Series 1960, No. 21

Issued February 1965

SOIL SURVEY
Jefferson 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 SOIL SURVEY of Jefferson County, Tex., will serve several groups of readers. It will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; aid foresters in managing woodlands; and add to our knowledge of soil science.

Locating Soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding Information

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

Farmers and ranchers and those who work with them can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of Soils." In this way, they first identify their soils and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units, Capability Units, Range Sites, and Woodland and Wildlife Suitability Groups" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county, and the page where each is described. It also lists, for each soil and land type, the capability unit, range site, and woodland and wildlife suitability groups, and the pages where each of these occur.

Foresters and others interested in woodlands can refer to the section "Management of Woodland." In that section the soils in the county are grouped according to their suitability for trees, and factors affecting the management of woodland are explained.

Engineers and builders will want to refer to the section "Engineering Interpretations of Soils." Tables in that section show characteristics of the soils that affect engineering.

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the section "Genesis, Classification, and Morphology of Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

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

* * * * *

Fieldwork for this survey was completed in 1960. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time. The soil survey of Jefferson County was made as part of the technical assistance furnished by the Soil Conservation Service to the Coastal and Trinity Bay Soil Conservation Districts.

Cover picture: Combining rice in Jefferson County, Tex.

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C., 20402

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SOIL SURVEY OF JEFFERSON COUNTY, TEXAS

BY JACK D. CROUT, DOUGLAS G. SYMMANK, AND GLENN A. PETERSON, SOIL CONSERVATION SERVICE

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

JEFFERSON COUNTY is in the extreme southeastern part of Texas. It is bordered by Hardin County on the north, Orange County and Cameron Parish, La., on the east, Chambers and Liberty Counties on the west, and the Gulf of Mexico on the south. The location of the county is shown in figure 1.

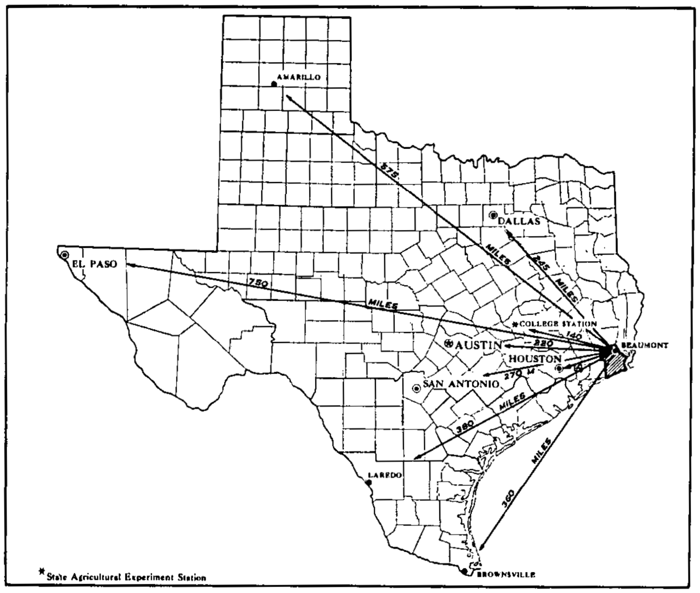

Figure 1.—Location of Jefferson County in Texas.

The county covers a total area of 1,006 square miles, or 643,840 acres. Beaumont, the county seat, is on the Neches River waterway, about 20 air miles from the Gulf of Mexico.

Although Jefferson County is best known as a highly industrialized area, agriculture still contributes materially to the economy. The most important commercial crop is rice. Other less important crops are corn and forage sorghums. Ranching and woodland production are also important to the economy of the county. Production of petroleum and petroleum products is a major industry.

How Soils Are Mapped and Classified

Soil scientists made this survey to learn what kinds of soils are in Jefferson 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 or bored 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. Acadia and Harris, 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 the 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. Harris clay is a soil type in the Harris series.

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 soil phases. The name of a soil phase indicates a feature that affects management. For example, Acadia silt loam, 1 to 5 percent slopes, is one of two phases of Acadia silt loam, a soil type that ranges from nearly level to gently sloping.

After a guide for classifying and naming the soils has 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 in 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 and call it a soil complex. Ordinarily, a soil complex is named for the major soil series in it, for example, Byars-Acadia complex. 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 Coastal land, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and 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

As one travels over a county or other large land area, it is fairly easy to see differences in the landscape from place to place. There are differences in the shape, steepness, and length of slopes, and in the depth, length, and speed of streams. Also, there are differences in vegetation. With these obvious differences, there are other, less easily noticed differences in the patterns of soils. The soils differ along with the other parts of the environment.

By drawing lines around the different patterns of soils on a small map of Jefferson County, one may obtain a general soil map. Such a map is useful to those who want a general idea of the soils in the county. It is useful for comparing one area with another and for locating large areas suitable for some particular kind of farming or other broad land use. It does not show accurately the kinds of soils on a single farm or small tract of land.

There are three general landscapes in Jefferson County: (1) East Texas timberlands, (2) coast prairie, and (3) coast marsh. These landscapes have been divided into seven general soil patterns, or soil associations. Each association is named for the major soils in it, but soils other than those named can be present also. The seven soil associations are described in the following pages and are shown on the colored map of the county in the back of this report.

The relative position of the major soils of the coast prairie and coast marsh is shown in figure 2; that of the major soils of the East Texas timberlands is shown in figure 3.

1. Bibb-Alluvial land association: Loamy soils of the flood plains, East Texas timberlands

This association occurs in the extreme northern part of the county on the low-lying flood plains of Pine Island Bayou and the Neches River. It occupies approximately 1 percent of the county.

Broad, flat areas of this association are occupied by the poorly drained and frequently flooded Bibb soils. A few narrow, well-drained sandy ridges are present, but they are not large enough to be shown on the general soil map. Part of the association, principally on Pine Island Bayou, consists of a series of small knolls and ridges bordered by short, choppy slopes and drainageways. The soils in this area are of such a mixture that they were mapped together as Alluvial land. Large, flat or depressed, thinly wooded areas that are covered with water most of the time are in this association. These permanently wet areas are mapped as Swamp.

There is no farming in this association. Many small tracts, 1 to 10 acres in size, are owned by individuals and are used for fishing and hunting camps. Most areas are used mainly for woodland, wildlife habitat, and recreation.

Some of the major problems are wetness, flooding, and accessibility.

2. Garner-Byars-Acadia association: Clayey and silty soils of the East Texas timberlands

This association occurs in the northern part of the county in a narrow band paralleling the soils of the flood plains (Bibb-Alluvial land association). It is also in an isolated area surrounded by coast prairie soils in the central part of the county near Fannett. The association is of small extent. It comprises approximately 5 percent of the county.

The association is composed of a series of broad flats that have low, depressed areas and short, choppy slopes that lead to natural drainageways. The broad flats are occupied by the heavy clayey Garner soils and the loamy Acadia soils. The low, depressed areas are occupied by the very poorly drained Byars soils. The Acadia soils are in the more sloping areas. The Caddo and

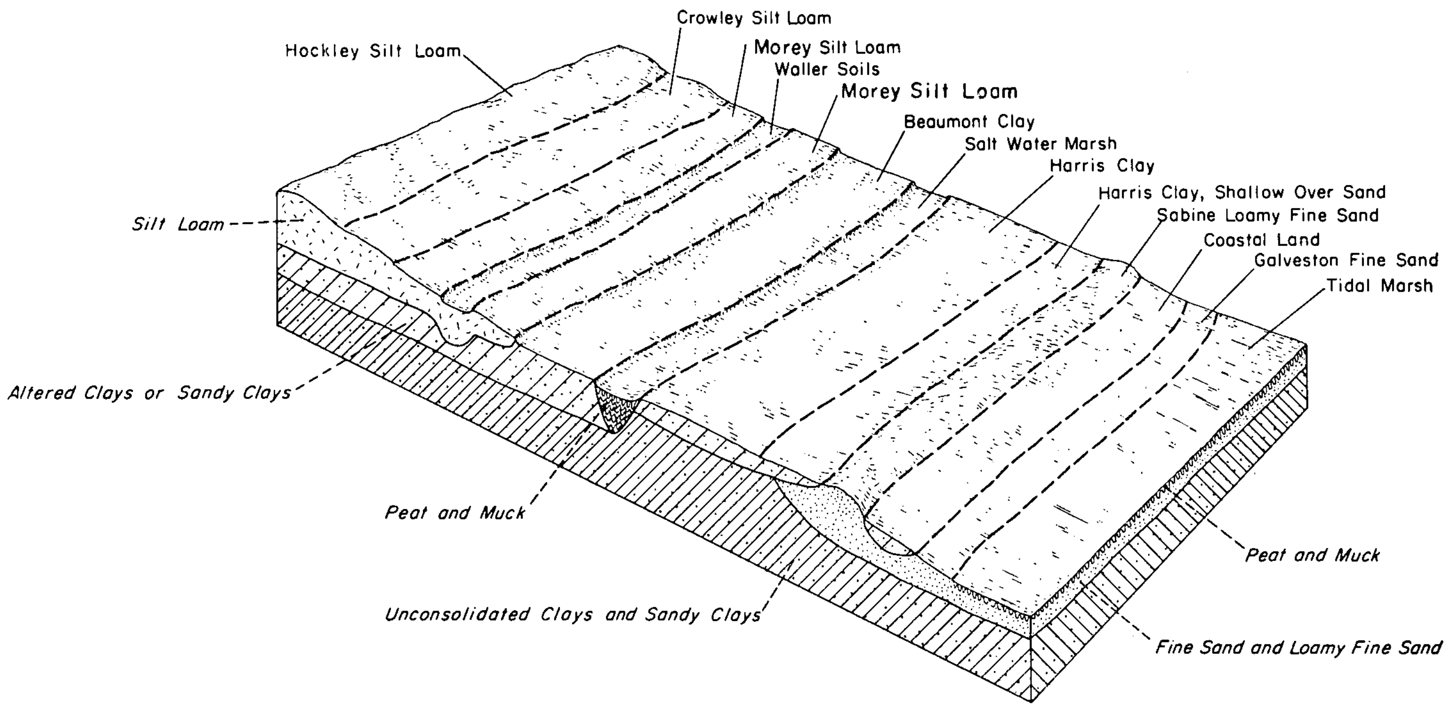

Figure 2.—**Relative position of the major soils of the coast prairie and coast marsh.**

