogen* than in any other plant nutrient. This deficiency is more severe in the sandy soils on uplands than in the clayey soils. Growing cotton and grain sorghum continuously has depleted the organic matter and soluble nitrogen in many areas. Although additions of nitrogen are needed on all the soils, nitrogen added to the clays and clay loams may not be economical in years when the moisture supply is low. Growing legumes frequently in the cropping system will supply a part of the nitrogen needed by other crops, and legumes themselves respond to small amounts added before or at planting time. On the upland soils nitrogen and phosphorus combined are normally more economical than nitrogen used alone.

Annual sweetclover and other deep-rooted legumes improve soil structure and increase the rate of percolation. Although nitrogen is not added by buffelgrass, blue panicum, and Angleton bluestem, these grasses improve soil structure and increase the rate of percolation. The grasses may be used for hay or pasture, but they should be managed to permit extensive development of roots. In addition, much of the top growth should be returned to the soil before a soil-depleting crop is planted.

If a legume is grown in the cropping system during winter, it may deplete soil moisture and reduce yields of the crop that follows it in spring. If, however, the soil is fallowed a year following the legume, the yield of the crop is likely to increase because of soil improvement and the above average supply of moisture stored during the fallow year. Crop yields are higher for 3 or 4 years following a crop of deep-rooted legumes. The large amounts of crop residue produced by grain sorghum (fig. 7) and flax help to maintain organic matter, to increase fertility, and to improve tilth. By improving seedbeds, this residue also helps germination of seeds and the growth of plants.

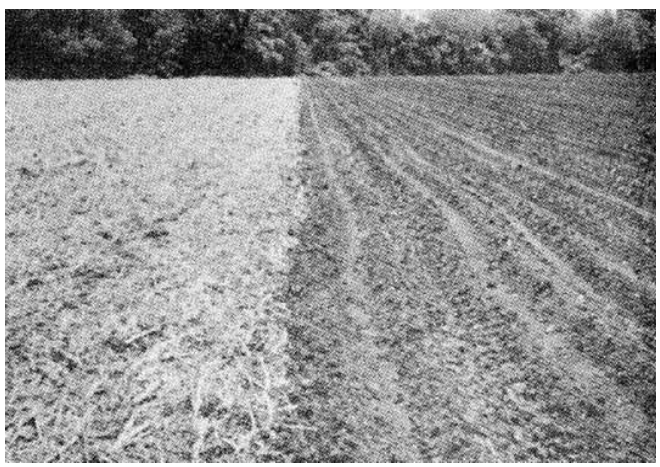

Figure 7.**—On field to the left, grain sorghum has been harvested and the residue left at or near the surface as a mulch. Field to the right has not been protected in this manner.**

If high-residue crops are fertilized, the organic matter produced is increased and more of it can be returned to the soil. Large amounts of residue may temporarily tie up some of the nitrogen in the soil, but adding nitrogen fertilizer prevents reduced yields in the next crop.

Controlling erosion.—Although erosion by water and wind is not serious in a large part of Nueces County, water is likely to wash away part of the surface soil on slopes of more than 1 percent. This loss of surface soil reduces the supply of plant nutrients and the amount of organic matter. Because the soil is made less absorbent, more water runs off, erosion increases, and less water is added to the soil.

Sheet and rill erosion are the most common forms of erosion caused by water. Unless the soils are adequately protected, they are damaged in places where the water concentrates. The amount of erosion depends on the cover of growing plants, the length and steepness of slopes, the texture and structure of the soils, and the rate of water intake.

Water erosion can be controlled (1) by terracing cropland on slopes of 1 to 5 percent; (2) by establishing suitable grasses in waterways and outlets; (3) by diverting water that runs off higher areas; (4) by plowing and planting on the contour or parallel to the terraces; (5) by leaving crop residue at or near the surface for protection during heavy rains; and (6) by growing deep-rooted grasses and legumes and close-growing crops to speed up the intake of water and to slow down runoff.

The damage caused by wind is most noticeable on some of the sandy soils where sand particles have remained and the silt and clay particles have been blown away. During long droughty periods, the clay and clay loam soils may break down into small particles that are moved by high winds. This movement damages small plants in some places.

Where wind damage is expected to be greatest, the soils should be kept in growing plants or crop residue should be left at or near the surface. If wind erosion starts on an unprotected field, emergency tillage is needed to roughen the surface so that soil material is held until a crop is established.

Tillage.—Frequent tillage destroys the structure of the soil. It produces a powdery surface layer, which does not absorb water readily and is susceptible to wind erosion. Frequent tillage also speeds up the destruction of organic matter.

Plows and tractors pack the soil and block pore spaces and channels through which water ordinarily enters the soil and moves downward (fig. 8). Heavy, blackland clays are compacted and paddled if they are plowed or cultivated when wet. Consequently, they take in water slowly during the rest of the growing season, and much of the rain runs off or evaporates. The roots of plants penetrate the compacted subsoil with difficulty, and yields are reduced in many places.

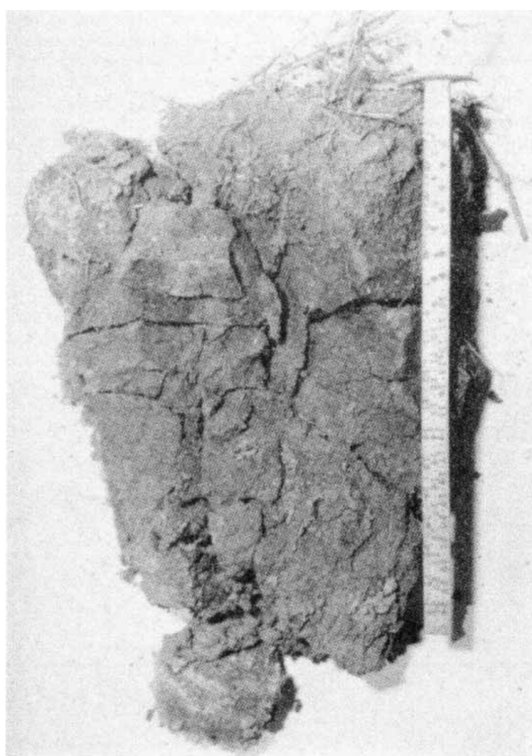

***Figure* 8.—Below the plow layer this soil has been compacted by heavy machinery.**

Although the clay soils in this county normally crack during summer, they recover some of their structure in fall when rains wet them and cause slaking and crumbling. Unlike the clays, loamy soils do not crack, but they develop a hard plowpan and require special management.

Normally, when the moisture content in the surface soil is ideal for good plowing, that in the subsoil is excessive and favors compaction. Even if care and good judgment are used, it is not always possible to till the soil without compacting the subsoil. To prevent excessive loss of water caused by a compact subsoil, deep-rooted, soil-improving crops are grown; or in places, chiseling or some other method is used to maintain good structure and porosity of the subsoil.

To lessen the effects of tillage, (1) plow the soil only enough to prepare a good seedbed and to control weeds and volunteer plants; (2) vary the depth of plowing; (3) use light equipment to do light work; (4) eliminate unnecessary trips over the soil; and (5) grow deep-rooted legumes and perennial grasses, for they have an extensive root system that helps to keep channels open into the soil layers (fig. 9). If the soils are in good tilth, they recover quickly from the effects of occasional wet tillage and crops are not likely to fail.

***Figure* 9.—Deep-rooted perennial grasses grown in a crop rotation to improve soil structure.**

Capability groups of soils

The capability classification is a grouping of soils that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, on the risk of damage when they are used, and on the way they respond to management.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. Eight capability classes are in the broadest grouping and are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other seven classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that, without major reclamation, they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclass is indicated 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 a close-growing plant cover is maintained; *w* means 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* indicates 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 or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c* because the soils in it have little or no susceptibility to erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, which are groups of soils 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 identified by numbers assigned locally, for example, IIe-2 or IIIe-3. These numbers are not consecutive in Nueces County, because not all of the capability units used in Texas occur in this county. The soils in each capability unit have about the same limitations and require about the same treatment.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The classes, subclasses, and capability units used in this county are described in the list that follows. No soils in Nueces County are in class I or in class VIII.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe. Soils that are susceptible to moderate erosion unless they are protected.
  - Capability unit IIe-2.—Deep, gently sloping loams that are moderately permeable or slowly permeable.
  - Capability unit IIe-3.—Deep, gently sloping soils that are moderately coarse textured and moderately permeable.
- Subclass IIw. Soils that have moderate limitations because of excess water.
  - Capability unit IIw-1.—Deep, moderately permeable, loamy soils that are on bottom lands and are occasionally flooded.
  - Capability unit IIw-2.—Deep, nearly level, crumbly soils that are slowly permeable, imperfectly drained, and occasionally flooded.
- Subclass IIs. Soils that have moderate limitations of moisture capacity or tilth.
  - Capability unit IIs-1.—Deep, nearly level, crumbly clay soils that are slowly permeable.
- Subclass IIc. Soils that have moderate limitations because they are dry in some periods.

Capability unit IIc-2.—Deep, nearly level loams that are slowly or moderately permeable.

Capability unit IIc-3.—Deep, nearly level, moderately coarse textured soils that are moderately permeable.

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

Subclass IIIe. Soils that are susceptible to severe erosion if they are cultivated and are not protected.

Capability unit IIIe-1.—Deep, gently sloping, moderately coarse textured soils that contain a claypan and are very slowly permeable.

Capability unit IIIe-3.—Deep, gently sloping, crumbly soils that are fine textured and slowly permeable.

Capability unit IIIe-4.—Deep, moderately sloping or gently sloping, eroded soils that are fine textured and slowly permeable.

Capability unit IIIe-8.—Deep, moderately sloping soils that are moderately coarse textured and moderately permeable.

Capability unit IIIe-16.—Deep, very slowly permeable soils that have a loose, sandy surface layer and a clayey subsoil.

Subclass IIIw. Soils that have severe limitations because of excess water.

Capability unit IIIw-1.—Deep, nearly level soils that are crusty, very slowly permeable, and imperfectly drained.

Subclass IIIs. Soils that have severe limitations of moisture capacity or tilth.

Capability unit IIIs-1.—Deep, nearly level, crusty soils that are very slowly permeable.

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

Subclass IVe. Soils that are susceptible to very severe erosion if they are cultivated and are not protected.

Capability unit IVe-3.—Deep, moderately sloping soils that are moderately coarse textured and very slowly permeable.

Capability unit IVe-6.—Deep, strongly sloping soils that are moderately coarse textured or coarse textured and moderately permeable.

Capability unit IVe-11.—Deep, moderately to rapidly permeable, sandy soils that are susceptible to moderately severe wind erosion.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass Vw. Soils that are too wet for cultivation and cannot be feasibly drained or protected.

Capability unit Vw-1.—Deep, fine-textured, very slowly permeable soils in undrained depressions.

Capability unit Vw-2.—Deep, crumbly, fine-textured alluvial soils that are slowly permeable and frequently flooded.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe. Soils severely limited by risk of erosion unless protective cover is maintained.

Capability unit VIe-5.—Deep, hummocky, loose, rapidly permeable fine sands.

Subclass VIw. Soils severely limited by excess water and generally unsuitable for cultivation.

Capability unit VIw-1.—Deep, nearly level, loose, fine sandy soils that are slowly permeable, wet, and moderately saline.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features.

Capability unit VIs-1.—Deep, nearly level and gently sloping soils that are very slowly permeable and moderately saline.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation, and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion unless protective cover is maintained.

Capability unit VIIe-1.—Deep, loose, very rapidly permeable sands.

Capability unit VIIe-2.—Gullied land.

Capability unit VIIe-3.—Gullied land that is saline.

Subclass VIIs. Soils very severely limited by moisture capacity, stones, or other soil features.

Capability unit VIIs-1.—Deep, nearly level, clay soils that are slowly permeable, wet, saline, and frequently flooded.

Capability units in Nueces County

In this subsection each capability unit is described and the soils in it are listed. Suggestions are given on how to use and manage the soils in each unit. As stated in the explanation of capability grouping, a capability unit consists of soils that are suited to the same crops, require similar management, and produce about the same yields.

CAPABILITY UNIT IIe-2

This capability unit consists of deep, gently sloping loams that are moderately permeable or slowly permeable. These soils are—

Clareville loam, 1 to 3 percent slopes.
Clareville complex, 1 to 3 percent slopes.

Because these soils are more sloping than those in capability unit IIc-2, they are more likely to lose soil material and water, but in other respects the soils of the two units are similar.

The soils in this capability unit are alkaline to strongly calcareous in the surface layer. Falling rain easily detaches fine particles if the surface layer contains little organic matter. The loose, fine particles clog the pores at the surface and increase runoff and loss of soil.

Runoff and erosion can be controlled by a complete system of terraces that is protected by outlets and waterways well covered with perennial grasses. A cover of growing vegetation improves filth and fertility of the soils and reduces erosion between the terraces. Suitable cover can be sweetclover, peas, guar, or some other soil-improving crop grown 1 year out of 3, or well-fertilized grain sorghum or another high-residue crop grown every 1 or 2 years. Crop residue left as a mulch at or near the surface protects the soil and supplies organic matter.

Where these soils are not terraced, more intensive use of vegetation is needed. Erosion can be controlled and the soils improved by using flax, oats, sudangrass, or some other close-growing crop for 3 years out of 4, and sweetclover, peas, guar, or another soil-improving crop the other year. All crop residue should be left at or near the surface as a mulch. Also suitable in areas not terraced are perennial grasses at least 1 year out of 3, and a close-growing or high-residue crop the rest of the time. Again, crop residue should be used as mulch. Perennial grasses seeded in rows on the contour help to reduce runoff and erosion and to make tillage easier.

If soil-improving crops are not used in the cropping system, a mulch can be substituted. About 3 tons of cotton burs or other organic matter per acre is a suitable mulch. A temporary shortage of nitrogen can be prevented by adding 20 pounds of this nutrient for each ton of cotton burs or other organic matter applied. Perennial grasses are needed to protect places where water concentrates.

CAPABILITY UNIT IIe-3

In this capability unit are deep, gently sloping soils that are moderately coarse textured and moderately permeable. The soils are—

Hidalgo fine sandy loam, 1 to 3 percent slopes.
Willacy fine sandy loam, 1 to 4 percent slopes.

These soils are similar to those of unit IIc-3, but they are more sloping and more likely to lose soil and water through runoff. Needed to control runoff and erosion is a complete system of terraces with protected outlets. Excess water can be disposed of safely through waterways in which perennial grasses have been established.

If terraces are used, the cropping system should keep a soil-improving crop on the soils one-third of the time. If terraces are not used, another cropping system is better for improving and protecting these soils. This system keeps flax, oats, sudangrass, or some other close-growing crop on the soils 3 years out of 4; sweetclover, peas, guar, or another soil-improving crop is grown on them the fourth year. With this system, all crop residue should be left at or near the surface as a mulch.

Another system suitable for fields not terraced is perennial grasses for 1 year and close-growing crops or high-residue crops for 2 years. The crop residue is left at or near the surface as a mulch. Perennial grasses can be seeded to heal gullies and to protect other places where water concentrates and erosion is active.

A mulch of about 3 tons of cotton burs or other organic matter per acre can be substituted for the soil-improving crop in the cropping systems. Adding 20 pounds of nitrogen per acre to this mulch prevents a nitrogen deficiency in the crop that follows.

CAPABILITY UNIT IIw-1

This capability unit consists of deep, moderately permeable, nearly level soils that are on bottom lands and are occasionally flooded. These soils are—

Frio clay loam.
Zavala fine sandy loam.

The soils of this unit are easily worked. They have good surface drainage and internal drainage. Floodwaters tend to leach them because their permeability is moderate and their drainage is good. Consequently, cultivated areas are low in fertility after a few years of cropping. At times, however, crops are benefited rather than damaged by the floodwaters. The flooding is normally shallow and occurs only about once in every 5 to 10 years. Cotton and grain sorghum are the principal crops. Watermelons can be grown successfully on the Zavala soil.

Fertility can be increased and maintained by growing grasses or soil-improving crops every fourth year, or by growing closely spaced crops that produce a large amount of residue. If crops are properly fertilized on these soils, they produce large amounts of residue, especially during years when flooding occurs. The crop residue can be left near the surface as a mulch; it should be at least partly covered to prevent floods from carrying it away.

CAPABILITY UNIT IIw-2

In this group are deep, nearly level, crumbly soils that are slowly permeable, imperfectly drained, and occasionally flooded. These soils are—

Trinity clay, occasionally flooded.
Victoria clay, low.

Victoria clay, low, receives water from adjoining areas, and this sometimes delays tillage. At times excess water delays or prevents tillage of Trinity clay, occasionally flooded.

Fertility and tilth can be maintained and improved and evaporation decreased by managing these soils in the same way as Victoria clay, 0 to 1 percent slopes, which is in capability unit IIs-1.

Contour tillage is not needed for erosion control, but in a few places this practice may help to distribute water more evenly. Simple, easily constructed drainage ditches, normally of the W type, help to remove excess water from Victoria clay, low. On this soil the hazard of flooding can be reduced by constructing diversions on adjacent, higher soils or by managing those soils so that water is distributed. The control of flooding is not now practical on Trinity clay, occasionally flooded.

The soils in this unit normally can be tilled and the crops harvested at times when flooding is least likely. In some places, particularly during dry years, the soils produce higher yields than similar soils that do not receive extra water. Once or twice in a period of 5 years, however, the soils in this unit may be so wet that crops are lost or damaged because weeds cannot be controlled or the crop harvested.

CAPABILITY UNIT IIs-1

Victoria clay, 0 to 1 percent slopes, is the only soil in this capability unit. It is deep, slowly permeable, and crumbly. This soil occupies about 58 percent of the county. Nearly four-fifths of its acreage is cropped.

This soil occurs mainly in large, smooth areas, some of which are several thousand acres in size. Because its surface soil is heavy clay, more powerful equipment is needed on this fertile soil than on other soils in the county.

This soil produces moderately high yields of all locally grown field crops. Yields of cotton depend on weather, management, and the degree of insect infestation. Yields of grain sorghum range from 1,200 to 4,600 pounds an acre.

This soil holds a large amount of moisture, but not all of the moisture is available to plants. Unless the supply of organic matter is maintained, roots and moisture penetrate slowly, and the soil dries and cracks before young crops can provide enough shade to slow evaporation.

Surface drainage is slow, but a system of large ditches, including road ditches, provides adequate artificial drainage. Because slopes fall 2 to 6 feet in a mile, and because infiltration is slow, water flows from the higher to the lower part of the fields. As a result, the higher part of a field is dry enough for tillage sooner than the lower part. Tilth varies because water is distributed unevenly. Also variable are the growth of crops and the time of their maturity.

Contour tillage can be used to distribute water more evenly throughout a field. Because the furrow slice slows the water as it moves down the slope, the water at the upper part of the field has more time to penetrate the soil, and less water moves to the lower part. Water is distributed throughout one field more evenly, and a time for initial plowing and for subsequent tillage can be selected that is suitable for all parts of the field. Throughout the field, a crop will probably mature and can be harvested at about the same time. This is especially important in harvesting grain sorghum. In this county yields of cotton and grain sorghum have been increased by contour farming.

In some years contour farming causes Victoria clay, 0 to 1 percent slopes, to become excessively wet for short periods, particularly in places where the content of organic matter is low and where practices to improve tilth have not been used.

Contour farming saves and distributes rainfall, but it does not improve soil structure or aid in reducing evaporation. A good cropping system helps to bring about these changes and to improve fertility. One-fourth of the land can be planted each year to a deep-rooted crop such as sweetclover that improves the soil; or one-third can be planted to a fertilized, high-residue crop such as grain sorghum. Crops need to be changed each year so as to follow a regular 4-year or 3-year rotation. Grain sorghum can follow the soil-improving crop and alternate with cotton in the rotation. All crop residue can be left at or near the surface as a mulch.

If 3 tons of cotton burs or other organic material is applied per acre, the soil-improving crop is not needed. To help prevent a temporary shortage of available nitrogen, add 20 pounds of nitrogen for each ton of organic material.

CAPABILITY UNIT IIc-2

This capability unit consists of deep, nearly level loams that are slowly or moderately permeable. The soils are—

Clareville loam, 0 to 1 percent slopes.
Clareville complex, 0 to 1 percent slopes.

These soils are easily tilled. The movement of air and water and the development of roots are good in the surface layer but are moderate or slow in the subsoil. Water-storage capacity and fertility are fairly high. These soils are slightly sticky when wet and tend to form a hard, compact layer, or plowpan, below plow depth. The plowpan does not crack and shatter in dry weather as it does in the soils of capability unit IIs-1.

Although these soils are moderately drought resistant if well managed, they are droughty where a plowpan has formed, because the plowpan restricts the movement of water. The plowpan can be cracked and shattered by planting sweetclover or another deep-rooted legume once every 4 years. Leaving all crop residue at or near the surface as a mulch improves fertility, increases the intake and storage of water, and helps to reduce runoff and erosion.

The soils in this unit are alkaline or strongly calcareous. In a few to many small areas of cultivated fields, some crops, particularly grain sorghum, are damaged by chlorosis (yellowing). Apparently, this yellowing is most severe in dry periods early in spring, but as rainfall increases, crops normally recover, except in a few small spots where they die or produce low yields.

Yields of grain sorghum and most other crops are moderately high on these soils unless a plowpan is permitted to form. Moderate to high yields can be maintained if the soils are farmed on the contour and are net tilled when they are wet. Contour farming improves distribution of water and permits more moisture to enter the subsoil.

As a substitute for sweetclover or another soil-improving crop, a mulch of cotton burs or other organic material can be added at the rate of about 3 tons per acre. Adding about 20 pounds of nitrogen to each ton of this mulch prevents a nitrogen deficiency in the following crop.

CAPABILITY UNIT IIc-3

In this capability unit are deep, nearly level soils that are moderately coarse textured and moderately permeable. The soils are—

Hidalgo fine sandy loam, 0 to 1 percent slopes.
Willacy fine sandy loam, 0 to 1 percent slopes.

These soils are easily tilled. Their surface soil and subsoil transmit air and water and permit development of roots moderately well. They are moderately fertile and have a moderate capacity for storing water. Because they are nearly level, these soils are not likely to be eroded by water, but they are slightly susceptible to wind erosion unless they are properly managed during dry periods. The soils in this unit are more drought resistant than finer textured soils in this county but have less capacity to store moisture. Crops can use most of the available moisture, but the soils are less fertile than the liner textured soils.

These soils produce moderate yields of cotton and grain sorghum, the principal crops. Yields of flax, a deep-rooted, cool-season crop, are moderately high. Grain sorghum and flax are grown almost entirely for grain or seed in the cropping systems most commonly used. They are harvested with combines, and all crop residue is normally left on the soils.

Applying fertilizer at or immediately before planting time has been economical because it has increased cotton yields. However, adding fertilizer to fields of grain sorghum has not been economical, because in most years not enough moisture is in the root zone when the crop is approaching full growth. Consequently, in addition to improving fertility, there is a need to improve the infiltration of water.

Some local farmers have improved these soils (1) by planting at least one-fourth of the land each year to sweetclover, peas, guar, or some other soil-improving crop and by leaving the residue at or near the surface as a mulch; or (2) by planting one-third of the land each year to grain sorghum or another high-residue crop, by applying fertilizer, and by leaving all the crop residue to protect and improve the soils. Crops need to be rotated so that the soil-improving crop is grown every 3 or 4 years.

A mulch consisting of about 3 tons per acre of cotton burs or other organic material can be substituted for the soil-improving crop. Results are best if this material is placed at or near the surface. To prevent a nitrogen deficiency in the crop that follows, about 20 pounds of nitrogen should be added to each ton of organic material applied.

Hidalgo fine sandy loam, 0 to 1 percent slopes, is poorly suited to grain sorghum because chlorosis (yellowing) is caused by the large amount of lime in the surface soil. The effects of this disease can be reduced by using the soil-improving practices described, particularly those that supply a large amount of organic material.

CAPABILITY UNIT IIIe-1

Miguel fine sandy loam, 1 to 3 percent slopes, is the only soil in this capability unit. It is a deep, moderately coarse textured soil that contains a claypan and is very slowly permeable.

Except that it is more sloping, this soil is similar to the soils in capability unit IIIs-1, which have slopes of only 0 to 1 percent. Because infiltration is very slow, loss of soil and water is moderately high. Particularly in areas where the content of organic matter is low, tillage readily compacts this soil because its surface layer is thin and its subsoil is hard and clayey.

Loss of soil and water can be reduced by providing a complete system of terraces with outlets and waterways protected by grass. The rate that water penetrates this soil between terraces can be increased by growing a deep-rooted, soil-improving crop at least once every third year. The hard subsoil can be shattered by deep chiseling late in summer. If 20 pounds of superphosphate per acre is added, the roots of legumes grow more vigorously and extend deeper into the subsoil.

Terraces are not needed if a cropping system is used that improves the soil and helps to control erosion. In one such system grasses are grown for 1 year and close-growing or high-residue crops are grown for 2 consecutive years. All crop residue is left at or near the surface as a mulch. Also, grasses should be established wherever the flow of water is likely to erode the soil.

A mulch of 3 tons of cotton burs or other organic material per acre can be used instead of the soil-improving crop. To prevent a nitrogen deficiency in the next crop planted, 20 pounds of nitrogen should be added to each ton of organic material.

CAPABILITY UNIT IIIe-3

Victoria clay, 1 to 3 percent slopes, is the only soil in this capability unit. It is a deep, crumbly, slowly permeable soil and, unless protected, is susceptible to water erosion.

The management needed for protection of this soil depends on the management used on Victoria clay, 0 to 1 percent slopes, in capability unit IIs-1, for runoff is received from large areas of that higher, adjacent soil. If possible, the soil upslope should be treated first.

Water from adjoining areas can be controlled by diversion terraces that have outlets and waterways well covered with grass. If this method is used, the soil is protected and improved mainly by vegetation. Close-growing crops should be kept on the soil continuously for 3 years, and a soil-improving crop should be grown the fourth year. Crop residue is left at or near the surface as a mulch.

Another cropping system suitable for use with diversion terraces consists of grass for 1 year in 3 and a close-growing or high-residue crop for 2 years in 3. Again, the crop residue is left at or near the surface as a mulch. This system is also suitable in places where diversion terraces are not needed. In these places, however, a complete system of ordinary terraces is needed. Outlets and waterways should be protected by grass that has been established before the terraces are constructed.

A mulch of 3 tons of cotton burs or other organic matter can be substituted for the soil-improving crop. A temporary shortage of nitrogen can be prevented by adding 20 pounds of nitrogen for each ton of organic material applied.

CAPABILITY UNIT IIIe-4

In this group are deep, moderately sloping or gently sloping, eroded soils that are fine textured and slowly permeable. The soils are—

Clareville complex, 3 to 5 percent slopes.
Victoria clay, eroded.

These soils lie below large areas of Victoria clay, 0 to 1 percent slopes, and receive much runoff from them. Loss of soil and water may be high, but it can be controlled by providing a complete system of terraces with protected outlets and waterways. The waterways should be well covered with grass before the terraces are constructed.

Tilth and fertility can be improved and loss of soil and water checked between terraces by growing a soil-improving crop at least every third year and a close-growing or high-residue crop 2 years out of 3. The crop residue should be left at or near the surface as a mulch.

A suitable substitute for the soil-improving crop is grass grown in contoured rows for 2 or 3 consecutive years, or a mulch consisting of 3 tons of cotton burs or other organic matter per acre. For each ton of organic material, 20 pounds of nitrogen should be added to prevent a nitrogen deficiency.

CAPABILITY UNIT IIIe-8

Hidalgo fine sandy loam, 3 to 5 percent slopes, is the only soil in this capability unit. It is a deep, moderately sloping soil that is moderately coarse textured and moderately permeable.

A complete system of terraces is needed on this soil to help control loss of soil and water. The outlets and waterways of the system should be well covered with grass. If the terraces are planted to soil-improving crops every third year, and crop residue is left at or near the surface as a mulch, tilth and fertility are improved, and loss of soil and water is reduced between the terraces.

In one suitable cropping system for terraced soils, close-growing crops or crops that produce a large amount of residue are grown 2 years in 3 and perennial grasses every third year. A good substitute for the soil-improving crop is a mulch consisting of 3 tons of cotton burs or other organic matter per acre. For each ton of organic material, 20 pounds of nitrogen should be added to prevent a nitrogen deficiency.

If these soils are not terraced, a close-growing crop can be grown each year, but every third year, the close-growing crop should be one that improves the soil. On unterraced soils erosion is active or is likely to occur in all places where runoff is concentrated unless these places are well covered with grass.

CAPABILITY UNIT IIIe-16

Miguel loamy fine sand is the only soil in this capability unit. Although it is deep and has a loose, sandy surface layer, this soil is very slowly permeable. Its clayey subsoil underlies the loamy fine sand, normally at a depth of 15 to 30 inches. The surface layer takes in water rapidly but has a low capacity for storing it and is low in fertility. Crops use nearly all the moisture stored in the surface layer. Although the subsoil absorbs water very slowly, it can store more than the surface soil.

In most places shallow-rooted crops cannot reach much of this moisture, but it can be reached by watermelons, peas, and peanuts, as well as by perennial grasses, sweetclover, and other deep-rooted crops. Grasses and deep-rooted legumes are better suited to this soil than other plants, for their deep roots penetrate the clay subsoil. The roots of many plants follow cracks in the subsoil.

Water erosion is not likely on this soil, but normally the surface layer dries out rapidly and is susceptible to wind erosion unless it is protected. Also, maintaining fertility is difficult.

The moisture capacity can be increased and fertility improved by growing a soil-improving crop on at least one-third of the land each year, in rotation, and by keeping another third in a close-growing or a high-residue crop. Crop stubble should be left standing after the crops are harvested. If as much of the residue as possible is left on the surface, wind erosion is less likely after the soil has been prepared and planted.

In another suitable cropping system, one-third of the acreage is in grass, one-third is in row crops, and one-third is in close-growing or high-residue crops. All the crop residue is left on the surface as a mulch. All these crops can be grown in strips so that the clean-tilled soil is protected from the wind. To protect and improve all the soil, plant the close-growing crop after 1 year of a row crop, and keep the soil in grass for 1 or 2 years.

The amount and kind of fertilizer needed depend on the crop to be grown. This need is indicated by a soil test. Because the soil holds little moisture, fertilizer should be applied at intervals rather than all at one time. Before the fertilizer is applied, it is best to determine the content of moisture and to estimate the amount that will be added during the growing season. After the perennial grass is fully established, the annual requirement of fertilizer can be applied at one time.

CAPABILITY UNIT IIIw-1

This capability unit consists of deep, nearly level soils that are crusty, very slowly permeable, and imperfectly drained. The soils are—

Banquete clay.
Orelia clay loam.

The soils in this unit are more depressional than those in capability unit IIIs-1 and accumulate runoff water that, in some places, delays or prevents tillage.

Simple drainage practices are needed to remove or divert the excess water, but in other respects, management is about the same as that on soils in capability unit IIIs-1. Also, crop suitability is about the same. Orelia clay loam normally occupies the shallow valleys of small drainageways. Bridges and culverts across these valleys interfere with drainage in some places. In these places straightening or relocating the channels is needed to remove the excess water.

CAPABILITY UNIT IIIs-1

In this group are deep, nearly level, crusty soils that are very slowly permeable. They are—

Miguel fine sandy loam, 0 to 1 percent slopes.
Orelia fine sandy loam.

These soils are commonly called hardpan land. They are easy to till for only short periods after rains because they dry quickly, harden, and crust. Surface drainage is fairly uniform, but the subsoil normally remains too wet for plowing after the surface layer dries. For this reason the subsoil compacts and takes in water very slowly.

Because moisture and the roots of most crops have to follow the line cracks between blocks in the subsoil, the amount of moisture that can be stored and used is limited. They frequently mature early and produce low yields because there is not enough moisture. Cotton has stronger and deeper roots than grain sorghum and is better suited to the soils in this unit. Yields of most crops are moderately low.

These soils can be improved by growing sweetclover or another deep-rooted, soil-improving crop every third year. If, late in summer, these soils are deep chiseled and 20 pounds of superphosphate is added per acre, the subsoil will be shattered and the roots of legumes can penetrate deeply and vigorously. If all crop residue is left at or near the surface as a mulch, the surface soil is improved and the amount of water available to plants is increased.

A mulch consisting of 3 tons of cotton burs or other organic matter per acre can be used instead of the soil-improving crops. For each ton of organic material, 20 pounds of nitrogen should be added to prevent a temporary deficiency in nitrogen.

CAPABILITY UNIT IVe-3

Miguel fine sandy loam, 3 to 5 percent slopes, is the only soil in this capability unit. This soil is deep, moderately coarse textured, and very slowly permeable. It is likely to erode and to lose water.

Although the best way to manage, protect, and improve this soil is by growing grasses continuously, other crops can be grown in a suitable cropping system. In one such system, complete terracing is required that provides protected outlets and waterways in which perennial grasses have been established. Half of the acreage should be in close-growing crops or crops that produce a large amount of residue, and half, in a deep-rooted crop that improves the soil. If an entire crop is removed for hay or ensilage, organic material can be added as a mulch. The crops should be fertilized according to their needs.

In another suitable cropping system on terraced soils, grass is grown for 2 years and is followed by flax or another close-drilled crop. All residue from the flax should be left at or near the surface as a mulch. These crops also ought to be fertilized according to their needs.

CAPABILITY UNIT IVe-6

Only Sandy sloping land is in this capability unit. It is deep, moderately coarse textured or coarse textured, and moderately permeable. The surface layer ranges from thick, loose, and sandy to thin and moderately sandy. Slopes range between 5 and 12 percent.

This land is mostly in native plants, mainly mesquite trees, thorny brush, and a little grass. Its use for cotton, grain sorghum, or other clean-tilled crops is limited. Some areas have been cleared, but they are used mainly for flax, sudangrass, forage sorghums, introduced grasses, and other crops that are close growing or produce a large amount of residue. Although these crops, as well as legumes, grow well, the land is better suited to permanent plants.

Runoff and the loss of soil can be reduced by using a complete system of terraces that have outlets protected by grass. To prevent deep gullying, waterways should be established and protected with grass before the terraces are constructed. Also, cropping systems can be used that reduce the risk of gullying and, at the same time, maintain fertility and increase the water storage capacity of the soil.

In one suitable cropping system, one-half of the land is planted each year to a soil-improving crop, one-fourth to a close-growing or a high-residue crop, and one-fourth to a clean-tilled crop, in rotation, so that the clean-tilled crop is grown just 1 year in 4. In another suitable system all the land is kept in a soil-improving, close-growing, or high-residue crop for 3 years, and in the fourth year a clean-tilled crop is grown. All crop residue should be left on the soil as a mulch.

Organic material should be added as a mulch if an entire crop is removed for ensilage, hay, or fodder, a common practice on dairy farms. Organic material is also needed if less than 2,000 pounds of stubble per acre remains after grazing. Suitable mulch consists of 3 tons of cotton burs or other organic material per acre. Adding 20 pounds of nitrogen to each ton of organic material prevents a shortage of nitrogen in the next crop planted. Nitrogen can be supplied on dairy farms by adding cow manure at a rate of 8 to 10 tons per acre.

If this land is not terraced, it should be kept in continuous close-growing crops, half of which are crops that improve the soil. Residue left at or near the surface as a mulch protects the land between growing seasons. A cover of perennial grasses is needed in all active gullies or in other places likely to erode.

Terraces are not needed if grasses are grown in contoured rows for 4 years out of 5, but places where runoff is concentrated should be kept permanently in grass to avoid damage through erosion.

This land lies on the valley slopes of the Nueces River with other less sloping and better soils. Much suburban development has taken place on this land from Corpus Christi westward, and more and more of the land is used for this purpose each year. Many of the native plants, such as mesquite, anacua, ebony, hackberry, elm, and some of the thorny shrubs, are left for shade and landscaping. Until it is needed for urban development, more profitable use can be made of this land by removing most of the less suitable trees and brush and by improving the cover of grasses for grazing.

CAPABILITY UNIT IVe-11

Nueces fine sand, the only soil in this capability unit, is deep and moderately to rapidly permeable. Because it is dry, it is susceptible to moderately severe wind erosion.

In this county the surface layer is 15 to 40 inches thick, and it takes in water rapidly. The subsoil, however, is more slowly permeable than is typical of Nueces soils. This soil is susceptible to severe wind erosion if it is cultivated. Because it is low in natural fertility, it is not suited to most, locally grown crops. A few small fields that were formerly cultivated are now used for grazing.