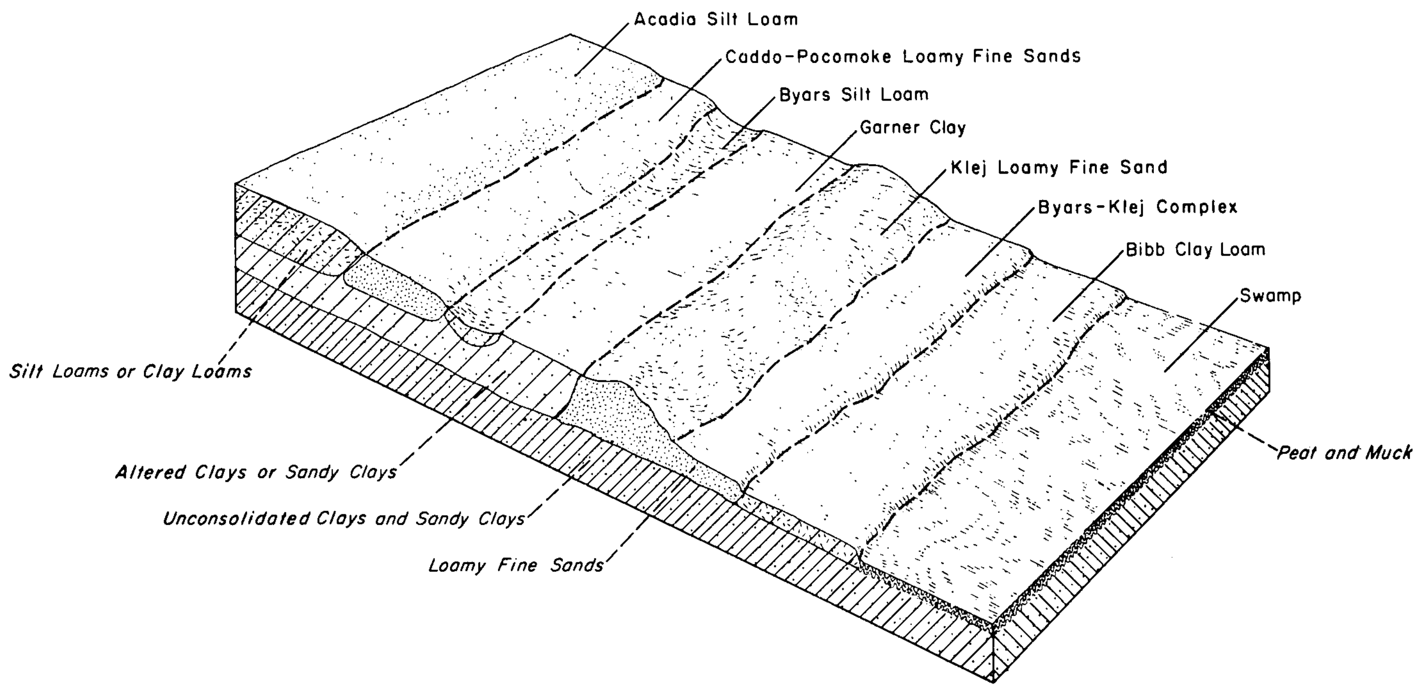

Figure 3.—**Relative position of the major soils of the East Texas timberlands.**

Pocomoke soils are in the gently undulating, ridgelike area near Fannett. The Caddo soils occupy the ridgelike areas, and the Pocomoke soils are in the depressions between the ridges. Some mounds and ridges in the association are occupied by the sandy Klej soils.

In the northern part of the county near Beaumont, many new homes have been built on the soils of this association. Many subdivisions have already been laid out, and others are planned. There are also many homesites, 1 to 20 acres in size, that have home gardens and small pastures. Most of the association is still in large holdings owned by woodland companies, farmers, or ranchers, and is used for the production of pine and hardwood timber.

The major soils of the association are moderate or low in fertility, and the gardens, lawns, and pastures respond favorably to applications of fertilizer. Management is needed in pine woodlands to control the spread of undesirable hardwood trees.

3. Morey-Crowley-Hockley association: Silty soils of the coast prairie

This association occupies the nearly level to undulating, better drained, ridgelike areas throughout the coast prairie. It occupies approximately 18 percent of the county.

In the higher areas of this association are the friable, moderately well drained Hockley soils. The silty, imperfectly or somewhat poorly drained Crowley soils are below the Hockley soils in a nearly level but slightly elevated area. The silty, poorly drained Morey soils occupy the more nearly level areas of the association below the Crowley soils. Minor areas of Waller and Beaumont soils are also in the association.

The Morey and Crowley soils are primarily used for growing rice. Rice is not grown on the Hockley soils, but corn is grown on some areas. All soils in this association are used for growing feed crops and improved pasture for beef and dairy animals. Most farms are more than 100 acres in size.

Some of the major problems are moderate to low fertility, droughtiness during hot summer months, and wetness in the more nearly level areas.

4. Beaumont-Morey association: Clayey and silty soils of the coast prairie

This association is the largest in the county; it comprises approximately 46 percent of the acreage. It occurs throughout the county and borders all other associations.

Differences in topography are not very marked in this association. There are few natural drains. As a whole, the association is nearly flat, and water stands for long periods after heavy rains. The fine-textured, clayey Beaumont soils are in the wider and more nearly level areas of the association. The silty Morey soils are on slightly higher areas than the Beaumont soils. Rice levees often show this difference in the location of the two soils. The levees are far apart on Beaumont soils but are closer together and more crooked on Morey soils. Minor areas of Crowley, Waller, and Lake Charles soils are in this association.

The association is used mainly for growing rice and tame pasture for beef production. Some areas are in native grass. Where this association joins the soils of the East Texas timberlands, some excellent stands of pine and hardwood timber have encroached on these tighter and wetter soils of the coast prairie.

The water supply for growing rice in this association comes from the Neches River through an extensive system of canals. The average farm in the area is more than 200 acres in size. The land is farmed by both owners and tenant farmers.

Some major problems are wetness, soil compaction, poor tilth, and moderately low fertility.

5. Harris-Made land association: Clayey soils of the coast marsh

This association occupies both sides of the Gulf Intracoastal Waterway, which extends across the southern part of the county near the Gulf of Mexico. It comprises approximately 25 percent of the county.

This association consists of broad flats covered with coarse, salt-tolerant vegetation. These flats are occupied mostly by Harris soils. Near the bayous and lakes are some small areas of organic marshes and swamps. Many natural lakes and water areas are in the association.

Made land consists of spoil banks from excavated canals and bayous. Some spoil banks left from dredging and pumping operations in the waterways are also included. Made land is a mixture of clay, sand, and shells. In some places it is smooth, and in others it consists of steep embankments. The elevation ranges from 1 to 10 feet above the normal ground level of the association.

Most of this association is in large ranches. Areas used for range are grazed by beef cattle and are used for wildlife habitats. Some industrial plants are built on Made land. Some areas are used for recreation.

Some of the major problems are accessibility, wetness, gulf storms, and insects.

6. Salt water marsh-Tidal marsh association: Soft marsh areas of the coast marsh

This association occurs in the northeastern part of the county that borders the lower half of the Neches River. It also occurs in the extreme southeastern tip of the county that borders the Gulf of Mexico. It occupies approximately 3 percent of the county.

In most areas this association lies at or below sea level. It is composed of thick, extremely wet, boggy beds of organic material over permanently waterlogged clay, sand, and shells. The areas that will support the weight of grazing livestock are classed as Salt water marsh. These areas are not covered daily by tides. The areas in the southern part of the association, however, are covered daily by tides from the Gulf and will not support livestock. These areas are classed as Tidal marsh.

The Salt water marsh-Tidal marsh association makes up part of the large ranches in the county. Because of the many hazards, it is used almost entirely for occasional grazing of beef animals and for wildlife habitats.

Some of the major problems are accessibility, daily tides, gulf storms, hurricanes, and insects.