Most of this soil is in native range, but the soil can be farmed if suitable crops are grown, wind erosion is controlled, and fertility is improved. The crops should be cover crops or high-residue crops, and all residue should be left at or near the surface. By planting crops in strips, a cover crop can be alternated with a high-residue crop if all residue is left on the soil. Grass can be grown 4 years out of 5 if strips of these grasses are left to protect the soil against wind erosion where the rest of the land is tilled. Adding fertilizer according to the need indicated by soil tests is essential.

CAPABILITY UNIT Vw-1

Banquete clay, low, is the only soil in this capability unit. It is deep, fine textured, and very slowly permeable.

This soil occupies basinlike depressions, locally called swales or lagunas. These depressions generally range from 1 to 20 acres in size, but a few are larger than 20 acres. Most of them cannot be economically drained. Native plants normally are grasses that commonly grow in swales, and sennabeans, brushy plants, and a few large trees.

Areas that have been cleared of woody plants are first invaded by grasses and sennabeans and then by huisache and retama trees. Grazing animals do not like mature vine-mesquite and other grasses that grow in swales.

Sennabeans normally occupy the lowest areas and areas that are ponded for long periods. Nearly every year most of the depressions are dry for varying periods. The water level varies with the amount of rain.

Angleton and medio bluestems grow well in most areas, but these grasses may drown in the lowest parts of basins that remain ponded for long periods. Later they spread out again at the edges of the basins. Invading plants can be controlled by herbicides or by grubbing.

If these grasses are grazed properly and fertilized according to their needs, they grow vigorously and produce high yields.

CAPABILITY UNIT Vw-2

This capability unit consists of deep, fine-textured alluvial soils that are slowly permeable and frequently flooded. The soils are—

Clayey alluvial land.
Trinity clay, frequently flooded.

These soils cannot be cultivated. They occupy old stream channels and other low areas, mainly on the flood plain of the Nueces River. The flooding that occurs several times each year keeps these soils so wet that they cannot be tilled.

Brush and a few large trees grow in some places, and weeds, mainly asters, grow in many places. If these plants were cleared and the soils seeded to suitable grasses, excellent pasture could be established. Angleton bluestem is well suited and is an excellent pasture grass that can survive several weeks of flooding. Medio bluestem is well suited to most areas of these soils. Coastal bermudagrass is also excellent. If these grasses are properly grazed and fertilized, their growth is vigorous and their yields are high.

CAPABILITY UNIT VIe-5

Galveston and Mustang fine sands are the only soils in this capability unit. They are deep, hummocky, loose, and rapidly permeable.

These soils lie in a narrow band along the coast of the mainland, and they occupy the hummocky parts of Padre and Mustang Islands. They take in water rapidly, but their capacity for storing it and their fertility are low. During most of the year the subsoil is moist and contains a perched water table in places because the soils are near salt water, the atmosphere is humid, and southeasterly breezes blow almost constantly. Consequently, the soils can support a thick growth of plants.

In the better drained areas, the native vegetation consisted of bluestem, switchgrass, and brownseed paspalum, and in the less well drained areas it was cordgrass, gulfdune paspalum, and sedges. A few live oak and bay trees grew on the mainland. The grasses have been overgrazed and replaced by small live oak and bay trees, which on the mainland are thick in most places. On the islands the trees have a foothold in only a small area near the causeway.

The loose surface layer of these soils is powdery and in cleared areas is readily blown by the constant sea breezes. A few small areas have been cultivated from time to time, but tillage has been discontinued, mainly because of wind erosion, low natural fertility, and the limited choice of suitable crops. Well suited to these soils, after the brush is removed are deep-rooted grasses grown continuously. Yields of forage are high if grazing is properly managed and the soils are fertilized yearly.

CAPABILITY UNIT VIw-1

Mustang fine sand, the only soil in this capability unit, is deep, nearly level, and loose. It is slowly permeable, wet, and moderately saline.

This soil is nearly level and occurs mainly on the offshore islands. Most areas are less than 5 feet above sea level and are occasionally flooded by high tides during storms. The amount of salt in the soil ranges from small to large and depends on the frequency of flooding and on how much salt has been washed down through the loose fine sand by rainwater. A water table occurs at a depth of 2 or 3 feet, and the soil is marshy.

On the islands more forage is produced on this capability unit than on any other unit. The plants are mainly grasses that are suited to wet, salty soils. The most common grasses are cordgrass, gulfdune paspalum, and, in places, broomsedge, bluestem.

CAPABILITY UNIT VIs-1

In this capability unit are deep, nearly level and gently sloping soils that are very slowly permeable and moderately saline. The soils are—

Orelia-slickpot complex.
Point Isabel clay.

These soils are moderately saline to a depth of about 15 inches and are strongly saline below that depth. They are not suited to cultivated crops, for they produce low yields. Many kinds of native brushy plants and grasses grow on them, but growth is limited by salt.

Native grasses can be improved in quality and quantity by controlling woody plants and by managing grazing in a way that encourages the more desirable kinds of grasses to increase. Where desirable native grasses are sparse, a suitable perennial grass can be overseeded to insure revegetation.

CAPABILITY UNIT VIIe-1

Only Coastal dunes are in this capability unit. They are deep, loose, very rapidly permeable, and sandy.

These dunes lie entirely on Mustang and Padre Islands. The soil materials are deep, loose sands that were washed ashore by waves and were mounded by the wind into high, steep-sided ridges. Where they have been disturbed by machinery or by grazing, the dunes are active. They are moving northwestward and are almost bare of vegetation. Along the eastern shoreline of the islands, waves breaking on the beach spray the dunes and provide moisture that permits adapted native grasses and weeds to grow and to control wind erosion. Among the principal plants are sea oats, gulfdune paspalum, and croton weed.

If grazing is limited, the native plants can be maintained and improved. The damage by trampling is reduced if watering troughs and salt are placed in areas where the dunes are not likely to erode.

CAPABILITY UNIT VIIe-2

Gullied land makes up this capability unit. This land is too steep or too badly eroded for cultivation. Most areas receive runoff from large areas of other soils and, in many places, are marked by large, deep gullies. Controlling erosion and improving the land mechanically is difficult and, in most places, is not economical. If the remaining surface soil is disturbed, the risk of further erosion is increased.

In many areas brush and weeds can best be controlled by applying herbicides. High quality grasses grow poorly on most of the land, and in some places overseeding may be needed to control erosion and to increase forage. If grazing is limited and the range is otherwise managed well, a good cover is maintained and the soil is improved.

CAPABILITY UNIT VIIe-3

Only Gullied land, saline, is in this capability unit. This land is eroded and steep. Some areas have lost most of their former surface soil and are practically bare of growing plants. In most areas, however, small islands of surface soil have been left between the gullies and are in scrubby brush, mainly mesquite trees and a few grasses.

Loss of soil can be controlled and production of grasses increased by removing brush with herbicides and by over seeding with grasses that tolerate salt. Grazing should be limited.

CAPABILITY UNIT VIIs-1

Lomalta clay, the only soil in this capability unit, is deep, nearly level, slowly permeable, and saline.

It is mainly on the flood plain of the Nueces River, between Calallen and Nueces Bay. Here, it is susceptible to flooding by fresh water from the river and by salt water during storm tides. Because this soil is salty and is wet most of the time, it cannot be cultivated.

The thick gulf cordgrass on this soil is grazed by beef cattle and is fair for that use. It is not high quality forage, but it remains green throughout the year and is not damaged much during dry periods. Proper use, including management of grazing, is needed if growth is to be vigorous and yields high.

Predictions of yields

In table 2 are listed the estimated yields of the principal crops that can be expected from the soils of Nueces County under two levels of management. The estimates in columns A are based mainly on information (1) from farmers whose farms contain some of the soils listed, (2) from county agricultural workers, (3) from members of the Texas Agricultural Experiment Station who have studied test plots in this county, and (4) from others who have observed yields under the prevailing management. The estimates in columns B are based on yields obtained by members of the Texas Agricultural Experiment Station and by farmers who use conservation management in this and nearby counties on the same kinds of soils as those listed in table 2.

The management needed to obtain the yields in columns B is that described in the subsections “Management of Soils for Agriculture” and “Capability Units in Nueces County.”

Clayey alluvial land, Coastal beach, Coastal dunes, and the other miscellaneous land types in the county are not used for crops and are not listed in table 2.

Engineering Applications

To make the best use of the soil maps and descriptions, engineers need to know the physical properties of the soil materials and the in-place condition of the soils. This report contains information that engineers can use to—

(1) Make soil and land use studies that will aid in selecting sites for industrial, business, residential, and recreational developments.
(2) Make preliminary estimates of the engineering properties of the soils in planning the construction of farm ponds and irrigation systems and in planning soil and water conservation measures.

(3) Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, and storage areas, and in planning detailed soil investigations of selected locations.
(4) Locate probable sources of sand, gravel, topsoil, and other construction material.
(5) Correlate performance of engineering structures with soil mapping units, and thus develop information that will be useful in designing and maintaining structures.
(6) Determine the suitability of the soils for crosscountry movement of vehicles and construction equipment.
(7) Supplement information obtained from other published maps and reports and from aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
(8) Develop other preliminary estimates that can be used for construction purposes in a particular area.
(9) Make preliminary evaluations of soils for selected sites and for development of urban areas.

This subsection and other parts of the report do not contain enough information to enable the engineer to omit sampling and testing the soils at the construction site and at other places where soil is taken for use in structures. The information should be used in planning more detailed field surveys to determine the in-place condition of the soils at proposed sites.

Tables 3, 4, and 5 give much data that are useful to engineers and other builders. Some terms used by soil scientists may be unfamiliar to engineers, and other terms may have a special meaning in soil science. These terms are defined in the Glossary at the end of the report.

Engineering descriptions of soils

In table 3 are descriptions of the soils in Nueces County and estimates of their physical properties that are important in engineering. An explanation is needed fox some of the columns.

The depth from the surface is that of the typical profile. The soil material in the main horizons of a soil is classified according to the textural terms used by the United States Department of Agriculture and according to the Unified and AASHO systems. The USDA system is the textural classification used by the Soil Conservation Service in soil surveys.

The Unified classification system (*14*) was developed by the Corps of Engineers, U.S. Army, at the Vicksburg Waterways Experiment Station. In this system soil material is put in 15 classes that are designated by pairs of letters. These classes range from GW, which consists of well-graded gravel, gravel and sand mixtures, and a little fine material, to Pt, which consists of peat and other highly organic soils. Soils that are on the borderline between classes are indicated by hyphenated symbols, for example, SM-SC.

Many highway engineers classify soil material according to the system approved by the American Association of State Highway Officials (*1*). In this system soil materials are classified in seven principal groups. The groups range from A-1, consisting of gravelly soils that have high bearing capacity, to A-7, consisting of clayey soils that have low strength when wet.

The grain-size distribution shown in table 3 was estimated from data provided by the Texas Highway Department and listed in table 5.

The permeability and the available water capacity were compiled from data used by technicians in Nueces County. Permeability is listed in inches per hour and is the rate that water moves through a specific soil horizon. The available water capacity is given in inches per inch of depth. It is a measure of the water available for plant use. A layer of dry Victoria clay 1 inch thick holds 0.25 inch of water if this water is placed on the surface. Another 0.25 inch of water will wet another inch of soil. A layer of Galveston fine sand 1 inch thick holds only 0.08 inch of water.

The dispersion and the shrink-swell potential were estimated by specialists who are familiar with the soils in the county. Dispersion refers to the degree and speed with which soil structure breaks down and slakes in water.

The shrink-swell potential is an estimate of how much a soil shrinks and swells under extremes of wetting and drying. A knowledge of this potential is important in planning the use of a soil for building roads and other engineering structures. In general, soils classified as CH and A-7 have a high shrink-swell potential. Clean sands and gravel (single-grain structure) and those having small amounts of nonplastic to slightly plastic fines, as well as most other nonplastic to slightly plastic soil materials, have a low shrink-swell potential.

Engineering interpretations

Table 4 gives estimates of the suitability of the soils for highway construction and for conservation engineering. These estimates are based on the information given in table 3, on the actual test data in table 5, and on the knowledge of specialists. Also available was information from State highway engineers and laboratory technician, and from personnel in construction companies.

If the soil material is properly placed and compacted all soils in this county except Coastal dunes are suitable for road fill. Because the sandy surface layer of some soils is poorly graded, finer textured layers in the soil profile are mixed with the surface layer so that it is improved as fill material. Sands are most difficult to place and compact because they do not contain enough material for binding. Clay soils are most stable when compacted at or near optimum moisture content. When compacted at a higher or lower moisture content, unstable fills and corrugated and uneven surfaces may result. An unstable fill can be prevented by mixing sandy material with the heavier clays.

The suitability of the soil material for road subgrade is based on the texture of the material. Soils with plastic clay layers impede internal drainage and have low stability when wet. They are poor for subgrade.

All soils in the county are suited to winter grading. Some soils near the coast have a fairly high water table but subfreezing temperatures are not likely to last long enough to be a problem. None of the soils in the county are suitable as a source of sand and gravel, but some sand and gravel are mined west of Calallen on bottom lands along the Nueces River. Here the deposits are small and are covered with about 20 feet of soil that must be removed before the sand and gravel can be mined.

In this county excavation for construction is not likely to be deep enough to reach bedrock. The soils should be carefully studied at all proposed sites before construction is planned.

Urban and Suburban Uses of Soils

As the population in and around Corpus Christi increased in recent years, there has been a great increase in the building of urban structures on the soils and in using the soils for other urban purposes. Between 1940 and 1960, the population of the city increased 192.6 percent, or from 57,301 to 167,690; the population of the county increased 139 percent, or from 92,661 to 221,573.

In many areas this expansion has been into areas that are not so well suited to buildings and other urban uses as are many of the more loamy, better drained areas in the older part of the city. During the expansion, planners, builders, and maintenance men have been beset by costly failures that can be traced to mistakes made in selecting soils for urban uses or to a lack of information about the soils that had to be used.

This subsection consists of two parts. The first part discusses capabilities and limitations of the soils in Nueces County for five principal urban and suburban uses. The second part deals with the use of soils for septic disposal systems.

Urban structures, recreational sites, and transportation facilities

In table 6 the suitability of each soil and land type in the county is rated for five uses, and soil properties or hazards that limit these uses are listed. Agricultural areas are included because the suitability and value of an agricultural area should be weighed against its suitability and value for urban use.

This soil survey is of only medium intensity, and it does not extend into all of the city. Consequently, there is need for a more intensive, specialized soil survey that is designed for urban planning and for structures and facilities required in residential, commercial, industrial, recreational, and transportation development.

In table 6 homes and other small buildings refer to houses, schools, churches, and small stores. Agricultural areas are rated according to their suitability for crops commonly grown in the county. Recreational areas are rated according to suitability for development into parks, golf courses, picnic grounds, and wildlife areas. Buildings for commerce and light industry include buildings and facilities used for commerce, for light industry, for shopping centers, and for small businesses that do not cause annoying smoke, fumes, or noise. Transportation facilities include streets, roads, airports, and large parking lots.

For these and other uses, the suitability of a soil depends on the properties of that soil. Steep slopes are less desirable than gentle slopes for most uses. Soils that are wet for long periods or those that are frequently flooded are not so well suited for most uses as are drier or less frequently flooded soils. These limitations vary from time to time and, in many places, can be changed by grading, ditching, hiking, and other means. Slope, on the other hand, is a permanent limitation unless earth-moving, equipment is used for leveling.

In table 6 the properties listed as limiting or hazardous are those of an undisturbed soil that has not been changed from its natural state. The ratings are very good, good, fair, poor, or unsuited. Limitations are few for soils rated very good but are progressively greater for soils with less favorable ratings. A soil rated poor or unsuited has major limitations that are expensive or impractical to correct. For example, Tidal flats are not suited for homes or other small buildings, because it is impractical to prevent daily flooding. But for those soils that can be feasibly improved, the feasibility of this improvement was considered when the soils were rated. For example, some soils can be improved without great expense by covering them with topsoil or by digging ditches.

Because only a few soils in the county are less than 10 feet above sea level, surface drainage can be improved without much difficulty. For example, the improvement of drainage on Banquete clay, Victoria clay, and some Orelia soils is fairly easy. On the other hand, Banquete clay, low, normally is in basinlike depressions that are impractical to drain. Also, diverting water so that it bypasses these depressions is difficult.

Most of the soils within and adjacent to Corpus Christi are underlain by and were formed from heavy clays of the Beaumont geologic formation. By far the largest acreage consists of Victoria soils. These soils have a fine-textured surface layer and subsoil that contain clay with a high shrink-swell ratio. This characteristic alone may be responsible for the failure of sewer and water lines, foundations and walls, power line and pole alignment, and pavements that crack and heave. Salinity of the subsoil, poor surface and internal drainage, and erosion are among the factors that contribute to corrosion of utility installation, failures of septic systems, cost of maintaining streets and expressways, and problems in disposing of storm water.

In much of the urban urea and areas designated for urban development, the Victoria soils are nearly level and there are large areas of nearly level Orelia soils. Although these soils are better suited to farming than to urban uses, it will be difficult for the city to expand without using some of them for urban purposes. Fortunately, surface water can be disposed of easily in most areas of Victoria and Orelia soils because most of these areas are 10 to 75 feet above sea level and are fairly close to lower areas. Other limiting factors that are more permanent and more difficult to overcome include high shrink-swell potential, slow permeability, and salinity of the subsoil.

Loamy and sandy soils are more desirable than clays for urban uses. Soils of this kind lie in bands on slopes along the Nueces River and along Laguna Madre in the vicinity of Flour Bluff. Surface drainage is good in most places, and internal drainage is good in many. Galveston and Mustang fine sands are in these areas. They are low in fertility, and their surface layer has low water-holding capacity. Below a depth of 3 or 4 feet, these soils have a layer of sandy clay or sandy clay loam that is less permeable than the surface layer. These soils may be temporarily saturated in wet periods. Also, watering lawns may add water that causes trouble. Nevertheless, adequate drainage can be planned in areas of Galveston and Mustang soils because these areas are 10 to 25 feet above sea level. Because the thickness of the sandy layers varies considerably, the area should be surveyed in detail before it is developed.

Grasses, trees, and shrubs.—During droughts in summer, sandy or loamy soils are better suited to grasses than are heavy clays. Victoria soils and other heavy clays are more fertile than sandy soils and produce as well if the clays are watered regularly. In the clays the cracking of the surface layer can be reduced and the evaporation of moisture decreased by adding fine sandy loam, loam, or organic material to the surface layer. Surface layers that are not well suited to grass can be replaced by or covered with a layer of more productive soil if it is practical and economically feasible to do so. However, the kinds and amounts of vegetation that will grow on saline soils are limited. For more detailed information on establishing and caring for turfed areas, refer to “Home Lawns,” Bulletin B-203, Texas Agricultural Extension Service (*12*).

Trees and shrubs can be grown on almost all soils suited to urban uses if the soils are irrigated and fertilized. A good local reference on the culture of trees and shrubs is “Corpus Christi Garden Book,” a joint project of the Beautification Committee, Chamber of Commerce, and the Corpus Christi Council of Garden Clubs (*2*).

Septic tank disposal systems

In an efficient septic tank disposal system, soil material is required that is permeable enough to permit moderate to rapid percolation of effluent. Soils are not suitable if they are wet most of the time or are subject to flooding. Table 7 rates the suitability of the soils and land types in Nueces County for septic tanks and lists soil properties and hazards that limit use for this purpose.

In most soils of the county that are 10 feet or more above sea level, the surface drainage can be improved; in some of these soils, internal drainage can also be improved and the effects of flooding reduced. Exceptions are alluvial soils on the flood plain of the Nueces River and the flood plain of creeks that drain the mainland. In some places Banquete clay, low, may be difficult or impractical to drain. Normally, it is not economical to control the flooding caused by daily high tides or by storm tides. Soils susceptible to these floods are generally less than 10 feet above sea level.

Formation and Classification of Soils

This section has three main parts. The first part discusses the factors of soil formation and tells how they have affected the formation of soils in Nueces County. The second part classifies the soil series by soil orders and great soil groups and also describes each series in the county and gives a profile representative of each series. In the third part are the data from mechanical and chemical analyses of selected soils and descriptions of the profiles of these soils.

Factors of Soil Formation

Soil is the product of climate, living organisms, parent materials, topography, and time. If the interaction of these live major factors has been the same in a given area, the nature and characteristics of the soil in that area are the same. If in two areas, however, the interaction of these forces differs, the soils in the two areas also differ. Within short distances the resulting soil differences may be slight or great. The importance of the differences depends on their relation to man's activities, which are primarily concerned with his need for food, clothing, and shelter, or with his quest for more knowledge about the resource that produces these things.

Climate

The climate in Nueces County is intermediate between that of the humid, subtropical region to the northeast along the coast of Texas and that of the semiarid region to the west and southwest. Because the county is near the Gulf of Mexico, humidity is fairly high throughout the year, and it lessens the amount of moisture that might be lost through evaporation and transpiration. The average humidity is normally higher near the coast and decreases as one moves westward. Consequently, plants grow less vigorously in the western part of the county and yields are lower, especially during years of abnormally low rainfall and high temperatures.

The average temperature and the distribution of rainfall by months are shown in figures 2 and 3, p. 2. Because of periodic shifts from humid climate to semiarid, back and forth across the county, all the soils have been subjected to about the same climatic influences. Periods of dry weather occur almost annually and last long enough to cause deep cracks in the clay soils and to affect them considerably in other ways. Droughty periods are normally followed by periods of abundant rain. These soils contain montmorillonitic clay. Climate and parent materials are dominant factors in their formation. In addition to clays that formed from montmorillonitic clay, there are other clayey soils that formed from the Beaumont formation. Both kinds of soils show the effect of the subhumid climate in their strongly alkaline and saline layers, from which not all of the bases or salts have been leached. Except for the Grumusols and sandy Regosols, most soils in the county have a layer where calcium carbonate has accumulated at the depth to which the limited rainfall normally penetrates.

Temperature has played an important role in the development of the soils of the county. The temperature is fairly high throughout the year, and normally there are two growing seasons.

In the first period, germination and early growth of plants depend mainly on moisture stored during the previous fall. As the plants increase in size, rainfall normally increases until May, when most plants need the most moisture. Rainfall decreases in June during most years, and the annual plants begin to mature. During July and August, rains are scarce and the temperature is high. Perennial plants grow slowly, and many become dormant. If moisture is increased by tropical disturbances during summer, dormancy is occasionally reduced or does not occur. These disturbances occur infrequently, however, possibly every 5 to 10 years. They come as relatively tranquil easterly waves or as violent hurricanes.

At about the beginning of September, the balance between moisture and transpiration again favors seed germination and plant growth. Most native plants and many cultivated crops have time to attain full growth. The season is long enough for some plants to produce a second crop. Occasionally, large quantities of rain come in tropical storms. This moisture is stored deeply in soils and, during succeeding seasons, is available to deep rooted plants. These plants add large quantities of organic matter to the soils.

The long growing seasons and high annual temperatures encourage the growth and development of soil organisms, and these, in turn, rapidly reduce much of the raw, organic residue of plants to their end products. In this county, bacterial activity probably continues throughout the year in almost every year.

Normally, the soils do not freeze. Snow falls infrequently and normally melts rapidly. The minimum average temperature for December, January, and February is 50° F., and the average temperature for these months is about 65°. Periods that have temperatures below freezing are infrequent and last only a few hours or, at most, a day or two. In some winters killing frosts do not occur.

Cultivated soils are normally wet by fall rains. If weeds are controlled, these soils remain moist and do not crack during winter. The soils also retain much of their stored warmth. If enough crop residue is left at or near the surface, soil organisms continue to work throughout the winter.

Living organisms

Almost two-thirds of Nueces County consists of nearly level clays that once supported a fairly heavy growth of mid and short grasses. The mid grasses were mainly fourflower trichloris, Arizona cottontop, pink pappusgrass, bristlegrass, and Texas wintergrass. They grew on the better drained parts of the almost flat terrain. Vine-mesquite *(panicum obtusum)* and Hartweg paspalum grew in the less well drained parts, where very slow drainage favored their growth. Patches of buffalograss and mesquite that were intermingled with areas of mid grasses spotted the open areas. During extended droughty periods the mid grasses spread, but when the moisture content of the soils was favorable, the taller grasses encroached on the mid grasses.

The vegetation on the low ridges and knolls of fine sandy loam consisted almost entirely of mid grasses. In the northern part of the county, the more sandy soils along the slopes of the Nueces River supported a heavy growth of seacoast bluestem and other mid grasses. The deep sands of the ancient barrier reef near the coast were covered mainly with seacoast bluestem, brownseed, paspalum, fringeleaf paspalum, crinkleawn, some Indiangrass, and switchgrass. Small groves of live oak and bay trees also grew on this sand strip. The early Spanish settlers called this area the Encinal Peninsula because encinal is the Spanish word for a live-oak grove.

The only other trees in the county grew chiefly on the alluvial soils along the Nueces River and along small, shallow creeks. These trees were mainly hackberry, elm, ash, live oak, anaqua, and possibly a few mesquite and huisache trees. Because of the climate, grasses made up most of the vegetation, but there were other kinds of plants. The kinds of plants that grew seem to have depended partly on variations in surface and internal drainage. In the clay soils, grasses have darkened the thick surface layer.

The native grasses that once covered Nueces County were eliminated by grazing, and brush, mainly mesquite and cactus, took their place. This brush was thickest on the loamy soils, but it also grew on the clayey soils and was in small scattered areas on the sandy soils that contain a claypan. The deep sands near the coast had a thick growth of small live oak and hay trees. Although short curly mesquite and buffalograss survived, their growth was not vigorous, because they competed for moisture with woody plants and with invading grasses. The differences caused in these soils by this change in vegetation is not known, but soil development was probably influenced by the trampling of thousands of cattle and by the invasion by mesquite trees and other brush.

Nearly all of the clays and most of the loamy soils are now cultivated. Their natural microrelief has been smoothed, drainage has been altered, and the surface has been artificially mulched through tillage. These changes probably affect the way the soils develop and the rate of this development.

Parent materials

The geologic materials from which the soils of Nueces County formed are Beaumont clay and materials of the Lissie formation and of the Recent epoch. The Recent materials are alluvial sediments of streams and eolian sands that were blown from beaches along the Gulf of Mexico.

Beaumont materials are largely fresh-water sediments that were deposited by rivers during the Pleistocene epoch. The sediments formed natural levees and deltas in and along the mouth of rivers that once emptied into lagoons and bays along the coast (*9*). The high clay content of the soils that formed on most of the Beaumont clay in Nueces County suggests that the parent materials were largely sediments deposited in slack water, possibly in lagoons. Because the surface of the county slopes to the southeast, the northern part of the county may have been on a natural levee of an early Pleistocene stream. This may account, in part, for the more loamy nature of the soils on slopes along the Nueces River. On the other hand, the truncated northern edge of the Beaumont clay in this county is thin over sandy materials of the Lissie formation (early Pleistocene). These sandy materials are exposed along the slopes as far east as Corpus Christi. Gas wells drilled in the Saxet Oilfield (*8*) have reached the base of the Lissie formation at a depth of 85 to 100 feet.

Ancient streams appear to have entered the county from the west at the beginning of the Pleistocene epoch when the materials of the Beaumont clay were deposited. At that time the level of the bays and lagoons may have been high, as indicated by the fine deposits that extend westward in an ancient bay as far as Alice in Jim Wells County.

For the most part, the coarse materials that normally form natural levees along stream channels are buried at a varying depth by fine, slack-water sediments that were laid down later in bays and lagoons. In the later stages of deposition, floodwaters took more defined courses and entered the county from the northwest instead of from the west. This change in direction may have occurred because the amounts of water decreased naturally, or because water was taken from the streams in Live Oak County to the northwest (*8*).

As the Pleistocene flood subsided, the sea receded and water in the bays and lagoons fell to a lower level. By this time the confluent waters were entrenched in the present valley of the Nueces River. During periods of flooding, water spilled over the natural levees, and the force of the current spent itself in the shallow bays and lagoons of the area that is now Nueces County.

The distributary streams coursed more slowly through the lagoons and dropped their load of silt and fine and very fine sand in narrow strips as the currents crossed. Tins deposition was mainly in the northern and eastern parts of the county. The narrow strips of sediments that marked the currents were leveled by the normal turbulence of the water so that the soils that formed from these deposits blended smoothly with the clay soils in slack-water areas, though they differ from those soils.

The strips of loamy materials in the southwestern part of Nueces County are believed to have been deposited as ancient stream levees. These strips were either interstream ridges of Lissie material, or they were laid down during floods as natural levees after the main Pleistocene floods had subsided and the sea had receded about to where Bishop and Driscoll are now. It seems more likely that the strips were natural levees because they consist of a strongly calcareous, loamy mixture made up of materials similar to those in geologic formations of counties to the west. These formations are Goliad sand, Oakville sandstone, and Catahoula sandstone. The deposits were probably washed from these formations. If the deposits had been laid down in bays or lagoons before the main Pleistocene flood, they would have been leveled and spread by turbulent water. They are fairly well segregated and form slightly elevated ridges and mounds that apparently have been reworked by wind to some extent. These strips consist of alkaline to strongly calcareous, moderately well drained fine sandy loam.

After the receding sea reached a point about 15 to 20 feet above its present level, recession appears to have slowed considerably. An offshore barrier beach, or reef, formed because the gradient of the marine floor, the depth of the water, and the prevailing winds were favorable. The reef consisted of a strip of littoral sand similar to that on Padre and Mustang Islands. When the sea receded further, this strip became a part of the mainland; it is the Encinal Peninsula.

This ancient barrier island probably extended along the shoreline and was contiguous, or nearly so, with a similar strip of sand, called Live Oak Ridge, which is in San Patricio County. In the reef there may have been small openings similar to those of Corpus Christi Pass and Packery Channel on the present offshore islands.

Corpus Christi Bay did not then exist. Its area was either a continuation of the coastal terrace or was occupied by a small bay similar to Oso Bay or to Baffin Bay in Kleberg County. The mainland was made up of recently exposed Beaumont material and, except for an area occupied by an ancient lagoon, extended smoothly to the shoreline. The wave-cut cliff was formed later.

A great tropical storm may have started to widen a gap in the reef and to enlarge it into Corpus Christi Bay. Waves during subsequent storms probably washed away the ends of the former sand ridge and carved the bay to its present size.

Most of the area occupied by the ancient lagoon behind the reef is now about 15 feet above sea level. However, Cayo del Oso is a small bay bordering the Enicinal Peninsula, and Laguna Larga is a large, shallow lake to the south, mostly in Kleberg County. The reef is made up of noncalcareous, loose fine sand that has been shifted by wind to a maximum width of 5 miles. The fine sands were blown into the shallow, brackish or saline water of the relatively quiet lagoon. The sands sank into the semi-suspended ooze and mud that normally accumulate in these waters. This mixture of sand, silt, mud, and ooze formed a dense, saline sandy clay loam. The soils that developed in this kind of material are very slowly permeable and are normally hard and crusty.

The alluvial materials of the Recent epoch occur almost entirely on the flood plain of the Nueces River. These materials are mainly calcareous clays and non-calcareous fine sandy loams, but clay loam occurs in a few areas. How the sandy alluvial materials were deposited in their present location is not known. Coarse sediments are near the channel; fine sediments are in slack-water areas some distance away; and medium-sized sediments are between the two. This simple pattern, however, is complicated by other factors.

Nearly all of the sandy material occurs within the flood plain in an area extending 10 miles from the northwestern corner of the county. Little or none occurs in the remaining 10 miles to the bays at the mouth of the river. This sandy material is from 25 to 50 feet above sea level. The presence of alluvium at this distance above sea level is accidental. The material was probably left in a bay that existed when sea level was at that elevation. The Nueces River deposited coarse, sandy alluvium in the bay after the river cut through the hard Goliad sand just northwest of the county line. This sandy alluvium was laid down in the form of a delta. From this delta to the present mouth of the river, the flood plain remained in slackwater bays, and only clay materials were deposited.

The sandy materials were eroded from geologic formations in the watersheds of the Nueces, Atascosa, and Frio Rivers. These formations were the Carrizo, the Wilcox, and the Yegua, and they consist dominantly of noncalcareous, sandy materials. The dominantly calcareous, clayey materials are from the Edwards, Goliad, Jackson, Oakville, and Catahoula geologic formations.

Small areas of sandy materials of the Lissie formation are exposed on the flood plain to a point west of Calallen. In places these materials are thinly covered by alluvium that was laid down recently. Flooding of these areas ranges from occasional to frequent.

Topography

Nueces County lies on a nearly level coastal terrace that is about 40 miles wide. In 95 percent of the county, slopes are less than 1 percent. Offshore islands and tidelands make up slightly less than 10 percent of the county. Three-fourths of the mainland is covered by nearly level clay soils. A narrow band of moderately sloping and strongly sloping, loamy soils extends along the northern edge of this nearly level area, which is truncated by the Nueces River.

The smooth surface of the clay is marked by a few undulations. It has an almost uniform grade that slopes southeastward to the coast. Slightly billowy, deep sand that was blown inland from an ancient beach lies in a band, 3 to 5 miles wide, along the shoreline in the southeastern part of the county.

The highest point in the county is near the northwestern corner and is 146 feet above sea level. The lowest point is at sea level along Corpus Christi Bay, but the shoreline has been cut back by waves to an almost vertical cliff. This cliff ranges in height from about 15 feet near Cayo del Oso to about 35 feet at a point along Ocean Drive where Corpus Christi overlooks the bay. From the highest point to the lowest in the county, the average fall is approximately 4 feet to the mile. In some large areas, however, slopes fall about 2 feet to the mile, and in smaller areas they fall as much as 7 feet.

When the water receded from this area, it left a large, uniform and fairly smooth plain that is slightly tilted but unbroken. A few slightly concave areas remain where distributary currents spilled over the natural levees of the last of the Pleistocene rivers. Now, the drainage area that affects this county consists only of the watersheds of creeks originating east of the Bordas escarpment in Duval County, a distance of about 40 miles from the western edge of Nueces County. The runoff from that area once concentrated at the bottom of the great, shallow, ancient channels that were cut into the counties to the west by the Pleistocene flood. When small streams reached the flat coastal terrace, they meandered in wide courses left by ancient rivers and tributaries. During some succeeding floods, these streams carved a new channel. A network of small channels still exists in the hard Orelia soils along Agua Dulce Creek in Jim Wells County.

The coastal terrace in Nueces County is broken only by the shallow, narrow channels of Agua Dulce and Pintas Creeks. These creeks enter the county from the west and converge to form Petronila Creek, which crosses the county and leaves it at a point 7 miles southwest of the Chapman ranch. The head of Oso Creek is northeast of Robstown, on a presumed ancient levee. The creek flows southeastward in a narrow channel and empties into Corpus Christi Bay. A few other small, short drainageways occur in the county. The heavy, nearly level clays extend to the banks of the channels. In some places only a narrow band of gently sloping soil adjoins the channel. The creeks that receive runoff water from areas west of the county formerly overflowed their banks during periods of high rainfall, but this flooding has been controlled by constructing flood-retarding dams west of the county and by improving the channel downstream.

Partly because this county is nearly level, the dominantly clay soils absorb much of the limited amount of rain. This moisture has helped to make the surface soil dark and thick and has moved the salts downward.

Time

Geologically the soils of the county are young. The oldest soils developed in materials weathered from the Lissie formation and are mainly near the highest areas in the northwestern part of the county. Probably the age of the soils decreases from the northwestern part to the southeastern, or lowest, part of the county. Because of the way the clayey materials in this climate behave, however, time has not caused the soils in the western part to differ significantly from those in the eastern part. The loamy soils have developed moderately distinct horizons, except for those derived from materials recently reworked by wind. In a few places the surface layers may be partly windblown and partly genetic. In other places the horizons have formed normally, and leaching has been increased by flood waters from other areas. This leaching, together with high temperatures and the fact that there are two growing seasons, has made some of the soils in the county develop rapidly.

Classification of Soils by Higher Categories

In the comprehensive system of soil classification that is followed in the United States, soils are placed in six categories. Beginning at the top these categories are the order, suborder, great soil group, family, series, and type. This discussion deals only with the order, great soil group, and series. In the tabulation that follows, the great soil groups in the county are listed in their respective orders, and the soil series in each great soil group are named.

Order and great soil group	*Series*
Zonal—	
Reddish Chestnut	Clareville, Miguel, Willacy.
Intrazonal—	
Grumusol	Banquete, Victoria.
Calcisol	Hidalgo.
Planosol	Orelia.
Solonchak	Lomalta.
Azonal—	
Alluvial	Frio, Trinity, Zavala.
Regosol	Galveston, Mustang, Nueces, Point Isabel.

Classes in the highest category are the zonal, intrazonal, and azonal orders. The zonal order consists of soils with evident, genetically related horizons that reflect in their formation the predominant influences of climate and living organisms.