7. Sabine-Coastal land association: Mixed soils of the coast prairie and coast marsh

This association occurs in the southern part of the county. It extends from Sabine Pass to the western edge of the county and parallels Texas Highway No. 87. The area comprises approximately 2 percent of the county.

This association occurs on low-lying ridges that have almost level foot slopes. In places the ridges are about 8 feet above sea level, but near the Gulf they are only a few inches to 1 foot above sea level. The well-drained Sabine soils are on the higher sandy ridges, and Coastal land is on the lower foot slopes of the ridges. Coastal land is often covered by tidewater during gulf storms.

The low, sandy Galveston soils occupy the area just just above the edge of the Gulf of Mexico.

Some areas of this association are in small tracts used for pasture and occasional vegetable crops. Most areas are parts of large ranches in the county and, along with other areas, are grazed by beef cattle.

The Galveston soils provide excellent beaches and camping sites.

Some of the problems of the area are moderate to low fertility, occasional storms, and lack of fresh water.

Descriptions of the Soils

In this section the soils and miscellaneous land types of the county are described in alphabetical order. The approximate acreage of the mapping units and the percentage of the county they occupy are listed in table 1.

The soil series is discussed first. A brief description of the soil profile—the surface layer, subsoil, and deeper material—of a typical soil is given for each series. The surface layer refers to horizons in the upper part of the profile. It includes the entire A horizon. The subsoil refers to the soil below the surface layer, to a depth of about 3 feet. In most soils, this layer contains more clay than the surface layer. It includes the entire B horizon. Soil material beneath the B horizon is called the C horizon. In some soils it is like that from which the soil has developed.

The description of the profile is not given for each soil. It is to be assumed that all soils within the same series have basically the same kind of profile as the typical one described for the series. Any variation from this description is in the writeup for the individual soil.

Each mapping unit (type or phase) recognized in this area is described. The symbols following the name of each mapping unit identify the unit on the detailed soil map in the back of the report.

Miscellaneous land types are also mapping units, but they do not belong to any soil series. Therefore, no series description precedes the descriptions of land types.

The capability unit is given for each soil. The range site, woodland suitability group, and wildlife suitability group are given where appropriate. When the range site or woodland suitability group is not given, it is because the soil is not adapted to or used for range or woodland. The various groupings of soils are discussed in the section "Use and Management of Soils."

A list of the mapping units and the map symbol, capability unit, range site, woodland suitability group, and wildlife suitability group of each are given in the back of the report.

A more detailed description of each series and a typical profile description in more detail (showing all horizons) are given in the section "Genesis, Classification, and Morphology of Soils."

Acadia Series

In the Acadia series are deep, dark-colored, acid soils that have a heavy, brightly mottled clay subsoil. These soils developed under a mixed cover of pine and hardwood trees. They are mainly in the northern part of the county.

The thickness of the silt loam surface layer ranges from 2 to 18 inches. The upper few inches of this layer is gray; the rest is very pale brown and has some yellowish-brown mottles. The surface layer is strongly acid to medium acid, has granular structure, and is friable when moist and hard when dry.

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

Soil	Area	Extent
	Acres	*Percent*
Acadia silt loam, 0 to 1 percent slopes	8, 911	1. 4
Acadia silt loam, 1 to 5 percent slopes	2, 406	. 3
Alluvial land	2, 269	. 4
Beaumont clay	186, 275	29. 0
Bibb clay loam	2, 935	. 5
Borrow pits	150	(1)
Byars silt loam	3, 878	. 6
Byars-Acadia complex	2, 488	. 4
Byars-Klej complex	3, 947	. 6
Caddo-Pocomoke loamy fine sands	4, 488	. 7
Coastal land	5, 581	. 9
Crowley silt loam	23, 429	3. 7
Crowley-Waller complex	4, 430	. 7
Galveston fine sand	1, 513	. 2
Garner clay	10, 643	1. 7
Harris clay	129, 721	20. 1
Harris clay, shallow over sand	2, 857	. 4
Hockley silt loam, 1 to 3 percent slopes	4, 387	. 7
Klej loamy fine sand	289	. 1
Lake Charles clay	622	. 1
Made land	20, 171	3. 1
Morey silt loam	155, 997	24. 2
Oil-waste land	1, 142	. 2
Sabine loamy fine sand	1, 361	. 2
Salt water marsh	4, 872	. 8
Swamp	2, 119	. 3
Tidal marsh	5, 804	. 9
Waller soils	4, 660	. 7
Water	46, 495	7. 1
Total	643, 840	100. 0

[1] Less than 0.1 percent.

The subsoil is brownish-yellow to gray, tight, blocky silty clay loam and clay. It is about 20 inches thick and has many bright-red mottles. It is extremely acid to strongly acid and is sticky when wet and very hard when dry. This layer is wavy; its depth from the surface ranges from 2 to 18 inches, and in some disturbed areas it is exposed.

The parent materials are acid to alkaline sandy clay and clay.

The Acadia soils are better drained and more brightly mottled than the Byars soils. The surface layer and subsoil of the Acadia soils differ in texture, but the Garner soils are clay throughout.

Runoff from the Acadia soils is slow to rapid, and internal drainage is slow.

Acadia soils are low in nitrogen, phosphorus, potassium, and calcium. They contain these elements in amounts sufficient for production of timber, the purpose for which these soils are mainly used.

Acadia silt loam, 0 to 1 percent slopes (AcA).—This soil is in nearly level areas throughout the wooded part of the county.

The surface layer ranges from 4 to 18 inches in thickness and averages about 12 inches. In a few areas of minor extent, the surface layer is very fine sandy loam to a depth of 26 inches. Within areas of this soil, there are a few low, sandy, circular mounds that rise 1 to 2 feet above normal ground level and are 15 to 25 feet in diameter. On these mounds the surface layer is light gray to light yellowish brown and 14 to 24 inches thick. These mounds occupy less than 10 percent of the soil area.

The subsoil in the mounds and between the mounds is like that described for the Acadia series.

Included with this soil in mapping are small areas of Byars silt loam and Garner clay, which occupy less than 5 percent of the total soil area.

Runoff on this Acadia soil is slow, and internal drainage is slow. The soil can hold moderate amounts of water for plant use. Its tight subsoil restricts downward movement of water.

This soil produces mainly pine and hardwood trees. Some small, open areas are used for pasture and home gardens. Many areas are being developed for residential use. (Capability unit IIIw–3; woodland suitability group 1; wildlife suitability group 5)

Acadia silt loam, 1 to 5 percent slopes (AcB).—This soil is on short, narrow slopes that lead to natural drainageways in forested parts of the county. The average slope is 4 percent, but in minor areas the slope is as much as 7 percent.

The surface layer ranges from 2 to 14 inches in thickness. In places the subsoil is mottled red. Where timber has been removed and the soil has not been protected, the surface layer has been thinned by water erosion. In areas where erosion is severe, narrow and deep gullies have formed.

Small areas of Garner clay were included in mapping this soil. These occupy less then 3 percent of the soil area.

This Acadia soil has slow internal drainage and rapid runoff. It holds a moderate amount of water for plant use. Because of its slope, water runs off before the tight subsoil can absorb it.

Pine and hardwood trees are the principal products; some small areas are used for pasture. (Capability unit IIIe–1; woodland suitability group 1; wildlife suitability group 5)

Alluvial Land (Ad)

Alluvial land is made up of bottom-land areas that are variable in texture, drainage, and exposure to flooding. Some of the alluvium has been deposited recently, and some has been in place long enough to allow weak development of a soil profile. The texture ranges from sand to clay.

In general, this land type is undulating. It has many small ridges and islands 1 to 10 acres in size that are surrounded by low, flat areas and deep drainageways. The high areas are flooded every 2 to 5 years but drain readily when the floodwaters subside. The flat areas are flooded several times a year and drain slowly.

This land is used mainly for production of trees, chiefly water-tolerant hardwoods. A few pine trees grow on the small islands. Some of the higher areas are used as campsites.

This land is not suitable for cultivation. It needs clearing, flood protection, drainage, and smoothing before it can be cultivated. (Capability unit VIw–1; woodland suitability group 8; wildlife suitability group 6)

Beaumont Series

The Beaumont series consists of gray to dark-gray, poorly drained, acid soils that have a clay texture throughout their profile. These soils occupy broad, nearly level or flat areas throughout the coast prairie part of the county.

The gray or dark-gray surface layer is heavy clay. This layer is 4 to 36 inches thick, is mottled with strong brown and brownish yellow, has blocky structure, and is slightly acid to strongly acid. This layer is sticky and plastic when wet and very hard when dry.

The subsoil to a depth of 8 feet or more is also a gray, heavy clay. This layer has more mottles of strong brown and brownish yellow than the surface layer. It is strongly acid to moderately alkaline, has blocky structure, and is sticky and plastic when wet and very hard when dry.

The parent material is acid to alkaline clay of the coast prairie. It is exposed only in road cuts, ditches, and other excavations.

The Beaumont soils have more clay throughout their profile than the Morey soils. They are darker and have less bright mottles than the Garner soils. Also, they have more mottles than the saline Harris soils. Beaumont soils are more poorly drained, more acid, and more mottled than the Lake Charles soils.