The intrazonal order consists of soils with evident, genetically related horizons that reflect the dominant influence of a local factor of relief or parent materials over the effects of climate and living organisms.

The azonal order is made up of soils that lack distinct, genetically related horizons, commonly because they are young, are steep or have resistant parent material.

In Nueces County soils in the Clareville, Miguel, and Willacy series are zonal. These soils are genetically related and reflect the influences of climate and living organisms. Horizons in the Willacy soils are not so pronounced nor so consistent in sequence as they are in the Clareville soils. For this reason, the Willacy soils intergrade toward the azonal order. The surface layer of these soils appears to have been influenced, to some extent at least, by ancient to recent loamy material that was deposited by wind or water.

The Clareville and Willacy soils have a dark surface layer that developed under a cover of mid grasses. The Miguel soils also developed under a cover of mid grasses, but they are slightly older and more reddish than the Clareville and Willacy soils. The Clareville, Miguel, and Willacy soils all contain distinct horizons of calcium carbonate.

Soils in the Banquete, Hidalgo, Lomalta, Orelia, and Victoria series are intrazonal, and they make up almost three-fourths of the county. About 80 percent of this acreage is occupied by Victoria soils, which are Grumusols. The Hidalgo soils are strongly calcareous and reflect the dominant influence of parent materials and the subhumid climate. Small areas of Hidalgo soils occur in the northern and western parts of the county, normally with Willacy soils. Although Hidalgo soils are classified as Calcisols, they resemble Willacy soils and grade toward the Chestnut great soil group.

The Orelia soils in Nueces County are Planosols. They occur only in nearly level areas that normally are subject to flooding by water from other areas. Surface drainage is slow but is good enough to permit regular tillage. The A horizon in uncleared areas generally is only about 4 inches thick, and the plow layer normally includes 1 inch or more of the B horizon. The Orelia soils developed in more loamy parent materials than the Victoria soils, but Orelia soils contain enough fine particles to make them dense. Throughout their development, parent material, relief, and climate have been dominant. Layers of calcium carbonate occur at a depth of 18 to 24 inches, but the C horizon has remained sodic. In the lower layers a lack of internal aeration impaired the activity of organisms.

Soil horizons are less distinct in the eastern part of the county than they are in the western part. Where some of the soils developed in ancient lagoons near the coast, it seems highly probable that at least a part of the surface layer consists of littoral materials that were blown from an ancient beach.

The Lomalta soils are in the Solonchak great soil group. These soils contain large quantities of salts and alkali. They have developed from alluvial sediments under poor drainage. The Lomalta soils have lightly crusted, friable, granular structure. They are low in organic-matter content.

Azonal soils are less extensive in Nueces County than intrazonal soils, though most of the county is a nearly level marine terrace. Azonal soils occupy about 9 percent of the county and zonal soils, only about 6 percent.

The azonal soils in this county are of the Frio, Galveston, Mustang, Nueces, Point Isabel, Trinity, and Zavala series. The Frio, Trinity, and Zavala soils are Alluvial soils that are developing in recent alluvial sediments on the flood plain of the Nueces River. The Galveston, Mustang, Nueces, and Point Isabel soils are Regosols that are developing in deep, unconsolidated sands and clays. Their parent materials were washed ashore by waves and were recently blown by wind over the clayey coastal terrace.

The Alluvial soils do not have genetic horizons. This is because they are young and because floods of the Nueces River constantly deposit fresh sediments on them. The Zavala soils are higher than the Frio and Trinity soils. Zavala soils resemble some of the Willacy soils that have been reworked by wind and have faint horizons. The thin, distinct, medium and moderately coarse textured layers of the Frio soils indicate that those soils are very young. Frio soils resemble the Hidalgo soils on uplands, which, in this county, were probably formed from material deposited at an earlier time than that of the Frio soils, but in the same way. The Trinity soils are the recent counterpart of the Victoria soils on uplands. But Trinity soils are younger and less well drained than Victoria soils and are not so well developed.

The Point Isabel soils formed from salty, clayey and loamy material that was blown from the bays and deposited on small clay islands that had been formed from salty material of the coastal terraces. This windblown material resisted wave action when the bays were carved out by the storms. Since the clayey material is salty and very slowly permeable, and the deposits are recent, horizons in Point Isabel soils are faint or indistinct.

The Galveston, Mustang, and Nueces soils consist mainly of fine quartz sand that is not likely to weather appreciably in the process of horizon development. These soils, mainly because they are very young, do not have genetic horizons other than a thin A1 horizon. The subsoil of Nueces soils is a IIB2 horizon and consists of material that is geologically different from that in the surface layer. The sandy surface soil was blown onto the clayey materials of the Beaumont geologic formation or, in some places, was blown over mixed sediments in bays and lagoons. This same kind of clayey material also underlies the other Regosols in this county, but the material is 6 feet or more below the surface. Because of its depth, this material does not appreciably influence the behavior of plants in this climate, and, consequently, does not alter the classification of the soils.

In the Nueces soils the IIB2 horizon is overlain by a layer of fine quartz sand 1 to 4 feet thick. This layer is rapidly permeable and is low in water-holding capacity. Most of the rainfall reaches and is stored in the lower subsoil, where plant roots and other organisms develop. Shortly after the material of the surface layer was deposited, the IIB2 layer probably began functioning and continued developing as a nearly normal genetic layer. Nueces soils are drier than Galveston soils, however, either because they have a thinner surface layer or because they are farther from the coast and do not get air moistened by spray from waves that lash the shore.

Even though Galveston soils receive considerable amounts of salt from the air along the coast, this salt is washed downward when heavy rains occur occasionally and the rainwater percolates through the sandy, rapidly permeable profile to a depth of 6 feet or more. For this reason, the modal Galveston soils are not salty.

Mustang soils lie less than 5 feet above mean sea level. They are occasionally flooded during high storm tides by the water that breaks through the passes in the barrier islands and moves over the soils from the bays and lagoons on their leeward side. Water from the lagoons rises 1 to 5 feet over these soils during storms, and it smooths out any small dunes that have accumulated. Consequently, these soils are not hummocky like the Galveston soils, which are more than 5 feet above mean sea level and are not smoothed by the tides. When the flooding subsides, the small amount of salt that adheres to the smooth grains of quartz sand is easily washed down by the next heavy rain. The salt probably rises as the water table rises and falls as the rain washes it downward.

Representative soil profiles

In the following pages each soil series in Nueces County is discussed generally, and a profile of a soil representative of the series is described.

Banquete series.—This series consists of clayey, slightly depressional, imperfectly drained soils on the Rio Grande Plain of southern Texas. These soils developed under grass from calcareous clays of Recent or Pleistocene age. The native vegetation consists of Hartweg paspalum, retama, huisache, and sennabean.

Profile of Banquete clay (4 miles north of Banquete on Farm Road 666 and 2 miles west on Farm Road 1833, in a pasture one-eighth mile south of the road):

A11—0 to 4 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; weak to moderate, fine, subangular and irregular blocky structure; very hard and crusty when dry, firm when moist, sticky and plastic when wet; pH 6.5; clear boundary.

A12—4 to 18 inches, dark-gray (10YR 4/1) light clay, very dark gray (10YR 3/1) when moist; few, fine, faint mottles of brownish yellow; moderate, medium and fine, subangular blocky structure; very hard when dry, very firm when moist, plastic and sticky when wet; few, fine pores; a few, fine, ferromanganese concretions; pH about 7.0; gradual boundary.

AC—18 to 34 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; weak structure, probably subangular blocky; very hard when dry, very firm when moist, plastic when wet; noncalcareous; pH 8.0; gradual boundary.

C 34 to 60 inches, light-gray (10YR 7/2) sandy clay, light brownish gray (10YR 6/2) when moist; weak structure, apparently subangular blocky and granular; hard when dry, friable when moist, slightly sticky when wet; a few fine concretions of calcium carbonate, but horizon is noncalcareous; pH 8.0.

The color of all layers ranges from 1 value higher to 1 value lower than that described. The surface layer ranges from heavy clay loam to light clay, and the AC horizon ranges from sandy clay loam to clay. The C horizon is weakly calcareous in some places. Surface drainage is very slow or ponded. Internal drainage is very slow.

Banquete soils occur with Orelia soils, which are very slowly drained Planosols that have horizons of distinctly different texture. Banquete soils are similar to the slightly depressional Victoria soils in surface drainage but, unlike those soils, have a noncalcareous, compact, crusty surface layer. Banquete soils have a thicker solum and a less saline subsoil than Point Isabel soils. The Point Isabel soils have a convex, well-drained surface that is lighter colored than that of the Banquete soils.

Banquete soils occupy about 3 percent of this county. The areas are small and scattered.

Clareville series.—This series consists of dark, crumbly, noncalcareous soils that developed under grass from calcareous sandy clay. These soils were derived mainly from materials of the Lissie geologic formation. The native vegetation consists of fourflower trichloris, plains bristlegrass, curly-mesquite grass and a dense invasion of brush, chiefly whitebrush, mesquite, and granjeno.

Profile of Clareville loam (three-quarter mile north of Farm Road 70 at a point 10 miles south and 2 miles east of Aqua Dulce, in a cultivated field west of a refinery):

Ap—0 to 8 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) when moist; moderate, fine and very fine, granular structure; hard when dry, friable when moist, slightly sticky when wet; slightly hard surface crust after rains; noncalcareous; pH 7.5; clear boundary.

B1—8 to 18 inches, very dark gray (10YR 3/1) heavy clay loam, black (10YR 2/1) when moist; fine, subangular blocky structure that breaks easily to very fine, subangular blocky structure; hard when dry, friable when moist, slightly sticky when wet; continuous glossy films on surface of all peds; many medium and fine pores and worm casts; noncalcareous; pH 7.5; gradual boundary.

B2t—18 to 26 inches, dark grayish-brown (10YR 4/2) sandy clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist, sticky when wet; few, strongly calcareous, light-colored insect casts; weakly calcareous; gradual boundary.

B3—26 to 40 inches, gray (10YR 5/1) sandy clay, dark gray (10YR 4/1) when moist; weak structure; hard when dry, very firm when moist; few hard concretions of calcium carbonate; strongly calcareous; gradual boundary.

Cca—40 to 60 inches, light-gray (10YR 7/2) sandy clay, light brownish gray (10YR 6/2) when moist: weak structure; very hard when dry, firm when moist, sticky when wet; many hard concretions and thin seams of limy crystalline material; strongly calcareous.

The A1 horizon ranges from dark gray to very dark brown. The B1 horizon ranges from 2 to 12 inches in thickness. It is nearly black in most places, and its structure is fine to very fine subangular blocky. The B2t horizon ranges from firm to friable in consistence and from sandy clay to clay loam in texture. The pH of the A and B horizons ranges from 7.0 to 8.0.

Clareville soils range from nearly level to gently sloping, but in most places their slope is less than 0.5 percent. About 11 percent of their acreage in this county is gently sloping (slopes of as much as 3 percent). Surface drainage is slow in nearly level areas and medium on the gentle slopes. Internal drainage is moderately slow. Because most areas of these soils are between areas of higher and lower soils, they receive runoff from the higher soils but lose part of it on the lower ones.

A noncalcareous, loamy surface layer distinguishes Clareville soils from the Victoria soils. The Victoria soils have a strongly calcareous surface layer. Clareville soils are less clayey throughout than the Victoria soils; furthermore, they have distinct horizons, some of which contain a pronounced accumulation of calcium carbonate. Clareville soils are similar to the Orelia soils in color, texture, and reaction, but their porous, crumbly A and B horizons are less dense than those of the crusty Orelia soils.

In this county Clareville soils occupy a few moderately large areas but are dominantly in scattered small areas. These soils occur mainly in the western and northern parts of the county in places where the parent material is loamy.

Frio series.—The Frio series consists of calcareous, loamy Alluvial soils. The parent materials are sediments that were washed from calcareous soils in the watersheds of the Nueces River. Tributaries of this river extend across the Rio Grande Plain, and some originate in the limestone soils of the Edwards Plateau. The native vegetation of the Frio soils consists of hackberry, ash, elm, and an understory of thorny shrubs, grapevines, and mid grasses.

Profile of Frio clay loam (2 miles northwest of Bluntzer along a hard-surfaced road, in a cultivated field south of the road and about 400 feet east of a gravel pit):

Ap—0 to 6 inches, gray (10YR 5/1) clay loam, dark gray (10YR 4/1) when moist; moderate, fine and very fine, granular structure; slightly hard when dry, friable when moist, slightly sticky when wet; few, fine, small shell fragments; strongly calcareous; gradual boundary.

A1—6 to 20 inches, dark-gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) when moist; strong, very fine, subangular blocky and granular structure; hard when dry, friable when moist, slightly sticky when wet; strongly calcareous; clear boundary.

AC—20 to 32 inches, gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) when moist; moderate, very fine, subangular blocky and granular structure; hard when dry, friable when moist; strongly calcareous; gradual boundary.

C—32 to 60 inches, light, gray (10YR 7/2) silty clay loam, light brownish gray (10YR 6/2) when moist; moderate, very fine, subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky when wet; strongly calcareous; a few lumps of calcium carbonate.

The surface soil is heavy clay loam in shallow, abandoned channels but is loam on ridges between the channels. It ranges from very dark grayish brown in depressed areas to light gray on the ridges and mounds. In many places thin layers of calcareous and noncalcareous fine sandy loam and loamy fine sand occur in the AC and C horizons. These layers range from light gray to grayish brown.

Most areas of Frio clay loam are nearly level or slightly convex. Slight irregularities of the surface occur as a series of concentric, crescent-shaped, slightly elevated ridges and as slightly concave, old stream channels. Runoff is slow to medium, and permeability is moderate. These soils are flooded once or twice every 2 or 3 years.

Frio soils are strongly calcareous and are more clayey than the noncalcareous Zavala soils. They are less clayey than the Trinity soils, have more rapid surface and internal drainage, and are not so nearly level or so dark in color.

Frio soils have a small total acreage in this county. They occupy small areas at the inside curve of horseshoe bends, mainly along old, abandoned stream channels on the flood plain of the Nueces River.

Galveston series.—Soils of the Galveston series are wet, sandy Regosols on sand dunes along the gulf. The sand in these dunes was deposited by waves and shifted by winds, but the dunes have been stabilized by live oak and bay trees, sea oats, broomsedge bluestem, seacoast bluestem, Indiangrass, switchgrass, and other plants. These soils are hummocky in most places.

Profile of Galveston fine sand (200 feet east of a hard-surfaced road near the eastern end of the Padre Island Causeway, in a grove of live oak trees south of a tourist camp):

A1—0 to 12 inches, light-gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) when moist; structureless; loose when dry or moist; noncalcareous; pH 6.5; gradual boundary.

C1—12 to 20 inches, light-gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) when moist; structureless; loose when dry or moist; pH 6.0; diffuse boundary.

C2—20 to 60 inches +, very pale brown (10YR 8/3) fine sand, pale brown (10YR 6/3) when moist; structureless; loose when dry or moist; pH 6.0: soil is very moist at a depth of 3 to 5 feet and is saturated below 5 feet; water table at a depth of 6 feet.

These soils range from grayish brown to light brownish gray in the surface layer and from light gray to white in the lower layers. In most places the pH ranges from 5.5 to 8.0, but near the gulf side of Padre Island, the pH may be higher because salt water sprays these soils during periods of high wind. Sea oats grow on the dunes, and salt-tolerant grasses are abundant in depressions between the dunes and the coast. The depth to the water table varies between 3 and 6 feet.

The surface is hummocky; dunes are convex, and areas between the dunes are smooth or concave. From the crest to the toe, the slope of the dunes is generally less than 6 percent. The soils are nearly level in most places. Runoff is very slow; internal drainage is normally rapid above the water table. These soils are not likely to be flooded by high tides.

Galveston soils are higher lying, better drained, and less saline than the Mustang soils. They are less choppy, less well drained, and more stable than Coastal dune. Unlike Nueces soils, Galveston soils have moist or saturated subsurface layers most of the time, and they lack clayey layers within a depth of 6 feet.

Galveston soils are moderately extensive along the coast. A few moderately large areas occur on the shore of the mainland and on the offshore barrier islands.

Hidalgo series.—The Hidalgo series consists of grayish, calcareous soils that are young and moderately well drained. These soils are in the Calcisol great soil group, but they grade toward Chestnut soils. Hidalgo soils developed under grass in strongly calcareous, loamy materials, mainly on the Quaternary deltaic or marine terraces in the Rio Grande Plain of Texas.

Profile of Hidalgo fine sandy loam (near the intersection of State Route 9 and Up River Road, southeast of Calallen, between road intersection and the Missouri Pacific Railroad):

A1—0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; strong, fine and very fine, granular structure; slightly hard when dry, friable when moist; few small fragments of snail shells; strongly calcareous; gradual boundary.

AC—10 to 28 inches, light brownish-gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) when moist; weak structure to weak, fine and very fine, granular structure; slightly hard when dry, friable when moist; a few large and medium pores and many fine ones; few, fine, hard concretions of calcium carbonate and fragments of snail shells; strongly calcareous; gradual boundary.

Cca—28 to 60 inches, very pale brown (10YR 8/3) light sandy clay loam, very pale brown (10YR 7/4) when moist; weak, granular structure; slightly hard when dry, friable when moist; a few large and medium pores and many fine pores; a few fine concretions and threads of calcium carbonate; strongly calcareous.

In Nueces County the Hidalgo soils are nearly level to sloping. They range from fine sandy loam to loam in texture and from dark gray to light grayish brown in color. Most areas are grayish brown (10YR 5/2) when dry. The surface layer ranges from 8 to 16 inches in thickness; it is thicker on gentle slopes than on strong ones. Small concretions of calcium carbonate and small fragments of snail shells are common through these soils. Layers containing calcium carbonate range from weakly to strongly calcareous. In a few places, layers of sandy clay loam are cemented with hard concretions of calcium carbonate that make up 30 to 40 percent of a layer. Normally, the cemented layers are at a depth of 24 to 36 inches, but in severely eroded areas they may be exposed at the surface.

Sixty percent of the acreage ranges from gently sloping to sloping. Runoff is slow on the nearly level soils. The sloping soils are slightly more permeable than the nearly level soils, and they lose little water in runoff if they are properly managed. Hidalgo soils have moderate internal drainage.