The Beaumont soils have very slow runoff and internal drainage. They are moderately productive but are low in nitrogen and phosphorus, and in some places, potassium.

Beaumont soils are often referred to as hogwallow land because they are marked with clay mounds 2 feet in diameter and 8 inches high. These mounds are the result of shrinking and swelling of the clay. When Beaumont soils dry, the clay particles shrink, pull apart, and leave cracks in the soil 6 to 8 inches wide and 5 to 8 feet deep (fig. 4). When moisture is available, the cracks fill with water. The heavy clay subsoil absorbs the water, swells, buckles upward in an uneven, wavy pattern, and forms the small mounds. In the mounds, the subsoil may be only 4 inches below the surface, but between the mounds, it is 36 inches or more from the surface. The mounds, on the average, are 15 feet apart. During wet weather, water stands in the low areas between the mounds.

Beaumont clay (Ba).—This is the only Beaumont soil mapped in Jefferson County. Where it is in native range or improved pasture, the upper 4 inches may be granular in structure. Where the soil is farmed, this structure is soon destroyed, and the soil becomes massive.

Figure 4.—Large cracks in a dry Beaumont clay.

The degree of mottling varies considerably in the soil profile. In the upper 2 feet, mottles occupy 1 to 20 percent of an exposed surface, and in the subsoil, 15 to 50 percent.

Near the outer edge of this soil there are some small, included areas of Morey silt loam. These included areas occupy less than 1 percent of the total soil area. Where this Beaumont soil joins Harris clay, it is slightly saline in some places.

Rice is the main crop, but the soil is also used for native range, improved pasture, and feed sorghum. In a few places the soil supports a good growth of pine and hardwood trees, but generally it is not well suited to woodland. (Capability unit IIIw–1; Blackland range site; woodland suitability group 7; wildlife suitability group 1)

Bibb Series

The Bibb series consists of gray, acid, poorly drained, frequently flooded bottom-land soils. These soils developed under a dense cover of water-tolerant hardwoods on the flood plains of the Neches River and Pine Island Bayou.

The surface layer to a depth of 2 to 10 inches normally is gray or dark grayish-brown clay loam that has some yellowish-brown mottles. This layer is very strongly acid, has blocky structure, and is sticky and plastic when wet and hard when dry.

The subsoil to a depth of 38 inches is light-gray to light brownish-gray clay loam marked with many yellowish-brown mottles. This layer is very strongly acid, has little or no structure (massive), and is sticky and plastic when wet and hard when dry.

The parent material consists of sediments washed from sandy and clayey soils that have been mixed by water and deposited on the local flood plains.

The Bibb soils generally have a substratum that consists of mixed layers of sand, clay loam, and clay. This substratum is at a depth of 45 inches or more.

The Bibb soils occupy lower positions, have less sand in their profile, and are more poorly drained than the Klej soils. They are more frequently flooded and have less clay in the subsoil than the Byars soils.

The Bibb soils have very slow runoff and internal drainage. They are low in nitrogen, phosphorus, potassium, and calcium. Nevertheless, the supply of these is sufficient for growth of trees. The soils are used to grow trees, and to a limited extent for grazing beef cattle, for production of food for wildlife, and as campsites.

Bibb clay loam (Bb).—This soil is level to nearly level. A few, small areas are flooded infrequently. During normal floods, these isolated areas appear as islands and can be reached only by boat. The water table is permanently high and seldom is lower than 18 to 38 inches from the surface.

In some places the surface layer is a silty clay loam that has many brownish mottles throughout the profile. In places the substratum is white sand at a depth of 45 inches or more.

Small areas of Alluvial land and Swamp are included with Bibb clay loam in mapping. The included areas of Swamp support cypress trees. Also included in this mapping unit are a few small ridges occupied by Klej loamy fine sand. The inclusions make up less than 10 percent of the soil area.

This soil can hold large amounts of water for plant use. Because of the position and the frequency of flooding, this soil has a surplus of water. There is not enough water for cypress trees, but too much for pine trees. The amount of water is ideal for producing water-tolerant hardwoods, the principal crop. (Capability unit VIw–1; woodland suitability group 8; wildlife suitability group 6)

Borrow Pits (Bp)

Borrow pits are made up of scattered areas throughout the county. They have been used or are now used for excavating soil material for construction work, roadbeds, and fill. This material consists of sand, loam, and clay. The pits range from 2 to 10 acres in size and from 5 to 15 feet in depth.

After Borrow pits are abandoned, they fill with rainwater and runoff. They provide some fishing and a fresh-water supply for livestock and wildlife. (Capability unit VIIIs–1)

Byars Series

The Byars series consists of deep, gray, very poorly drained, acid soils that occupy level to depressed areas in the forested part of the uplands in the county. These soils developed under a thick stand of hardwood trees.

The surface layer to a depth of 14 to 30 inches is a gray silt loam with mottles of dark gray and yellowish brown. In most areas this layer contains streaks of white sandy loam. It has little or no structure (massive) and is slightly sticky and plastic when wet and hard when dry. It is strongly acid to medium acid.

The subsoil is about 32 inches thick. It is light gray and has many mottles of yellowish brown and strong brown. Streaks of white sandy loam are also common. The subsoil is usually clay loam in the upper 14 inches and clay in the lower part. It is strongly acid, massive, and sticky and plastic when wet and very hard when dry.

The parent material consists of acid sandy clay and clay.

The Byars soils are more poorly drained, have less bright mottles, and have less clay in the upper subsoil than the Acadia soils. The surface layer and subsoil of the Byars soils differ in texture, but the Garner soils are clay throughout.

The Byars soils have very slow runoff or are ponded, and they have very slow internal drainage. They are low in nitrogen, phosphorus, potassium, and calcium. However, they have enough of these nutrients for growing timber, which is their main use.

Byars silt loam (Br).—In most places the surface layer of this soil is gray; however, in some places there are so many brownish-colored mottles that no color seems to be dominant. In places the surface layer is very fine sandy loam. In a few minor areas, clay is not present to a depth of 40 inches. Where the clay is at this depth, the upper subsoil is silty clay loam.

Included with this soil in mapping are small areas of Acadia silt loam, Klej loamy fine sand, and Garner clay. The inclusions make up less than 5 percent of the soil area.

Byars silt loam will hold moderate amounts of moisture for plant use, but water does not enter it readily. As the soil receives runoff from other soils, it is waterlogged. Consequently, water-loving hardwoods are well suited.

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(Capability unit IVw–1; woodland suitability group 6; wildlife suitability group 6)

Byars-Acadia complex (Bx).—This complex consists of areas of Byars silt loam and Acadia silt loam. From 50 to 70 percent of the complex is Byars silt loam, 20 to 40 percent Acadia silt loam, and 10 to 20 percent other soils. The other soils are Garner clay, Klej loamy fine sand, and Morey silt loam.

Acadia silt loam occupies positions that are 6 to 8 inches higher than those occupied by Byars silt loam and the other soils. The Acadia soil is in circular or egg-shaped areas that are completely surrounded by depressed areas of Byars silt loam. Where other soils occur in the complex, they separate Acadia silt loam from Byars silt loam.

Trees are the principal crop. Some areas are now being developed for residential sites.

Typical Acadia soils are described under the Acadia series. (Capability unit IVw–1; woodland suitability group 6; wildlife suitability group 6)

Byars-Klej complex (By).—This complex consists of a mixture of Byars silt loam and Klej loamy fine sand. It is near the present flood plain of the Neches River and in the central part of the county near Fannett.

Near the Neches River, 70 percent of the complex is Byars silt loam and 30 percent is Klej loamy fine sand. Near Fannett, 60 percent of the complex is Byars silt loam and 40 percent is Klej loamy fine sand. Included with the complex in mapping are minor areas of Garner clay, Bibb clay loam, and Morey silt loam.

Byars silt loam occupies depressed areas 1 to 5 feet lower than the better drained Klej loamy fine sand. Near the Neches River, Klej loamy fine sand occupies narrow ridges 20 to 100 feet wide. Near Fannett, this soil occupies circular mounds 30 to 60 feet in diameter. Where Klej loamy fine sand occupies mounds, it is underlain by gray sandy clay or clay at a depth of 48 inches.

The soils in this complex hold moderate amounts of moisture for plant use. Pine and hardwood trees are the principal crops. Pine is chiefly on Klej loamy fine sand, and hardwoods are chiefly on Byars silt loam. (Capability unit IVw–1; woodland suitability group 5; wildlife suitability group 6)

Caddo Series

Soils of the Caddo series are deep, gray, acid, and loamy. They developed under pine and hardwood trees in the uplands in the forested part of the county.

The surface layer is 14 to 30 inches of loamy fine sand. The upper 4 inches of the layer are gray; the rest of the layer is brownish gray and pale brown with mottles of yellow and brownish yellow. The surface layer is very strongly to strongly acid. It is very friable when moist, soft when dry, and granular in structure.

The subsoil is mottled light-gray and brownish-yellow sandy clay loam, 24 inches thick and with some red mottles. It is very strongly acid, has little or no structure (massive), and is slightly sticky when wet, friable when moist, and hard when dry.

The parent material consists of acid, mottled clay loam and sandy clay.

The Caddo soils have a thinner, lighter colored surface layer and are better drained than the Pocomoke soils. They also lack the sandy substratum that occurs in the Pocomoke soils. They are more poorly drained and have a heavier subsoil than the Klej soils.

The Caddo soils have slow runoff and internal drainage. They are low in nitrogen, phosphorus, potassium, and calcium. They have enough of these elements, however, for timber, which is the principal crop.

In this county Caddo soils are mapped only in a complex with the Pocomoke soils. Typical Pocomoke soils are described under the Pocomoke series.

Caddo-Pocomoke loamy fine sands (Cp).—This complex consists of areas of Caddo loamy fine sand and Pocomoke loamy fine sand. It is in the Gilbert Woods in the central part of the county.

Caddo loamy fine sand occurs on level to gently undulating surfaces. It occupies 60 to 80 percent of the complex. In a few places, the subsoil is clay loam. Mottled-gray and red clay occurs in places at a depth of 40 inches, or more. There are few to many, hard iron concretions in the Caddo soil.

Pocomoke loamy fine sand occurs on level to slightly depressed areas. It occupies 20 to 40 percent of the complex. In a few places the surface layer is fine sandy loam and the subsoil is sandy clay. The depth to the sandy substratum of the Pocomoke soil ranges from 40 to 50 inches. In a few places it is 80 inches below the surface.

The soils in this complex take up water readily. Since Pocomoke loamy fine sand is the lower lying soil in the complex, it receives seepage and runoff from the Caddo soils. Consequently, it has surplus moisture and a high water table. The depth to the water table ranges from 18 to 36 inches.

Areas of Acadia silt loam and Byars silt loam make up as much as 10 percent of the mapping unit.

Pine and hardwood trees are the only crops grown. (Capability unit IIIw–4; woodland suitability group 2; wildlife suitability group 5)

Coastal Land (Cs)

Coastal land consists of materials that have been deposited or reworked by salt water during storms from the Gulf of Mexico. It is located only in the southern part of the county.

Storm tides carry sandy, silty, and clayey materials that were gathered from the Gulf of Mexico. When the water spreads over Coastal land, the materials are deposited on the surface of existing soils. This building-up process continues during each storm. As a result, soil materials are deposited in layers that have different texture. One layer may be a sand; another, a loam; and another, a clay. The texture of the upper layer may change during any storm. The thickness of the various layers ranges from 1 to 36 inches and depends on the volume of material deposited during each storm.

The building-up process creates a low-lying ridge that is slightly higher than the surrounding area. Because of this slight ridge, Coastal land has more runoff than the wet, low-lying Harris soils. This land type is not so well drained as the sandy Sabine soils, which occur on higher elevations and are only occasionally damaged by storms.

The soil in this land type is too salty, too wet, and too frequently damaged by storms to be suitable for cultivation and improved pasture. It is well suited to range and the grazing of beef animals. When other parts of the marsh are covered by water, the better drained, slightly elevated areas provide a place for livestock to graze and bed down. (Capability unit VIIw–2; Salt Prairie range site; wildlife suitability group 4)

Crowley Series

The Crowley series consists of deep, gray, acid soils that have a thick surface layer and a heavy, tight subsoil. These soils developed under tall prairie grasses throughout the coast prairie part of the county.

The surface layer ranges from 18 to 24 inches in thickness. It is a gray and grayish-brown, friable silt loam that has some strong-brown mottles in the lower part. The structure is granular. This layer is strongly to slightly acid; it is nonsticky when wet and slightly hard when dry.

The subsoil is grayish-brown silty clay, about 28 inches thick, that has many red mottles. It is medium acid, has blocky structure, and is sticky when wet and hard when dry.

The parent material consists of slightly acid to weakly alkaline silty clay.

The Crowley soils are more poorly drained and have a less friable upper subsoil than the Hockley soils. They have a thicker surface layer and a more brightly mottled subsoil than the Morey soils. They are better drained and have a more brightly mottled subsoil than the Waller soils.

The Crowley soils have slow runoff and very slow internal drainage. They are moderately productive and moderately fertile. They are low in nitrogen, phosphorus, potassium, and, in some areas, calcium.

Crowley silt loam (Ct).—This soil is nearly level to level. Areas of Morey silt loam and Hockley silt loam less than 5 acres in size are included with this soil as mapped. Also included are small, circular, depressed areas of the poorly drained Waller soils. Inclusions make up less than 5 percent of the soil area.

When the soil is used for rice, the granular structure in the upper 12 inches is destroyed and the surface layer becomes massive and very hard when dry. Water and plant roots enter this layer readily, but their movement into the tight subsoil is restricted. Surface crusts and plowpans are common in cultivated fields.

The principal crops are rice and pasture. Some areas are used for feed sorghums, corn, small grain for grazing, and native range. (Capability unit IIw–2; Sandy Prairie range site; wildlife suitability group 1)

Crowley-Waller complex (Cw).—About 30 to 60 percent of this complex consists of Crowley silt loam, and about 40 to 70 percent consists of Waller soils. In most areas Crowley silt loam makes up 60 percent of the complex and Waller soils make up the rest.

Crowley silt loam occurs on small ridges that range from 30 to 125 feet in width. The ridges are 1 to 4 feet higher than the Waller soils.

The Waller soils are generally fine sandy loam. They occupy depressed areas 20 to 80 feet in diameter and are surrounded by Crowley silt loam. In some places the depressions are circular, and in others they are long and winding.

In places small areas of Morey silt loam and Hockley silt loam are included with this mapping unit. They make up less than 2 percent of the area of the complex.

The Waller soils in this complex are surrounded by the slightly elevated Crowley silt loam and do not drain well. Consequently, water stands on their surface most of the year.

The principal crops are range grass and sedges. A few, small areas are used for rice.

Typical Waller soils are described under the Waller series. (Capability unit IIIw–2; Sandy Prairie and Loamy Prairie range sites; wildlife suitability group 1)

Galveston Series

Soils of the Galveston series are loose very fine sands that have little or no profile development. The present vegetation consists of sparse stands of salt-tolerant grass.

The surface layer to a depth of 30 to 60 inches is light-gray to very pale brown fine sand. It is moderately alkaline, has little or no structure (single grained), and is loose when dry and when moist.

The parent material consists of only slightly weathered, sandy marine deposits.

The Galveston soils are lighter colored and are more sandy than the Sabine soils, and they occur in lower areas. They are more sandy than the Harris soils.

These soils have very slow runoff and rapid internal drainage. They are low in nitrogen, phosphorus, and potassium.

Galveston fine sand (Ga).—This soil occurs on nearly level areas or on low sand dunes in the southern part of the county.

Some areas of this sandy soil contain shells of various sizes and kinds ranging up to 2 inches in diameter. In some places there are thin layers of loamy fine sand mottled with yellowish brown and brownish yellow. A heavy, waxy clay occurs in places at a depth of 30 to 60 inches.

Long, narrow areas of sandy beach are included with this mapping unit.

Galveston fine sand takes up water readily, but because it is sandy, it retains small amounts of moisture for plants.

This soil is affected by salt sprays and high tides. Because of its location, it is used mainly for recreation and wildlife. Some small areas are used for range. (Capability unit VIIw–3; wildlife suitability group 4)

Garner Series

In the Garner series are deep, dark-colored, acid soils that have clay-textured profiles. These soils, at least during the latter part of their development, were under a mixed cover of pine and hardwood trees. They are mainly in the northern part of the county.

The surface layer to a depth of 1 to 34 inches is a heavy clay. It is gray to grayish brown and has strong-brown and brownish-yellow mottles. The structure is subangular blocky in the upper part and blocky in the lower part. This layer is very sticky when wet and very hard when dry and is strongly to slightly acid.

The subsoil to a depth of 54 inches is a heavy clay. It has no dominant color but is mottled gray, light gray, and reddish yellow. In places it is blocky or has little or no structure (massive). It is slightly acid to neutral and is sticky when wet and very hard when dry.

The parent material is alkaline to weakly calcareous clay.

The Garner soils are not so dark colored and have more bright mottles than the Beaumont soils. They have clay texture throughout their profile, whereas the Acadia and Byars soils do not have a clay-textured surface layer. The Garner soils shrink and swell like the Beaumont and Lake Charles soils. This characteristic of shrinking and swelling is described under the Beaumont series.

The Garner soils have very slow runoff and internal drainage. They are low in nitrogen, and phosphorus, and in some areas, potassium. These elements, however, occur in sufficient quantity for timber production, for which most areas of these soils are used.

Garner clay (Gc).—This soil is level to nearly level. It is the only Garner soil in Jefferson County.

A 1- to 3-inch layer of leaves and twigs normally is on the surface of the soil. In a few places, the surface layer is clay loam. Concretions that contain calcium carbonate are normally at a depth of 40 to 60 inches but in a few places are 90 inches from the surface. These concretions are as much as 3 inches in diameter. Red mottles occur in some areas that adjoin Acadia silt loam.

Small areas of Acadia silt loam and Beaumont clay are included with Garner clay in mapping. The inclusions make up less than 5 percent of the soil area.

This soil can hold large amounts of water for plant use, but its tightness restricts the movement of water, air, and plant roots.