The Hidalgo soils have a calcareous surface layer, but the Willacy and the Clareville soils do not. Less leaching has occurred in the subsurface layers of the Hidalgo soils than in those of the Willacy soils. Hidalgo soils are less clayey in their subsoil than the soils in Clareville complex. Horizons are not as distinct in the Hidalgo as they are in the Clareville soils. Although Hidalgo soils are similar to the Frio soils, the Frio formed in recent stratified alluvium and are subject to flooding by the Nueces River. The Hidalgo soils are not likely to be flooded.

Hidalgo soils have a small total acreage in this county. Areas are fairly small and are scattered mainly in the western part and in a narrow strip in the northern part.

Lomolta series.—The Lomalta series consists of saline, clayey soils along the gulf. These soils are semimarshy and marshy. They formed in clayey sediments. The sediments were washed by floodwaters from local and inland areas and were built up along the coast in shallow tidewater. Lomalta soils are slightly salty to strongly salty. On them is a dense growth of salt- and water-tolerant plants that include cordgrass, sanddune paspalum, vine-mesquite, and bushy sea oxeye.

Profile of Lomalta clay (1 mile west of the Missouri-Pacific Railroad bridge and one-fourth mile south of the Nueces River, along a graded road north of Up River Road near Annaville):

A1—0 to 20 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) when moist; moderate, very fine, granular and subangular blocky structure; very hard when dry, firm to friable when moist, plastic and sticky when wet; a few hard concretions; moderately calcareous; moderately saline; gradual boundary.

AC—20 to 38 inches, dark-gray (N 4/0) clay, very dark gray (N 3/0) when moist; weak, granular structure; extremely hard when dry, firm when moist, plastic and sticky when wet; a few hard concretions; moderately calcareous; moderately saline; gradual boundary.

C—38 to 60 inches, gray (N 5/0) clay, dark gray (N 4/0) when moist; massive (structureless); extremely hard when dry, very firm when moist, plastic and sticky when wet; a few concretions of calcium carbonate; strongly calcareous; strongly saline.

In most places the surface layer is a dark-gray clay, but in some places it is lighter colored and coarser textured. It ranges from slightly saline to strongly saline but is dominantly moderately saline. Subsoil layers range from moderately saline to strongly saline. They are gleyed in some places.

The Lomalta soils are nearly level. Their surface is slightly undulating in some places and is fairly smooth in others. They are deltaic near the mouth of streams or near embayed shorelines. Drainage from the surface is very slow or ponded. Internal drainage is slow in the surface layer and very slow beneath it. At times, the water table in these marshy soils is only 2 to 6 feet from the surface. The soils are subject to flooding by streams and high tides, for they are less than 5 feet above sea level.

A saline solum and a permanently high water table distinguish the Lomalta soils from the Trinity soils. The Trinity soils are strongly calcareous. Unlike the Banquete soils, Lomalta soils are saline and calcareous and are likely to be flooded by salt water at high tide. Compared to Orelia-slickspot complex, which lies 10 or more feet above sea level, Lomalta soils are less well drained and have, less distinct, and more clayey horizons.

The Lomalta soils in this county do not have a large total acreage. They are in moderately large and small areas near the mouth of streams and near inland approaches of bays along the coast.

Miguel series.—The Miguel series consists of grayish, noncalcareous soils that contain a mottled claypan. These soils developed on uplands from deep beds of sandy clays. In this county Miguel soils developed in materials weathered from the Lissie geologic formation and from other similar material. The vegetation consists mainly of mesquite trees and of seacoast bluestem, brownseed paspalum, red lovegrass, and other grasses.

Profile of Miguel fine sandy loam (5 miles west of Bluntzer and one-fourth mile north of Farm Road 624, in a cultivated field west of a graded road):

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 6.0; clear boundary.

A1—5 to 10 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) when moist; weak, granular structure; slightly hard when dry, friable when moist; noncalcareous; pH 6.0; abrupt boundary.

B21t—10 to 22 inches, dark grayish-brown (10YR 4/2) sandy clay, very dark grayish brown (10YR 3/2) when moist; few, fine, distinct mottles of red (2.5YR 4/6) and many, medium, faint mottles of yellowish brown (10YR 5/6); moderate, medium, blocky structure; very hard when dry, firm when moist, plastic when wet; noncalcareous; pH 6.5; gradual boundary.

B22t—22 to 30 inches, gray (10YR 5/1) sandy clay, dark gray (10YR 1/1) when moist; common, medium, faint mottles of pale brown (10YR 6/3); weak, blocky structure; very hard when dry, firm when moist, plastic when wet; noncalcareous; pH 7.0; gradual boundary.

Cca—30 to 55 inches, very pale brown (10YR 7/4) sandy clay loam, light yellowish brown (10YR 6/4) when moist; strong, coarse, blocky structure; very hard when dry, very firm when moist; many soft lumps and fragments of calcium carbonate; strongly calcareous; gradual boundary.

In this county both Miguel fine sandy loam and Miguel loamy fine sand have been mapped. When dry, the surface layer is generally dark grayish brown (10YR (1/2) in the fine sandy loam and grayish brown (10YR 5/2) in the loamy fine sand, but these colors may be 1 value and 1 chroma lower in places. The surface layer of the fine sandy loam ranges from 8 to 18 inches in thickness but is dominantly about 10 inches thick. That of the loamy fine sand ranges from 12 to 30 inches in thickness. If the surface layer is 15 inches or more thick, an A2 horizon occurs in the fine sandy loam and the loamy fine sand, but this layer is not distinct.

Miguel soils that have a thin surface soil commonly are slightly finer textured in the lower part of the A horizon than in the upper part. The B2t horizon ranges from dark gray to gray or to pale brown in color. Mottles range from fine to coarse and from faint to prominent. At a depth of 45 inches or more, both the fine, sandy loam and the loamy fine sand are underlain, in some places, by coarse-textured, friable material.

Internal drainage is very slow in Miguel soils because the subsoil is dense and clayey. Nearly level areas normally are smooth in the fine sandy loam but are weakly undulating in the loamy fine sand. In these areas surface runoff is slow but it is medium to rapid in the more sloping areas. The gently sloping and moderately sloping soils are weakly dissected and are on slightly convex ridges and in widely spaced, shallow, concave drains.

Miguel soils are normally less saline and less crusty than Orelia in soils and have a browner (higher in chroma), mottled, slightly more clayey subsoil. Compared to the Nueces soils, Miguel loamy fine sand has a darker (lower in value), less thick, less sandy surface layer. It also has less acid B2 layers and distinct accumulations of calcium carbonate.

Miguel soils are not extensive in this county. They occupy a few fairly large areas, many small areas in the northern part, and a few small areas widely scattered in other parts.

Mustang series.—The Mustang series consists of loose, noncalcareous, wet, sandy Regosols. These soils formed along the gulf in sands that were deposited by waves, shifted by winds, and smoothed by high tides. Growing on them are fairly dense stands of salt-tolerant and moisture-loving cordgrasses, paspalums, sedges, and other plants.

Profile of Mustang fine sand (1 mile northeast of beach access road No. 2 on Mustang Island, in a pasture on the west side of the hard-surfaced road):

A1—0 to 6 inches, light-gray (10YR 7/2) line sand, light brownish gray (10YR 6/2) when moist; structureless; loose when dry or moist; noncalcareous; pH 8.0; gradual boundary, 3 to 8 inches thick.

C1g—6 to 30 inches, white (10YR 8/2) fine sand, light gray (10YR 7/2) when moist; few, fine, faint mottles of yellowish brown (10YR 5/4); structureless; loose when dry or moist; water table at 30 inches; noncalcareous; pH 8.0; gradual boundary, 18 to 30 inches thick.

C2g—30 to 50 inches, light-gray (10YR 7/2) fine sand, light gray (10YR 7/2) when moist; common, medium, distinct mottles of yellowish brown (10YR 5/6); structureless; loose when dry or moist; noncalcareous; pH 8.0.

The surface layer ranges from light brownish gray to white. Depending on the degree of internal drainage, mottles vary from place to place in abundance, size, and contrast. Mucklike material and gray and dark-gray layers ranging from loamy fine sand to sandy clay loam occur at varying depths in some places. The depth to the water table varies between 0 and 40 inches.

Mustang soils have a smooth to slightly undulating surface. Although these soils are less than 5 feet above sea level, they are not subject to flooding by normal tides. They are, however, flooded occasionally when the adjoining lagoons and bays are filled during storms, and the soil surface is generally covered at very high tides. Surface and internal drainage are normally slow. The soils are perennially moist because the water table is near the surface. Water is ponded in the slightly concave areas after heavy rains.

Mustang soils are smoother than the higher lying, hummocky Galveston soils and are less well drained and more saline. They are thicker, more uniformly textured, and less saline than Tidal flats. Mustang soils are less well drained than Nueces soils and do not have a distinct B2 horizon. The faint A1 horizon distinguishes Mustang soils from Coastal beach. This horizon forms because Mustang soils are not exposed to severe lashing by waves and, consequently, are protected from being washed and rewashed. They normally lie on the leeward side of Coastal dunes or other higher lying bodies of soil.

In this county the total acreage of Mustang soils is small, but on Mustang Island between Coastal dunes and Tidal flats, there is a large area in a strip 1 to 3 miles wide. This strip extends from northeast to southwest for several miles through the center of the island. A few small areas occur on the other islands. On the shore of the mainland, small areas of Mustang soils are intermingled with Galveston soils in an undifferentiated soil group.

Nueces series.—In the Nueces series are light-colored, dry Regosols that formed on loamy Paleosols in the southern part of Texas. The Nueces soils in this county were derived from eolian sands of an old barrier island and from sediments in ancient lagoons and bays. These sands are not more than 5 feet thick and are underlain by buried sandy clay loams. Horizons in the Nueces soils are weak.

Scattered mesquite trees and grasses make up the present vegetation. Among the grasses are seacoast bluestem, brownseed paspalum, fringeleaf paspalum, signalgrass, and red lovegrass.

Profile of Nueces fine sand (1 mile west of Waldron Field, in a formerly cultivated field one-half mile north of a hard-surfaced road and west of a graded road):

A1—0 to 13 inches, light brownish-gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) when moist; structureless; loose when dry, very friable when moist; pH 6.5; gradual boundary.

A2—13 to 36 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) when moist; structureless; loose when dry or moist; pH 5.7; abrupt boundary.

IIB2—36 to 48 inches, light-gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) when moist; common, distinct, coarse mottles of yellowish brown (10YR 5/6); moderate, coarse, columnar structure; grayish-brown coatings on vertical surfaces; extremely hard when dry, friable when moist; many fine root channels in upper part of columns, few below; pH 7.5.

IIC—48 to 60 inches, light-gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) when moist; few, medium, faint, yellow mottles; weak structure; extremely hard when dry, firm when moist; noncalcareous; pH 8.0.

The surface layer ranges from 1 to 4 feet in thickness but is dominantly about 30 inches thick. Although it ranges from brownish gray to light gray, it is light gray in most places. Where the surface layer is thickest, the IIB2 horizon is lighter in color and the mottles are more prominent and of higher chroma. Structure in the IIB2 layer ranges from weak to strong and from columnar to prismatic or blocky.

Nueces soils that have a surface layer less than 30 inches thick are dominantly smooth; the soils with thicker surface layers are undulating and are marked by a few low hummocks. Nueces soils are normally nearly level, but in a few places they are gently sloping. Surface drainage is slow. Internal drainage is slow to moderate because the subsoil is dense. Runoff is medium where the surface layer is less than 15 inches thick. Water ponds in some of the widely scattered, slight depressions.

The surface layer of Nueces soils is thicker, coarser, and lighter colored than that of Miguel soils. Color is of higher value and lower chroma. Their subsoil is also lighter colored, and it is less alkaline. It does not contain the horizon of calcium carbonate that occurs in the Miguel soils. Nueces soils are distinguished from the Galveston soils by a thinner surface layer and a drier, more loamy subsoil.

Nueces soils are not extensive in this county. They occupy a few fairly large areas near the coast and are only in the southern part. They make up a. transitional strip between the thick sands of an old barrier beach and the finer textured soils that developed in an ancient lagoon.

Orelia series.—Soils of the Orelia series are dark-gray Planosols. These soils developed in the southern part of Texas from calcareous sandy clays under a cover of grass. The native vegetation consists of fourflower trichloris, plains bristlegrass, pink pappusgrass, curly-mesquite, and recent invasions of mesquite trees and pricklypear.

Profile of Orelia fine sandy loam (near the intersection of Farm Road 24 and State Route 9, in the north-central part of the county, in a cultivated field southwest of the intersection):

Ap—0 to 6 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) when moist; weak, granular structure; extremely hard when dry, friable when moist; noncalcareous; pH 6.5; abrupt boundary.

B2t—6 to 18 inches, dark-gray (10YR 4/1) heavy sandy clay loam, very dark gray (10YR 3/1) when moist; strong, medium, blocky structure; clay films on ped surfaces; extremely hard when dry, firm when moist; very few, fine pores; roots mainly between peds; noncalcareous; pH 7.5; gradual boundary.

B3—18 to 40 inches, gray (10YR 5/1) sandy clay loam, dark gray (10YR 4/1) when moist; moderate to strong, medium, blocky structure; distinct clay films; very hard when dry, friable when moist; strongly calcareous in lower part; a few soft lumps of calcium carbonate increase with depth; gradual boundary.

Cca—40 to 62 inches, light-gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) when moist; weak structure; hard when dry, friable when moist; moderately calcareous; few lumps of calcium carbonate.

In Nueces County 90 percent of the acreage in Orelia soils is fine sandy loam and 10 percent is clay loam. A small saline area of Orelia soils is mapped as Orelia-slickspot complex. The surface layer of Orelia soils is chiefly dark gray, but it ranges from gray to dark gray in both soil types. In most places, however, the B2t horizon is dark gray in the clay loam and is dark grayish brown in the line sandy loam. Near the coast the Orelia soils are more sodic and crusty than they are in the western part of the county. The subsoil layers range from sandy clay to sandy clay loam in texture. They are hard and have very slow internal drainage, partly because the subsoil contains sodium and partly because it is dense.

Slopes of Orelia soils are dominantly about 0.5 percent, and they exceed 1 percent in only a few places. In a few almost flat areas, surface drainage is very slow. Internal drainage is adequate for seasonal cultivation. Orelia clay loam in this county normally occupies drainageways on slopes of about 0.5 percent. Surface drainage is slow in these areas, but the soil is flooded only while water passes over it, unless natural drainage is obstructed in some way. Use is limited, however, by the likelihood of extended floods.

The Orelia soils occur mainly with the Banquete soils but have more loamy and more rapidly drained surface layers and more distinctly developed genetic horizons. Orelia soils are less crumbly, are more sodic and have poorer internal drainage than the Clareville soils.

Orelia soils have a fairly large total acreage in this county. They occur in a few moderately large and many small areas, mainly in ancient bays, lagoons, and drainageways.

Point Isabel series.—Soils of the Point Isabel series are Regosols. They are on stable clay dunes and eroded knolls along the wave-cut shoreline. The soil layers are thin over the parent material. They consist of saline, eolian, and coastal terrace material that is calcareous and has been only slightly modified.

Point Isabel soils occur with the Lomalta soils and, along the coast, are normally surrounded by occasionally flooded Tidal flats. The native vegetation consists of small mesquite trees, granjeno, Spanish dagger, lotebush, curly mesquite, buffalograss, bristlegrasses, and in some areas, cordgrasses and pickleweed.

Profile of Point Isabel clay (0.5 mile northeast of Calallen, on a large knoll in pasture):

A1—0 to 6 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; strong, fine and very fine, subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; weakly calcareous; slightly saline; gradual boundary.

AC—6 to 14 inches, light brownish-gray (10YR 6/2) clay, grayish brown (10YR 5/2) when moist; moderate, fine and very fine, irregular blocky structure; hard when dry, firm when moist, plastic and sticky when wet; few, fine pores and roots; a few soft lumps of calcium carbonate; strongly calcareous; moderately to strongly saline; gradual boundary.

C—14 to 60 inches, gray (10YR 6/1) sandy clay; grayish brown (10YR 5/2) when moist; erratic, thin bands of clay loam and sandy clay loam in lower part; weak, apparently subangular blocky and granular structure; slightly hard when dry, friable when moist; strongly calcareous; saline.

The surface layer is dominantly clay, but in scattered areas there are thin sandy and loamy layers where material has been caught by plants. The surface is dominantly smooth and slightly eroded, but in a few places the soil has slipped and is bare. Salinity ranges from slight to moderate in the surface soil and from moderate to strong in the subsoil.

Slopes are convex and dominantly gentle. Internal drainage is very slow, and runoff is medium to rapid. Point Isabel soils occur closely with the Lomalta soils but are lighter colored and better drained in the surface layer and subsoil. They are more clayey and have less distinct horizons than the Orelia soils. The surface of the Point Isabel soils is convex, but that of the Banquete soils is concave.

Point Isabel soils are in better drained areas than Banquete soils and have a lighter colored surface layer and a lighter colored, less modified subsoil.

The Point Isabel soils have a small total acreage in this county. They occur as scattered mounds and are intermingled with high Tidal flats in the deltaic approaches of small coastal bays. On the lowlands west of Nueces Bay, Point Isabel soils occupy knolls that are generally more than 5 feet above sea level.

Trinity series.—The Trinity series consists of dark-gray to black, calcareous Alluvial soils. The subsoil is clay. In this county Trinity soils developed from fine, calcareous alluvial sediments that were deposited in slack-water areas along the Nueces River. This river and its tributaries originate in Edwards limestone and drain an area of dominantly calcareous soils.

The native vegetation consists of hackberry, elm, and ash, of retama, huisache, and spiny aster, and of hairy seed paspalum, switchgrass, bristlegrass, trichloris, and other grasses.

Profile of Trinity clay (4 miles northwest of Bluntzer, at a point three-fourths mile northeast of the paved county road and about 600 feet west of the Nueces River):

A11—0 to 18 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) when moist; moderate, fine, subangular blocky structure; very hard when dry, very firm when moist, very sticky and plastic when wet; strongly calcareous; diffuse boundary.

A12—18 to 60 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; weak, irregular blocky structure; very firm when moist; a few very fine concretions of calcium carbonate at a depth between 38 and 40 inches; strongly calcareous.

The A11 horizon ranges from dark gray to very dark gray, and the A12, from dark gray to gray. The soil is normally calcareous but ranges from noncalcareous to strongly calcareous.