Pine and hardwood trees are the principal crops. (Capability unit IIIw-1; woodland suitability group 4; wildlife suitability group 5)

Harris Series

The Harris series consists of dark, wet, saline clay soils that occupy broad, flat to depressed areas in the marsh section in the southern part of the county. These soils developed under coarse, salt-tolerant grass and sedges.

The surface layer is gray to dark-gray clay with some yellowish-brown mottles. In most places it is about 20 inches thick. This layer is neutral to moderately alkaline, has blocky structure, and is very sticky when wet and very hard when dry.

The subsoil, to a depth of 38 inches or more, is gray clay with some strong-brown mottles. It contains streaks of light-gray fine sand. It is moderately alkaline, massive, and very sticky and plastic when wet and very hard when dry.

The parent material is gray, alkaline clay and silty clay.

The Harris soils are darker colored and are more poorly drained than Beaumont soils. They contain fewer mottles and are more saline. They are clay in texture, whereas the Galveston soils are sandy.

Surface water is ponded on the Harris soils. Consequently, there is little or no runoff and no internal drainage.

The Harris soils are used almost entirely for the production of native range grasses, which are grazed by beef cattle and supply food and protection for wildlife. These soils are not deficient in any of the elements needed by native plants.

Harris clay (Ha).—This soil is typical of the Harris series (fig. 5). In some places a layer or mat of organic material as much as 5 inches thick occurs on the surface of the soil. This layer varies in occurrence and in thickness. It is always present in areas that have not been burned over. It is absent or very thin, however, in areas that have been burned over when dry.

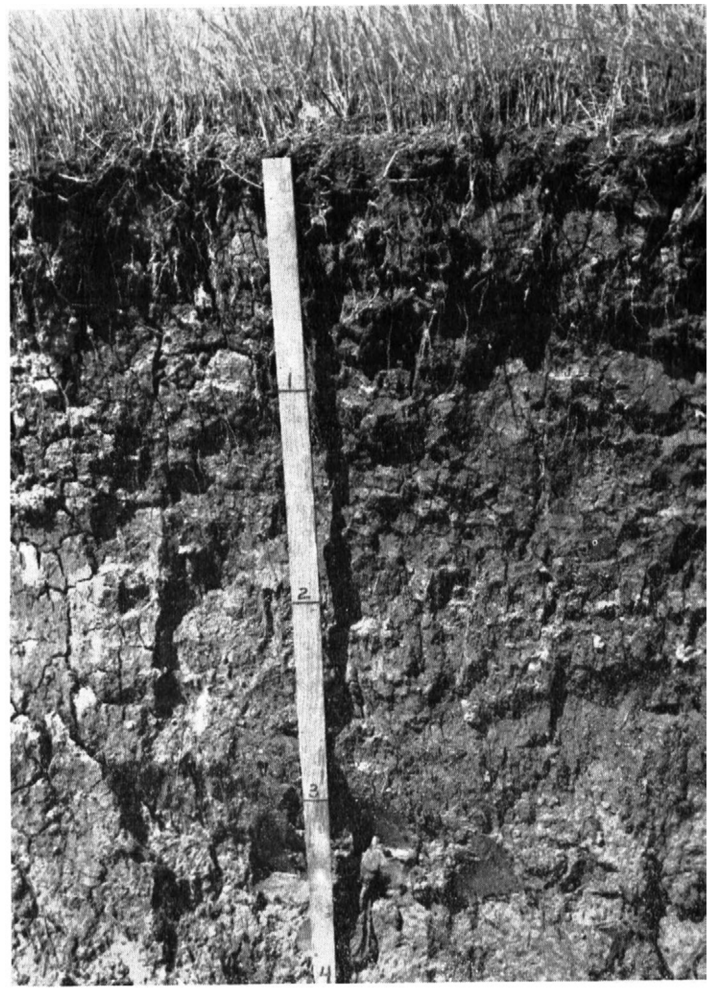

Figure 5.—**Profile of Harris clay showing the upper 4 feet of the dark, wet, saline clay of the marsh area.**

In a few places, the surface layer has subangular blocky structure. Also in a few places, there is a sandy substratum 38 to 60 inches below the surface.

Included with this soil in mapping are narrow, winding areas of Salt water marsh. In a few places, the soil has been protected from salt water by levees, and harmful salts have been leached from the surface layer by fresh water. In these places, the surface layer is usually slightly acid to neutral.

The vegetation is mainly salt-tolerant grass and sedges. (Capability unit VIIw-1; Salt Marsh range site; wildlife suitability group 3)

Harris clay, shallow over sand (Hs).—This soil consists of a 12- to 30-inch layer of heavy clay over mottled, brownish-gray and brownish-yellow fine sand. The sandy layer contains shells of various kinds as much as half an inch in diameter, as well as concretions of iron and manganese of buckshot size. In some places this sandy layer contains streaks or layers of silty clay; in others, it consists of loamy sand.

Harris clay, shallow over sand, is 1 to 2 feet higher than Harris clay. The slight difference in elevation allows better runoff.

This soil is used for grazing and for bedding areas for livestock when Harris clay is under water. The principal vegetation is salt-tolerant grass and sedges. (Capability unit VIIw-2; Salt Prairie range site; wildlife suitability group 4)

Hockley Series

The Hockley series consists of deep, acid silty loams with a friable upper subsoil. These soils occupy high positions in the coast prairie part of the county. They have developed under tall prairie grass.

The surface layer ranges from 14 to 30 inches in thickness. It is dark grayish-brown or pale-brown silt loam that has granular structure in the upper part and is massive in the lower part. This layer is strongly to slightly acid and is friable when moist and slightly hard when dry.

The subsoil has two main parts. The upper 8 inches is friable, light yellowish-brown silty clay loam with mottles of red and brownish yellow. This part has blocky structure and is slightly sticky when wet and hard when dry. The lower part of the subsoil to a depth of 50 inches is pale-brown silty clay with mottles of red and brownish yellow. This part has blocky structure and is slightly sticky when wet and very hard when dry. The subsoil is strongly acid.

The parent material is strongly acid and consists of mottled brownish-yellow, red, and light-gray sandy clay and clay of the coast prairie.

The Hockley soils tend to be more yellowish-brown in color and are more friable in the subsoil than the Crowley and Morey soils. They are also better drained. The Hockley soils also have a thicker surface layer than the Morey soils.

These soils have medium runoff and internal drainage. They are low in nitrogen, phosphorus, potassium, and in some places, calcium, and are moderately productive.

The Hockley soils are higher in elevation than other soils of the coast prairie, and for this reason, they are not used for rice.

Hockley silt loam, 1 to 3 percent slopes (HtB).—This soil is nearly level to gently undulating. The dominant slope range is from 1 to 3 percent, but some slopes are 0.5 percent and some are 5 percent.

The surface layer ranges from 14 to 30 inches in thickness. In a few places it is neutral in reaction. The upper subsoil is very pale brown and in places is like the lower subsoil. In these places the subsoil is clay loam. Small, ferromanganese concretions may occur in all parts of the soil.

In the more nearly level parts of this soil, small areas of Crowley silt loam are included in mapping. Also included in some places are depressed areas occupied by the very poorly drained Waller soils. Inclusions make up less than 5 percent of the soil area.

This soil can hold moderate amounts of moisture for plant use, and it absorbs water readily.

Improved pasture, range grass, feed sorghum, corn, and supplemental pasture are grown on this soil. (Capability unit IIe-1; Sandy Prairie range site; wildlife suitability group 2)

Klej Series

The Klej series consists of deep, acid, light-colored sandy soils that occupy terraced areas along the Neches River and upland areas in the central part of the county. These soils have developed under pine and hardwood trees.

The surface layer, or the upper 4 to 14 inches, is gray or grayish-brown loamy fine sand that has little or no structure. It is very strongly to strongly acid and very friable when moist and loose when dry.

The subsoil and parent materials, to a depth of 40 to 72 inches or more, are pale-brown or very pale brown loamy fine sand with some mottles of yellowish brown and yellowish red. These materials have little or no structure. They are very strongly to strongly acid and are very friable when moist and loose when dry.

On old stream terraces near the Neches River, the parent material consists of acid sandy alluvium. In the central part of the county, it consists of sandy marine sediment.

Klej soils are lighter colored and are better drained than Pocomoke soils. They are better drained, are less mottled, and have a more sandy subsoil than Caddo soils.

Klej soils have very slow runoff and rapid internal drainage and are moderately well drained. They are low in nitrogen, phosphorus, potassium, and calcium. They contain enough of these elements for timber production, however.

Klej loamy fine sand (Kf).—This soil occurs on undulating or billowy surfaces.

The slopes are dominantly 2 percent, but in a few places, they are as much as 3 percent and as little as 0.5 percent. Also, in a few places, the upper 4 inches is gray. The depth to the water table ranges from 40 to 70 inches.

This sandy soil takes up water readily, but it retains only small amounts of moisture for plant use.

Pine is the main crop. The larger areas of the soil are excavated for road-fill sand and for construction purposes. (Capability unit IIIs-1; woodland suitability group 3; wildlife suitability group 5)

Lake Charles Series

The Lake Charles series consists of dark, slightly acid to neutral clay soils that have developed under prairie vegetation. These soils occur on nearly level to level areas in the coast prairie part of the county.