The Trinity soils occupy weakly depressional, slack-water areas in and along channels that are filled with water at flood stage. They are also in nearly level, fairly smooth areas that are flooded occasionally. The lower soils lie some distance from the main channel of the Nueces River and are frequently flooded by the river at flood stage and by runoff from the adjoining uplands. About 80 percent of the acreage is flooded by the river two or three times in a period of 5 years. On the higher lying soils, flooding lasts from a few hours to several days, but on the lower lying soils, it lasts for several weeks or months. Internal drainage of the Trinity soils is slow.

The Wesley-Seale Dam, which impounds floodwaters of the Nueces River, is about 5 miles upstream from the northwestern edge of the county. Except when the water in the lake is high at a time when rains occur upstream, this dam reduces the frequency and duration of small floods.

In this county the Trinity soils are similar to the Victoria soils on the coastal terrace. They were, however, more recently formed and are subject to more frequent and intense flooding than the Victoria soils. Furthermore, Trinity soils do not crack so deeply as the Victoria soils, have weaker structure in the subsoil, and are slightly harder. Although the Trinity, Frio, and Zavala soils are all Alluvial, Trinity soils are less loamy and less rapidly drained than the Frio soils. They are finer textured than the Zavala soils and, in contrast to those soils, are strongly calcareous instead of noncalcareous.

The Trinity soils in this county occur mainly on the flood plain of the Nueces River. They occupy a larger acreage than the other Alluvial soils but make up less than 2 percent of the total acreage in the county.

Victoria series.—The Victoria series consists of dark-gray to nearly black, moderately crumbly, calcareous Grumusols. These soils developed under grass from calcareous clays. They are on nearly level coastal terraces of the Rio Grande Plain. Their native vegetation consists of fourflower trichloris, plains bristlegrass, pink pappusgrass, curly-mesquite, and invading small mesquite trees, pricklypear, and other thorny shrubs.

Profile of Victoria clay (about 4 miles south of Banquete, at a point 500 feet south of Pintas Creek and 0.3 mile southeast of the bridge):

Ap—0 to 6 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; moderate, fine, subangular blocky structure and very fine, granular structure; very hard when dry, very plastic when wet; strongly calcareous; abrupt boundary.

A1—6 to 36 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; moderate, fine, subangular blocky structure and moderate, fine, irregular blocky structure; very hard when dry, very firm when moist, very plastic when wet; peds have glossy surfaces; good root distribution; strongly calcareous; diffuse boundary.

AC—36 to 50 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; pocket and seams (formerly cracks) filled with dark-gray clay from surface layer; moderate, medium and fine, subangular structure and irregular blocky structure; very hard when dry, very firm when moist, plastic and sticky when wet; strongly calcareous; gradual boundary.

C—50 to 65 inches, very pale brown (10YR 7/3) clay, pale brown (10YR 6/3) when moist: vertical seams filled with gray material from layers above; weak structure, apparently fine and very fine, subangular blocky and very fine, granular; extremely hard when dry, very firm when moist, plastic and sticky when wet; strongly calcareous; a few fine concretions of calcium carbonate.

The surface layer ranges from light clay to heavy clay in texture and, when dry, from gray (10YR 5/1) to very dark gray (10YR 3/1) in color. The A1 and AC layers are dominantly of moderate, medium and fine, subangular and irregular blocky structure, but in some places they are weak and almost massive (structureless). These soils are strongly calcareous on the micromounds and are noncalcareous on the surface of micropits, particularly in undisturbed rangeland. Typically, the microrelief in undisturbed areas consists of depressions that are 6 to 12 inches deep and 5 to 15 feet in diameter. The distance between the depressions ranges from 10 to 20 feet. Where the soils have been cultivated for a few years, the depressions are completely obliterated or are not readily visible.

More than 90 percent of the acreage in Victoria soils is nearly level and smooth; the rest is gently sloping to moderately sloping. Almost every year these soils crack deeply and take in water rapidly. Surface drainage is normally slow, and a few small areas are imperfectly drained. Internal drainage is slow if the soils are wet but is adequate for good plant growth and seasonal tillage.

Victoria soils are similar to the Trinity soils of the Alluvial great soil group that are on the flood plain of the Nueces River. They are, however, more crumbly in the subsoil and are not subject to such intense and frequent flooding. For short periods Victoria soils are subject to only shallow flooding from local rains. The calcareous Victoria soils are more crumbly than the noncalcareous Banquete soils, are better drained at the surface, and have more rapid internal drainage. The surface layer of Victoria soils is thicker and less loamy than that of the Clareville soils.

The Victoria soils make up more than 60 percent of the total acreage in this county. Areas are large on the coastal terraces.

Willacy series.—The Willacy series consists of Reddish Chestnut soils that developed from calcareous, sandy material of Quaternary deltaic or marine terraces. The native vegetation consists of fourflower trichloris, Arizona cottontop, sand dropseed, hooded windmillgrass, and invading mesquite trees, granjeno, and agarito.

Profile of Willacy fine sandy loam (near Riverside Country Club grounds, 5 miles north of Robstown, in a native pasture):

A1—0 to 16 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, subangular blocky and granular structure; slightly hard when dry, friable when moist; few medium pores and many fine pores; noncalcareous; pH 6.0; gradual boundary.

B21t—16 to 32 inches, dark grayish-brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) when moist; weak, prismatic and subangular blocky structure; hard when dry, friable when moist; many fine pores; noncalcareous; pH 7.2; gradual boundary.

B22t—32 to 40 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) when moist; weak, prismatic and subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 8.0; gradual boundary.

Cca—40 to 60 inches, very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) when moist; weak, subangular blocky and granular structure; slightly hard when dry, friable when moist; strongly calcareous; few, fine, soft concretions of calcium carbonate.

The surface layer is dominantly dark grayish brown, but the range is from dark gray to grayish brown. It is light or heavy fine sandy loam. The B2t horizons range from dark grayish brown to brown but are normally intermediate between these colors. Calcareous material occurs at a depth between 12 and 40 inches. The concretions of calcium carbonate in the Cca layer vary in abundance from none to many, but this layer is normally calcareous and contains only a few concretions. Willacy soils are nearly level to sloping. Their surface is generally slightly convex and weakly dissected in sloping areas. Internal drainage is moderate, and runoff is slow to medium.

Unlike the Hidalgo soils, Willacy soils contain noncalcareous layers at a depth of 12 to 40 inches. Also, modal Willacy soils are more leached in their surface layer and have more distinct horizons than the Hidalgo soils. The subsoil in Willacy soils is less reddish, less leached, and less clayey than that in the Miguel soils. Willacy soils are distinguished from the Clareville soils by a less clayey subsoil, less distinct horizons, and weaker, less blocky structure.

Willacy soils have a small total acreage in this county. Many small areas and a few moderately large ones are mainly in the southwestern and northern parts of the county.

Zavala series.—In the Zavala series are well-drained, grayish-brown, noncalcareous Alluvial soils that have a moderately sandy subsoil. These soils occur on the Rio Grande Plain in sandy alluvium that washed from the Duval, Webb, Nueces, Miguel, and other soils. Duval and Webb soils are not mapped in Nueces County. The native vegetation consists of fourflower trichloris, bristlegrass, switchgrass, and huisache trees.

Profile of Zavala fine sandy loam (near Bluntzer and west of Farm Road 666, in a cultivated field on the flood plain of the Nueces River):

A1—0 to 30 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) when moist; weak, granular structure; slightly hard when dry, very friable when moist; many fine pores and a few medium pores; noncalcareous; pH 6.0; diffuse boundary, 12 to 30 inches thick.

AC—30 to 60 inches, gray (10YR 5/1) heavy fine sandy loam, dark gray (10YR 4/1) when moist; weak structure; slightly hard when dry, friable when moist; noncalcareous; pH 7.5.

This soil is fine sandy loam in most places, but it ranges from light fine sandy loam to loam. The subsoil ranges from light sandy clay loam to loamy fine sand. In about 25 percent of the acreage, layers of loamy fine sand occur at a depth of 2 feet or more. In most places a few, small, rounded pebbles ranging from $^1/_8$ to $^1/_4$ inch in size are scattered throughout the profile.

Zavala soils have a smooth to gently undulating, nearly level surface. Runoff is slow, and internal drainage is moderate. Most areas of these soils are occasionally flooded, but a few knolls are seldom flooded.

In contrast to the Frio soils, which are clayey and strongly calcareous in the subsoil, Zavala soils are moderately sandy and noncalcareous. Zavala soils do not contain distinct genetic horizons like those in the Willacy soils. Furthermore, their surface layer, in most places, is only slightly darkened by organic matter. Zavala soils are less sandy than the Miguel and Nueces soils and, unlike those soils, lack a B2 horizon. Zavala soils are less sandy and darker colored (lower in value) than the Galveston and the wet Mustang soils.

Zavala soils have a small total acreage in this county. They occupy a few moderately large areas on natural levees along the Nueces River in the northwestern part.

Mechanical and Chemical Analyses

In table 8 are data obtained by mechanical and chemical analyses of three soils in Nueces County. Profiles of these soils are described, beginning on page 61. Soil scientists can use the data in table 8 to assist them in classifying soils and in developing concepts of soil genesis. These data are also helpful in estimating water-holding capacity, wind erosion, fertility, tilth, and other characteristics that affect soil management. The data on reaction, electrical conductivity, and percentage of exchangeable sodium are helpful in evaluating the possibility of reclaiming and managing saline-alkali areas.

Field and laboratory methods

All samples used to obtain the data in table 8 were collected from carefully selected pits. These samples are considered representative of the soil material that is made up of particles less than $^{3}/_{4}$ inch in diameter. Estimates of the fraction of the sample consisting of particles larger than $^{3}/_{4}$ inch were made during the sampling. If necessary, the sample was sieved after it was dried, and rock fragments larger than $^{3}/_{4}$ inch in diameter were discarded. Then the material made up of particles less than $^{3}/_{4}$ inch in diameter was rolled, crushed, and sieved by hand to remove rock fragments larger than 2 millimeters in diameter. The fraction that consists of particles between 2 millimeters and $^{3}/_{4}$ inch in diameter is shown in table 8 as the percentage of coarse fragments greater than 2 millimeters in diameter. This value is calculated from the total weight of the particles smaller than $^{3}/_{4}$ inch in diameter.

The content given for the fractions that consist of particles larger than $^{3}/_{4}$ inch and of particles between 2 millimeters and $^{3}/_{4}$ inch is somewhat arbitrary. The accuracy of the data depends on the severity of the preparative treatment, which may vary with the objectives of the study. But it can be said that the two fractions contain relatively unaltered rock fragments that are larger than 2 millimeters in diameter, and that they do not contain slakeable clods of earthy material.

Unless otherwise noted, all of the chemical analyses shown in the last half of table 8 were made on oven-dry material that passed the 2-millimeter sieve. The values for exchangeable sodium and potassium are for amounts of sodium and potassium that have been extracted by the ammonium acetate method minus the amounts that are soluble in the saturation extract.

Standard methods of the Soil Survey Laboratory were used to obtain most of the data in table 8. Determinations of clay were made by the pipette method (*3, 4, 5*). The reaction of a 1:1 water suspension was measured with a glass electrode. Organic carbon was determined by wet combustion, using a modification of the Walkley-Black method (*6*). The calcium carbonate equivalent was determined by measuring the volume of carbon dioxide emitted from soil samples treated with concentrated hydrochloric acid. The cation exchange capacity was determined by direct distillation of absorbed ammonia (*6*). To determine the extractable calcium and magnesium, calcium was separated as calcium oxalate and magnesium as magnesium ammonium phosphate (*6*). Extractable sodium and potassium were determined on original extracts with a flame spectrophotometer. The methods of the U.S. Salinity Laboratory were used to obtain the saturation extract (*7*). Soluble sodium and potassium were determined on the saturation extract with a flame spectrophotometer.

Profiles of soils analyzed

The profiles of the soils listed in table 8 are described in the following pages.

CLAREVILLE SANDY CLAY LOAM, S-56-Tex-125-1-(1-8)

The profile described is west of the county in a field 1.6 miles south of Orange Grove on State Route 359 and 100 yards east of a county road. When sampled, this soil was almost dry through the B2 horizon and was only slightly moist in the horizons below. It has slopes of about 1 percent and lies along the interior margin of a broad coastal terrace.

Profile description:

Ap—0 to 5 inches, very dark gray (10YR 3/1) sandy clay loam, black (10YR 2/1) when moist; weak, granular structure; crumbly and friable when moist, hard when dry; very thin, light-gray, weak, platy crust on surface when dry; pH 7.5.

A1—5 to 11 inches, very dark gray (10YR 3/1) sandy clay loam, black (10YR 2/1) when moist; compound structure—weak, subangular blocky and moderate, fine, granular; crumbly and friable when moist, moderately sticky and plastic when wet; few fine pores; noncalcareous; but pH is 8.0; clear boundary.

B1—11 to 18 inches, sandy clay loam that is very dark gray (10YR 3/1) when dry; crushed peds black (10YR 2/1.5) when moist; compound structure—moderate, fine, subangular blocky and weak, granular; friable when moist; when dry, the soil is easily crumbled to a mass of very hard, fine peds; many fine and few very fine pores; thin, patchy clay skins on the larger peds; noncalcareous, but pH is 8.0; clear boundary.

B21t—18 to 25 inches, dark grayish-brown (10YR 4/2) heavy sandy clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine and medium, prismatic and moderate, medium, blocky structure; moderately friable when moist, very hard when dry; distinct, patchy (not continuous) clay skins on horizontal and vertical faces of peds; many fine pores; weakly calcareous; contains about 3 percent by volume of brown spots that appear to be the remains of insect casts; clear boundary.

B22t—25 to 33 inches, grayish-brown (10YR 5/2.5) clay loam, dark grayish brown (10YR 4/2.5) when moist; structure and consistence similar to those in B21t horizon, but clay skins more distinct; many fine pores; weakly calcareous; few soft lumps and hard concretions of calcium carbonate as much as 4 millimeters in diameter; clear boundary.

B3ca—33 to 38 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; structure similar to that in B21t horizon but weaker; moderately friable when moist; calcareous; contains about 5 percent by volume of soft lumps and hard concretions of calcium carbonate; many nests of worm casts as much as 5 millimeters in diameter; grades abruptly to horizon below.

Cca1—38 to 47 inches, clay loam that is mottled gray (10YR 5/1) and grayish brown (10YR 5/2) when dry; strongly calcareous; friable when moist, very hard when dry; contains about 30 percent or more by volume of calcium carbonate in soft lumps as much as 1 inch in diameter; many nests of worm casts.

Cca2—47 to 59 inches, very pale brown (10YR 8/3 and 7/3) fine material that appears to be mainly soft calcium carbonate; about 30 percent by volume made up of small nests of grayish-brown worm casts.

ORELIA SANDY CLAY LOAM, S-56-Tex-205-2-(1-8)

The profile described is 6.4 miles southwest of Sinton, in San Patricio County, at a point 0.45 mile west and 250 feet south of intersection of U.S. Highway No. 77 and Farm Road 630; site is in a cultivated field on the C. B. Ellis farm. When sampled, this soil was dry through the B3 horizon and was only slightly moist in the horizons below. It has slopes of less than 0.5 percent and is on a nearly level coastal terrace.

Profile description:

Ap—0 to 6 inches, dark-gray (10YR 4/1) light sandy clay loam, very dark gray (10YR 3/1) when moist; light-gray, weak, platy crust, 3 millimeters thick, on surface; moderate, medium, granular structure extends to a depth of ½ inch, very weak, granular structure to massive (structureless) below; friable when moist, very hard when dry; pH 6.0; abrupt, smooth boundary.

B21t—6 to 12 inches, very dark gray (10YR 3.5/1 and 2.5/1) sandy clay loam; weak, blocky structure; firm when moist, extremely hard when dry, plastic when wet; few fine pores; few small, dark, shotlike concretions, probably of ferromanganese; pH 6.5; clear, smooth boundary.

B22t—12 to 19 inches, sandy clay loam that is very dark gray (10YR 3.5/1) when dry; moderate, medium and coarse, blocky structure; thin, patchy clay skins; few fine pores; very firm when moist, extremely hard when dry; noncalcareous, but pH is 8.0; clear, smooth boundary.

B31ca—19 to 26 inches, dark-gray (10YR 4.5/2 and 3.5/2) sandy clay loam; moderate, medium, blocky structure; thin, patchy clay skins; few fine pores; very firm when moist, extremely hard when dry; weakly calcareous; calcium carbonate in soft and hard lumps, as much as 8 millimeters in diameter, make up about 5 percent of volume; clear, smooth boundary.

B32ca—26 to 37 inches, sandy clay loam that is coarsely mottled light gray (10YR 6/1) and gray (10YR 5/1) when dry; moderate, medium, blocky structure; few, thin, patchy clay skins; very few fine pores; firm when dry; calcareous; soft and hard concretions of calcium carbonate make up about 3 percent of volume; gradual boundary.

C1—37 to 43 inches, sandy clay loam that is mottled light gray (10YR 7/2) and grayish brown (10YR 5.5/2) when dry; weak, blocky structure; firm when moist, very hard when dry; calcareous; soft lumps and hard concretions of calcium carbonate make up about 5 percent of volume; few nests of insect casts; gradual boundary.

C21—43 to 55 inches, sandy clay loam that is light brownish gray (2.5Y 6/2) when dry or moist; apparently massive (structureless); friable when moist, hard when dry; calcareous; soft lumps of calcium carbonate, as much as 1 ½ inches in diameter, make up about 10 percent of volume; few nests of insect casts; gradual boundary.

C22—55 to 64 inches +, similar to C21 horizon; material extends to a depth of 9 feet or more.

VICTORIA CLAY, S-56-Tex-178-3-(1-8)

To reach the profile described, start at the railroad intersection in Robstown and travel west for 5.5 miles on the road along the north side of the Texas-Mexican Railway; then go 1.9 miles south and 0.4 mile east; then travel 0.5 mile south. Soil is in a field. When sampled, this soil was dry through the A horizon and only slightly moist in the horizons below. The sample was obtained from a nearly level coastal terrace, thousands of acres in size.

Profile description:

Ap—0 to 5 inches, very dark gray (10YR 3/1) clay, very dark gray (10YR 2.5/1) when moist; moderate, fine, granular structure; moist material easily crumbled to fine aggregates; on drying after being wet, soil naturally separates to very hard, fine aggregates; very sticky and plastic when wet; strongly calcareous.

A11—5 to 12 inches, clay that is very dark gray (10YR 3/1) when dry; weak, irregular, blocky structure in upper 2 inches and moderate to strong, fine and very fine, blocky structure below; extremely firm when moist, extremely hard when dry; few to common, fine and very fine pores; strongly calcareous.