The surface layer to a depth of 14 to 32 inches is dark-gray clay with a few mottles of yellowish brown. In undisturbed areas the structure is subangular blocky and granular, but in areas used for rice it is blocky. This layer is neutral in reaction and is very sticky when wet and very hard when dry.

The subsoil averages 25 inches in thickness. It is gray and has brownish-yellow mottles. It has blocky structure, is moderately alkaline, and is very sticky when wet and very hard when dry.

The parent material is alkaline clay of the coast prairie.

The Lake Charles soils are darker colored, better drained, and less mottled than Beaumont soils. They have more clay in their surface layer than the Morey soils.

These soils shrink and swell like the Beaumont and Garner soils. This characteristic of shrinking and swelling is described under the Beaumont series.

The Lake Charles soils have very slow runoff and slow internal drainage. They are low in nitrogen and phosphorus and they are moderately productive and fertile.

Lake Charles clay (La).—This is the only Lake Charles soil mapped in Jefferson County.

The color of the surface layer ranges from dark gray to to very dark gray. Concretions of various sizes that contain calcium carbonate are present in places throughout the profile. These concretions are as much as one-fourth inch in diameter in the surface layer and subsoil and as much as 2 inches in diameter in the parent material.

Small areas of Beaumont clay and Morey silt loam less than 5 acres in size are included with this soil in mapping. These inclusions occupy less than 1 percent of the total soil area.

This soil can take in and hold a large quantity of water for plant use. Some surface drainage is normally needed. Surface crusts and plowpans are common in cultivated fields.

Rice is the principal crop; however, some areas are used for improved pasture. (Capability unit IIw-1; Blackland range site 1; wildlife suitability group 1)

Made Land (Ma)

Made land consists of materials that have been excavated from canals, ditches, or waterways, and deposited on other soils. It occurs throughout the gulf marsh and coast prairie parts of the county. Approximately 90 percent of Made land is in the marsh area.

In most places, this land type is a heavy saline clay to a depth of more than 8 feet. In some places, it is a mixture of clay, sand, and shells of various kinds and sizes.

This land type is made in several ways. In some places, levees 2 to 10 feet high are constructed around a large area; then water, mud, and slush are pumped into it. After water is drained off, the mud and slush are left to dry. The result is a level, elevated area of Made land 2 to 10 feet higher than the surrounding areas.

In some places the mud and slush are pumped on areas that have no levees for holding the materials in place. These areas of Made land are nearly level but are only 1 to 3 feet higher than the surrounding soils.

Areas of spoil banks are included with this land type. This material was dug and left, without spreading, as steep embankments along the sides of waterways and ditches.

Made land is not suitable for cultivation; however, it does have many valuable uses. It furnishes some high areas for livestock and wildlife and also helps in regulating water levels in the marsh. New excavations may not support vegetation for several years, but most of the older areas support some vegetation for livestock.

Many of the major industries in this county are built on Made land. The Pleasure Pier Island at Port Arthur, a recreational area that includes a new golf course, is an example of what can be done with Made land. (Capability unit VIIw-2; Salt Prairie range site; wildlife suitability group 4)

Morey Series

The Morey series consists of deep, gray to dark-gray, poorly drained, acid soils with a tight silty clay loam subsoil. These soils are nearly level to level and have developed under grass vegetation.

The surface layer is gray or dark-gray, acid silt loam. The thickness of this layer ranges from 4 to 14 inches and averages about 12 inches. Under grass vegetation, this layer has a friable, granular structure and is only slightly sticky and hard. Under cultivation, it loses organic matter rapidly and becomes puddled when wet and very hard when dry.

The subsoil is gray, acid silty clay loam with yellowish-brown mottles. It is about 24 inches thick, has blocky structure, and is sticky when wet and very hard when dry. The tight subsoil restricts the penetration of water, air, and plant roots.

The parent material is alkaline to calcareous clay and silty sediment. The Morey soils have less clay in their profile than Beaumont soils. They have a thinner and less sandy surface layer than Crowley soils.

Low, sandy, circular mounds, 20 to 50 feet in diameter and 1 to 3 feet high, are usually on the surface of the Morey soils. Their surface layer is gray very fine sandy loam 14 to 36 inches thick. Their subsoil is heavy, blocky, olive-gray sandy clay that is mottled with various shades of yellow and brown. The mounds are normally leveled when the soil is cultivated.

Morey soils have very slow runoff and internal drainage. They are moderately productive and moderately fertile and are low in nitrogen, phosphorus, and potassium.

Morey silt loam (Md).—This mapping unit occurs throughout the nearly level coast prairie part of the county.

The surface layer is generally silt loam, but in a few included places, it is clay loam or very fine sandy loam with few to many yellowish-brown mottles.

In places the subsoil is olive gray and mottles occupy from 5 to 20 percent of an exposed surface. In some places red and yellowish-brown mottles are mixed. Reaction of the subsoil ranges from strongly acid to moderately alkaline. Large concretions that contain calcium carbonate are common in the lower subsoil and parent materials.

In most places the sandy mounds occupy from 5 to 15 percent of the mapping unit. In a few places they occupy as much as 20 percent. In some areas the soil at the base of the mounds is high in soluble salts. Where the surface layer is smoothed and salt is exposed on the surface, vegetation will not grow for several years. These spots are referred to as slick spots. The exposed salt should be removed at the time the land is leveled.

Areas less than 5 acres in size of Beaumont clay, Crowley silt loam, and Waller soils are included with this soil in mapping. In most places these included soils occupy less than 5 percent of the mapping unit, but in some places they occupy as much as 10 percent. Also included are sizable areas of a soil that has a more friable upper subsoil than Morey silt loam. Its surface soil ranges from slightly acid to neutral.

Morey silt loam can hold moderate amounts of moisture for plant use. Common surface crusts, plowpans, and the tight subsoil make it very difficult for water to enter the soil.

Rice is the main crop, but all crops in the county are grown. In some places where the subsoil is strongly to medium acid, the soil supports a good growth of mixed pine and hardwood trees. Most areas of this Morey soil are not suitable for woodland. (Capability unit IIIw–1; Loamy Prairie range site; woodland suitability group 7; wildlife suitability group 1)

Oil-Waste Land (Ow)

Oil-waste land consists of areas where oil and sulphur wastes have accumulated (fig. 6). It includes active or abandoned slush pits and adjoining areas of land that have been affected by wastes.

Though Oil-waste land is not suitable for agriculture, some areas may be reclaimed in time. (Capability unit VIIIs–1)

***Figure 6.*—Oil waste on agricultural land that was once productive.**

Pocomoke Series

In the Pocomoke series are deep, dark-gray, poorly drained, acid sandy soils. These soils developed under pine and hardwood trees in the uplands in the central part of the county.

The surface layer consists of 24 to 36 inches of loamy fine sand. It is dark gray in the upper part and light gray in the lower part. There are some dark-brown and yellowish-brown mottles in the layer. This layer is strongly to slightly acid, has granular structure, and is friable when moist and hard when dry.

The subsoil is light brownish-gray fine sandy loam with some brownish-yellow mottles. It is 8 to 18 inches thick, is strongly acid, and has little or no structure (massive). It is slightly sticky when wet and hard when dry.

The parent material is acid loamy earth. The sandy substratum, a common characteristic of these soils, is light-gray loamy fine sand and has some brownish-yellow and gray mottles.

Pocomoke soils have a darker surface layer and are more poorly drained than the Caddo soils. Unlike the Caddo soils, they have a sandy substratum.

These soils have slow runoff and internal drainage. They are low in nitrogen, phosphorus, potassium, and calcium. They contain these elements in amounts sufficient for timber, which is the principal crop.

In this county the Pocomoke soils occur only in a complex with the Caddo soils. This complex is described under Caddo-Pocomoke loamy fine sands.

Sabine Series

The Sabine series consists of deep, slightly acid, dark-colored sandy soils. These soils occupy low ridges, commonly called cheniers, in the southern part of the county near the Gulf of Mexico. They developed under grass vegetation.

The surface layer to a depth of 11 inches is dark grayish-brown to grayish-brown loamy fine sand. It has granular structure, is medium acid, and is very friable when moist and soft when dry.

From 11 to 50 inches below the surface, the subsoil is pale-brown loamy fine sand mottled with brownish yellow and yellowish brown. It is medium acid, has little or no structure (massive), and is very friable when moist and soft when dry.

The parent material consists of weakly alkaline sandy deposits; these are old coastal beaches of the Gulf of Mexico.

These soils have a darker surface layer, are less sandy, and occupy higher areas than the low-lying, more poorly drained, wet Galveston soils.

The Sabine soils have very slow runoff and medium to rapid internal drainage. They are low in nitrogen, phosphorus, and potassium.

Sabine loamy fine sand (Sa).—Most areas of this soil have slopes of less than 1 percent; a few, however, have slopes of 2 percent.