A12—12 to 19 inches, clay that is very dark gray (10YR 3/1) when dry; strong, fine and very fine, irregular blocky structure; peds have glossy surfaces when slightly moist; extremely firm when moist, extremely hard when dry; few to common, fine and very fine pores; slickensides in lower part.

A13—19 to 29 inches, very dark gray (10YR 3.5/1) clay, very dark gray (10YR 3/1) when moist; compound structure—moderate, coarse, blocky and medium to fine, irregular blocky; extremely firm when moist, extremely hard when dry; few fine pores; distinct or pronounced slickensides.

AC1—29 to 38 inches, clay that is very dark gray (10YR 3.5/1) mottled with gray (10YR 5/1) when dry; mottles are common, fine and medium, and distinct; structure generally moderate, coarse, and blocky, but a few blocks are fine and irregular; extremely firm when moist, extremely hard when dry; few fine pores; strongly calcareous; pronounced slickensides; gradual boundary.

AC2—38 to 45 inches, clay that is finely mottled dark gray (10YR 4/1) and grayish brown (10YR 5/2) when dry; weak, blocky structure; extremely firm when moist, extremely hard when dry; few fine pores; strongly calcareous; calcium carbonate in a few soft lumps, as much as 6 millimeters in diameter; pronounced slickensides.

C1—45 to 53 inches, very pale brown (10YR 7/3) clay, pale brown (10YR 6/3) when moist; splotches and streaks of gray; apparently weak, blocky structure; firm when moist; strongly calcareous; few soft lumps of calcium carbonate; no apparent slickensides; diffuse boundary.

C2—53 to 65 inches, similar to C1 horizon, but 1 to 2 percent of volume is soft lumps of crystallized gypsum and a few nests of very dark gray worm casts.

Additional Facts About the County

This section discusses early settlement of the county, natural resources, transportation and markets, agriculture, and other subjects of general interest.

Early History, Development, and Population

The explorer Alonzo de Leon named the Nueces River for the Spanish word meaning pecan because he found many pecan trees growing at a place where he crossed the river. According to local tradition, de Pineda discovered and named Corpus Christi Bay on the day of the Feast of Corpus Christi in 1519. Corpus Christi is Latin for “Body of Christ.” Cabeza de Vaca possibly visited the bay in 1528, and La Salle, in 1683.

The first permanent residents of Nueces County were Spanish ranchers who brought their herds north from the Rio Grande. From time to time, the Indians drove the settlers back to the river. The first effort to settle the county failed in 1749, but before 1766 Blas Maria de la Garza successfully established Santa Petronila Ranch on Petronila Creek in what is now Nueces County. These early settlers brought in the forebears of the famous longhorn cattle. These cattle multiplied and were later used to stock the ranges of the Great Plains.

During the Mexican and Texas revolutions, settlements were abandoned, but many cattle and horses were left behind and increased in number. In 1837 and 1838, cowboys drove herds of these wild, unbranded cattle to cities in the interior, where they were sold.

The famous Texas Trail started at the southern tip of Texas and passed through Nueces County near Banquete. It ran along the site of present Farm Road 666, which crosses the Nueces River north of Bluntzer. At various times this route was called El Camino Real (King's Highway), the Matamoros Road, Taylor's Trail, and the Cotton Road. The road was used by armies and other men who made Texas history.

During the Mexican and Civil Wars, herds of cattle and horses roamed untended on the unfenced coastal prairies. By 1865, these animals were the main source of wealth in the war-ravaged Southwest. They were valued chiefly for their hides, bones, tallow, and horns, because transporting and preserving their meat was difficult. Hundreds of thousands of cattle and horses were driven to the coast where hide and tallow factories were established. These animals were slaughtered, and their flesh was left to rot in pastures or bays. The less perishable products were shipped to the north and east by boats. This period of waste was brought to an end by 1880, when the herds were depleted.

Corpus Christi originated from a ranch that H. L. Kinney established south of the Nueces River between 1836 and 1846. In that period Nuecestown was established a short distance upstream. Nueces County, which was created from San Patricio County in 1846, first extended from the Nueces River to the Rio Grande. It was reduced to its present size by the formation of Jim Wells County in 1911 and of Kleberg County in 1913. Many of the early settlers came from the Irish colony that was established at Old San Patricio, across the Nueces River and north of the present community of Bluntzer.

During the Civil War some minor skirmishes were fought around Corpus Christi, but the real impact of the war was felt when Matamoros, Mexico, near the mouth of the Rio Grande, became the “back door of the Confederacy” and the only outlet for the South's cotton crop.

After the channel in Corpus Christi Bay was deepened to 8 feet in 1874, the Morgan Line's first steamship came into port. Two years later the Texas Mexican Railway, then called the San Diego and Rio Grande, extended its track into Corpus Christi. With improved transportation came the first land boom and more people. The first cotton was shipped from the port in 1883.

According to the 1850 U.S. Census, the population in the vast area covered by Nueces County was 650 white people, 47 slaves, and 1 free colored person. The corn crop was listed as 7,150 bushels. In 1860, there were 175 inhabitants in Corpus Christi. The population in Nueces County was 10,955 in 1900 and was 21,955 in 1910. It doubled to 51,779 in the next 20 years and more than tripled to 165,471 by 1950. The 1960 census showed 221,573 inhabitants.

Almost 90 percent of the population in the county is urban, and about 10 percent is rural. Corpus Christi has a population of 167,690: Robstown, 10,266; Bishop, 3,722; Port Aransas, 824; and Agua Dulce, 867. The rest of the population is scattered throughout the county in about ten other farm communities and market centers that range in size from 25 to 670 people. About 25,000 people are classified as rural.

Natural Resources

Nueces County has a rare combination of natural resources. The large areas of deep, fertile, nearly level blackland are in a healthful climate that is subhumid, yet wet enough for moderately high agricultural production. In addition, the county is along coastal waters that provide a deepwater port for oceangoing vessels, valuable commercial fishing, and one of the major resort areas of the State. Valuable oil and gas fields operate in many parts of the mainland and in bays and other offshore waters.

The waters of Nueces and Corpus Christi Bays are within the county and amount to 115,840 surface acres. These waters are valuable for the recreation of tourists and local residents; for transportation: for commercial fishing; for natural gas, oil, and shells; for use in industrial cooling systems; and for disposal of industrial waste and other effluent.

Transportation and Markets

The Missouri Pacific Railroad and U.S. Highway No. 77 cross the central part of the county from north to south, and the Texas Mexican Railway and State Route 44 cross the county from east to west. State Route 9 enters the county at Calallen, crosses the northeastern part, and runs into Corpus Christi. Hard-surfaced, farm-to-market roads extend through all parts of the county and are maintained well. Most farms can be reached by hard-surfaced county roads in all kinds of weather. As soon as the crops are harvested in the fields, they are taken from the farms to the marketing centers. As cotton is harvested, it is loaded into large trailers that are pulled through the fields by tractors. These loads are taken directly to the gins and left there until the cotton is ginned and baled. The baled cotton is hauled by large trucks or by rail from the gins to the warehouses at marketing centers.

Grain sorghum is combined, loaded onto trucks in the field, and hauled to marketing centers, where it is dried and stored in elevators. These elevators are normally at various points along railways or at the Port of Corpus Christi.

Products are transported by water from the deepwater port at Corpus Christi to the Gulf of Mexico by way of the Corpus Christi Ship Channel and Aransas Pass. In Laguna Madre the Gulf Intracoastal Waterway has been excavated to a depth of 12 feet. This waterway extends from Brownsville, at the southernmost tip of Texas, through the lagoons and bays of Nueces County. It connects with the Mississippi River at New Orleans by an inland waterway system. The waterway handles barges as well as small fishing boats for commerce and sport.

The Industrial Channel and the Tule Lake Channel, which are west of the Turning Basin at Corpus Christi, extend along the southern shore of Nueces Bay for a distance of several miles. They provide transportation for plants that process and refine cement, chemicals, oil, and other products. La Quinta Channel is at the northern edge of Corpus Christi Bay and is used to transport aluminum products and ore to and from an aluminum refining plant in San Patricio County. The Encinal Channel is near the Naval Air Station. The Humble Channel is used mainly by oil companies to service oil wells in Laguna Madre south of the causeway.

Several other transportation companies use a network of pipelines, some of them 3 feet in diameter. These pipelines are used to transport to other areas gas and oil products that are processed locally. They are also used to bring in gas and oil for local processing or for shipping to other ports in the United States and to foreign ports. Many of the pipelines that cross the county extend from the southern tip of Texas to large cities in other parts of the United States.

Industry and Commerce

Corpus Christi, the county seat and largest city in Nueces County, is a seaport and is the industrial and commercial center of the group of counties in the area known as the Coastal Bend. The port provides water transportation for western and southern Texas as well as for the Republic of Mexico and the States on the Great Plains.

The Corpus Christi Ship Channel consists of the main harbor and three terminals, which are at Harbor Island, Ingleside, and La Quinta in San Patricio County. In 1959, this channel handled 23,872,412 tons of cargo. A total of 2,202 ships and barges, of which 868 were large oceangoing vessels, unloaded or took on cargo at the port. More than 300 of these ships and barges represented some 23 foreign countries.

Grain storage facilities at the port had a capacity of 4,250,000 bushels in 1959. During that year a total of 45,724,000 bushels of grain went to sea on 107 vessels (fig. 10). Exports of cotton amounted to 164,028 bales. Oil products totaled 127,506,536 barrels. About 3,590,919 tons of cargo was made up of metallic ores, mainly bauxite, coming in and of refined metals going out.

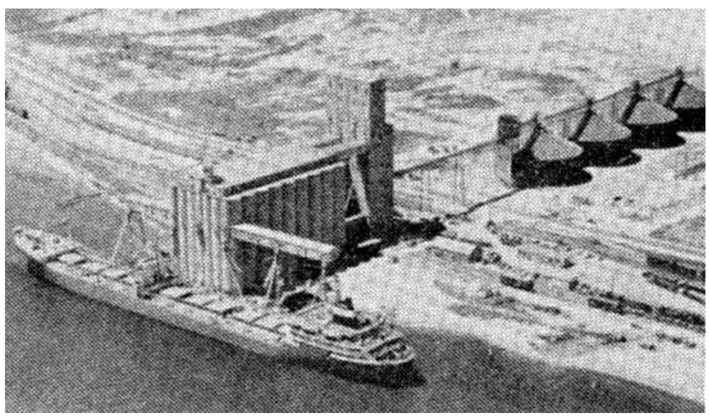

Figure 10.—Oceangoing vessel loading grain brought to the elevator by rail and motortruck. The soil shown here has been excavated from the harbor.

Among the other industries in the county are chemical plants, corn-products plants, recycling plants, and plants that process and refine petroleum. Some of these plants are scattered throughout the county, but most of them are in the vicinity of Corpus Christi.

Agriculture

Agriculture was not important in Nueces County until about 1868. At that time Capt. Mifflin Kenedy, a partner of Capt. Richard King, built fences to control his holdings and to improve his herds. Despite a severe drought in 1873, none of Capt. Kenedy's cattle died, and 5,000 prime head were ready for market by spring of that year. Thus, he demonstrated to others the advantages of controlled range.

Little land was cultivated until the railroads extended lines into the county about 1876. Corn for bread and for livestock feed, as well as hay for fodder, were grown on the loamy and sandy soils in the sloping areas south of Nueces Bay, in the vicinity of Nuecestown and of Annavilie, and west of Calallen, possibly as far as Bluntzer.

The heavy Victoria clay soils were harder to work with teams than the more loamy soils. Also, they were more droughty because their surface could not be mulched readily with the tools then available. Although yields of cotton were high on the heavy soils, less than 2,000 bales were ginned in 1900. Because World War I created a demand for more cotton and increased its market price, more of the blackland soils were planted to cotton. Later, tractors, improved steel plows, and other tools came into use, and tilling large areas of the nearly level, heavy soils was made easier.

The demand for cotton continued, and less and less of the acreage in the county was used to grow crops for home use and for livestock feed. Late in the 1920's, Nueces County led the State in the growing of cotton. In 1928, 270,000 acres of cotton yielded 80,700 bales. Although the average yield per acre in that year was only 143 pounds, the annual average over a period of years was about 225 pounds per acre. On a few thousand acres, cabbage, onions, beets, carrots, spinach, and other vegetables were grown for sale, and on about 20,000 acres, grain sorghum was grown, mainly as feed for livestock.

Much of the acreage in the county was shifted from cotton to other crops, mainly to grain sorghum, because foreign markets were lost and a serious depression began late in 1929. Tractor-drawn combines were introduced for harvesting sorghum, and varieties of sorghum that are better suited to mechanical harvesting were developed and improved.

The Conservation Needs Inventory reports that, in 1958, 73 percent of the acreage in this county was cropland, 13 percent was rangeland, and about 13 percent was in cities, towns, roads, and similar uses. About 1 percent was made up of farmsteads. The acreage reported as range included that on the offshore islands.

Crops

In table 9 are listed the acreages of the principal crops grown in this county in stated years between 1929 and 1959.

Livestock

As the acreage in cotton decreased during the 1930's, the number of cattle increased. Table 10 lists the number of livestock and poultry in the county between 1930 and 1959 as reported in the census of agriculture. The number of cattle reached a peak in 1940 but has since shown a downward trend, mainly because most of the soils in the county are better suited to cultivated crops than to grasses used for grazing. Land values are high in Nueces County, and on most farms, growing crops is more popular than raising livestock.

Size and number of farms

The average size of the farms in this county increased from about 192 acres in 1930 to about 573 acres in 1959, and this trend toward larger farms is continuing. In 1930, 344 farms ranged from 50 to 100 acres in size, but in 1959, only 75 farms were within this range. Between 1930 and 1959, the number of farms between 500 and 1,000 acres in size more than doubled and those 1,000 acres and larger almost quadrupled.

Farm tenure

Although more operators own their land today than they did 30 years ago, the percentage of absentee landowners is still fairly high. The large number of tenant-operated farms indicates that land values are high in the county. Of the 1,969 farms reported in the 1930 Census of Agriculture, 1,410 were operated by tenants, 530 by full or part owners, and 29 by managers. In 1960, there were 1,096 farms. Of these, 412 were operated by tenants, 671 were fully or partly owned, and 13 had managers.

Water Supply

Most of the ground water in Nueces County is too salty for irrigation and home use, but it can be used for watering livestock.

Lake Corpus Christi supplies water for domestic and some industrial uses to Corpus Christi and many other towns and communities. This lake is an artificial reservoir that contains water impounded by the Wesley-Seal Dam on the Nueces River. It is about 5 miles upstream from the northwestern corner of the county and at present has a storage capacity of about 305,000 acre-feet.

Most of the soils in the county are suited to irrigation, and a few acres have been irrigated for a number of years. Water suitable for this irrigation is available only when the Nueces River overflows and supplies more water than is needed for urban and industrial uses. During dry periods, water from the Nueces River cannot be counted on for agricultural uses.

Recreation

Each year many people visit the coast of the county for recreation. These visitors can fish, camp, and boat throughout the year because winters are mild and the sun shines much of the time. Beaches on Padre and Mustang Islands are excellent for surf fishing and swimming. Sports fishermen from the surrounding area and from other parts of the United States fish in the bays and lagoons, which abound in many kinds of fish. Sportsmen use motorboats along the Gulf Intracoastal Waterway and other channels to get to favorite fishing spots up and down the coast. The area is a natural wildlife refuge; more than 400 kinds of wildlife have been observed.

Waterfowl spend the winter along the coast of this county, and thousands of geese and ducks are shot every year by hunters in the shallow tidewaters.

Authorities on birds say that this area is a point where many migratory birds stop on their way north or south across the continent. Experienced birdwatchers report that they have counted more different kinds of birds here than in any other part of the United States. This area is the winter home of the almost extinct whooping cranes.

Glossary

Acidity. See Reaction, soil.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass, or cluster, such as a clod, crumb, block, or prism.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Barrier reef. A coral or sand reef roughly parallel to the shore but separated from it by a lagoon.

Buried soil. A developed soil that is overlain by a more recently formed soil. At one time the buried soil was exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium 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.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizons above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they could be shown separately only on a map of exceptionally large scale.

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 carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; soil will not hold together in a mass.

Friable.—When moist, soil crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, soil is readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky.—When wet, soil adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, soil is moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.**—**When dry, soil breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; soil is little affected by moistening.

Flat breaking, soil (flat furrow plowing). Plowing in such a way that the furrow slices are inverted and lie flat on the bottom of the adjacent furrow.

Granule. A single mass, or cluster, of many individual soil particles.

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.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms *for* expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Loam. The textural class name for soil having a moderate amount of sand, silt, and clay.

Morphology, soil. The makeup of the soil, including the texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properties of the various horizons of the soil profile.

Mottled. 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 drainage. Refers to the conditions 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 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 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 have mottling in the lower B and the C horizons.

Imperfectly or somewhat poorly drained soils are wet for significant periods but not all the time, and in podzolic soils commonly have mottlings below 6 to 16 inches in the lower A horizon and in the B and C horizons.

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.

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid,* and *very rapid.*

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 *(10):*

	pH		pH
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; or contains harmful salts and has a highly alkaline reaction; or contains harmful salts and exchangeable sodium and is strongly alkaline in reaction. The location in the profile of the salts, exchangeable sodium, and alkaline reaction is such that the growth of most crop plants is less than normal.

Saline soil. A soil that contains soluble salts in amounts that impair growth of crop plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Self-mulching soil. A soil that cracks deeply and becomes so granular at the surface as it dries that the granular mulch works into the cracks when rains begin. As the soil becomes moist it swells enough to force material upward between former cracks. The surface layer of a self-mulching soil may become so well aggregated that it does not crust and seal under the impact of rain.

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.

Sodic soil. A soil that contains sodium.

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 upon parent material, as conditioned by relief over periods of time.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the base 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 excessive exchangeable sodium, or alkali.

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 (1) *single grain* (each grain by itself, as in dune sand) or *(2) massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. In many soils, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil; the C or D horizon.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. Stream terraces are frequently called *second bott*oms, 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.

Topography. See Relief.

Undifferentiated soil group (mapping unit). Two or more soils or land types that are mapped as one unit because their differences are not significant to the purpose of the survey or to soil management.

Water-holding capacity. The difference between the amount of water in a soil at field capacity and the amount in the same soil at the permanent wilting point. Commonly expressed as inches of water per inch depth of soil.

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