In the subsoil brownish-yellow and pale-brown mottles occupy from 1 to 20 percent of an exposed surface. Shell fragments may be present at a depth of 40 inches, or more. In a few places, a 2- to 3-inch layer of gray clay loam was deposited on the surface during gulf storms. All layers of the soil range from medium acid to moderately alkaline.

Sabine loamy fine sand takes up water readily but retains only a small amount of moisture for plant use. The soil is affected by salt sprays from the Gulf of Mexico.

This soil is used mainly for improved pasture and range grass. Some areas are used for truck crops, mainly watermelons. (Capability unit IIIs–1; Coastal Sand range site; wildlife suitability group 2)

Salt Water Marsh (Sm)

Salt water marsh consists of a 16- to 36-inch layer of organic peat and muck over a clay or silty clay material that is also high in organic matter. It occurs along the lower one-half of the Neches River and other drainageways in the southern part of the county.

The water table is permanently high; it ranges from 6 inches above to 6 inches below the surface. Most of the area is affected by salt water and supports salt-tolerant vegetation that is grazed by beef cattle.

Unlike the miscellaneous land type Swamp, Salt water marsh is covered with brackish water and supports salt-tolerant vegetation rather than trees. Also, it has thicker layers of organic matter on the surface than Swamp. It differs from Tidal marsh in not being affected daily by the tide and in having more uniform soil material.

This land type is unsuitable for cultivation. It provides food for wildlife and limited grazing.

This land type should not be drained for agricultural uses. If it were drained the organic layer would dry out and decompose rapidly, the elevation would become lower, and the remaining soil would be very acid. (Capability unit VIIw-3; Deep Marsh range site; wildlife suitability group 3)

Swamp (Sw)

Swamp occurs on the flood plains of the Neches River and the major bayous of the county in low, flat or depressed areas that are flooded frequently by fresh water.

This land type consists of a 4- to 20-inch layer of brown to grayish-brown woody peat and muck over a 20- to 30-inch layer of gray sandy clay. The sandy clay is also high in organic matter and, consequently, has an oily feel.

The water table is normally at the surface during summer and 1 foot above the surface in winter. Since the water table is permanently high, the soil is never dry.

Included with this land type are small areas of Salt water marsh and small areas (less than 5 acres) of Bibb clay loam.

Swamp is covered with fresh water and supports fresh-water vegetation. The principal vegetation is cypress trees. In a few cleared areas, the soils produce a thick growth of water-tolerant grass and sedges. Daily salt-water tides do not affect Swamp as they affect Tidal marsh.

If Swamp were cleared, extensive reclamation work would be needed before the soil could be cultivated. Drained areas would require levees, and drainage ditches would require protection gates to keep salt water from the river and bayous. Salt water would kill or greatly reduce the existing stand of cypress. Accessibility is a major problem in this mapping unit. (Capability unit VIIw-3; woodland suitability group 8; wildlife suitability group 3)

Tidal Marsh (Tm)

Tidal marsh is covered daily by tidal water from the Gulf of Mexico. It comprises areas that are at or near sea level in the extreme southeastern part of the county. These areas are composed of a mixture of clay, sand, organic matter, and small shell islands. The subsoil is soupy, or unstable, and will not support the weight of livestock. The water table is permanently high and is very seldom below the surface. Tidal marsh is accessible only by use of boats and marsh buggies.

Tidal marsh supports a dense growth of salt-water vegetation, principally smooth cordgrass. Because of the tides and the position and unstable nature of this land type, it is suitable only for wildlife. (Capability unit VIIIw-1; wildlife suitability group 3)

Waller Series

The Waller series is made up of deep, gray, very poorly drained, acid soils. These soils occur in level to depressed areas throughout the coast prairie part of the county. They developed under water-tolerant grass and sedges.

The surface layer is gray and has some yellowish-brown mottles. It ranges from very fine sandy loam to clay loam in texture and from 6 to 14 inches in thickness. The layer contains streaks of light-gray fine sandy material and has little or no structure (massive). It is strongly to slightly acid and is slightly sticky when wet and very hard when dry.

The subsoil ranges from silt loam to clay loam and is usually from 20 to 30 inches thick. It is mottled with yellowish brown and contains streaks of light-gray fine sand. It is massive, slightly acid, and slightly sticky when wet and very hard when dry.

The parent material consists of slightly acid to moderately alkaline silt loam and sandy clay.

The Waller soils are lighter colored and are more poorly drained than the Morey soils. They are more poorly drained and lack the brightly mottled subsoil of the Crowley soils.

The Waller soils have very slow runoff, or are ponded, and they have very slow internal drainage. They are low to moderate in productivity. They are low in nitrogen, phosphorus, and in some areas, potassium and calcium.

Waller soils (Wa).—All Waller soils in the county, regardless of their surface texture, were mapped in this unit. The surface textures are so variable that it was not practical to map the different types separately.

In places the soils are silt loam to a depth of 60 inches or more. In local areas sandy clay is 14 to 36 inches below the surface. White sandy streaks are common in all Waller soils. They make up from 10 to 40 percent of each layer in places.

Small areas of Crowley silt loam, Beaumont clay, and Morey silt loam are included with Waller soils in mapping. Each inclusion is less than 5 acres in size, and all inclusions make up less than 5 percent of the total soil area.

Surface crusts and a plowpan are common in cultivated fields. It is difficult for water, air, and plant roots to penetrate the soils. Because of their low position, these soils accumulate runoff water from surrounding soils.

The principal crop is rice. (Capability unit IVw-1; Loamy Prairie range site; wildlife suitability group 1)

Water

Canals, rivers, bayous, reservoirs, fresh- and brackish-water lakes, and stock ponds make up about 7 percent of the county.

The size of the individual water areas vary from 1 acre to a lake of several thousand acres. The water is brackish, salty, or fresh. Reservoirs that are occasionally drained and farmed are not classified as water areas.

Included as water is a fresh-water marsh of about 1,000 acres on the Pipkin Ranch in the southwestern part of the county. Fresh water is maintained on the surface of this marsh most of the year. As a result, the soil produces a large volume of fresh-water vegetation that is left on the surface. The marsh has a soupy, unstable subsoil of peat and muck that remains saturated. The area is important as a wildlife habitat.

Areas in water are used for water supply, drainage outlets, shipping facilities, and recreational purposes. They are not placed in capability units or other soil groups.

Use and Management of Soils

The soils in Jefferson County are used chiefly for rice, improved pasture range, woodland, and wildlife food and cover. The management of soils varies according to the land use.

This section includes discussions of general management of cropland and improved pasture, capability groups of soils, estimated yields, management of rangeland, management of woodland, and management of wildlife.

General Management of Cropland and Improved Pasture

The climate and soils of Jefferson County are well suited to the growing of rice and improved pasture. Rice is the only cultivated crop of commercial importance grown in the county. Feed sorghum and corn are also grown on a few acres. These crops are used primarily for feeding livestock on the farm. A few acres of truck crops are grown, chiefly for home use.

Rice and beef cattle are usually raised together in a rice-beef cattle system of farming. For this reason, cropland and improved pasture are discussed together in this section of the report.

When soils are cultivated or used for improved pasture in this county, it is necessary to maintain the fertility and organic matter, improve the physical condition, and establish drainage systems. Proper irrigation systems are also required when the soils are used for rice. Good farming practices can be used effectively on all cropland and improved pasture in the county.

Rice farming, cropping systems and rotations, pasture and other suitable crops, drainage and irrigation systems, and fertilizers are discussed in this section.

Rice farming

To be suitable for rice, an area should have (1) moderately high temperatures during the growing season; (2) a dependable fresh-water supply (from rainfall or irrigation); (3) moderately tight soils that restrict the movement of water; and (4) level or nearly level topography. For the benefit of readers who are not familiar with the crop, a general discussion of rice and its production is given in the next few paragraphs.

Rice varieties are classed as short, medium, and long grain. This classification is based on the length of the grain. The principal varieties grown in Jefferson County are long grain. Varieties are also referred to as early, midseason, and late. This classification refers to the number of days from the date of planting that rice requires for maturing. Early varieties require from 109 to 132 days; midseason varieties, from 133 to 150 days; and late varieties, from 150 to 180 days.

If a farmer plants all of his rice on approximately the same date, he usually plants two or more varieties that mature at different dates. A farmer who plants only one variety normally plants it on different days so that all the rice will not mature at the same time. If two or more fields of rice mature on different dates, better distribution of labor and machinery is possible. In addition, there is some insurance against loss from bad weather that might occur during the planting and harvesting. High winds and heavy rains at harvesttime may cause rice to fall, or lodge (fig. 7). Some rice can still be harvested, but yields and quality are greatly reduced. Farmers that have different fields of rice at different stages of maturity may lose a crop in one field but still make a crop in another.

Figure 7.—**Combining lodged rice on Beaumont clay, following high winds during harvest season.**

The seedbed for rice is prepared any time from August to the following spring just before planting. If the soil is dry, the land is plowed with a disk plow to a depth of 3 to 8 inches. If the soil is moist, a moldboard plow is used. Land plowed in winter is disked or harrowed just before planting. Land plowed in summer is usually disked or harrowed several times to control grass and weeds during summer and fall. The use of land planes to smooth the soil is a common practice in the county (fig. 8). The planes are usually driven across the rice-fields several times before levees are constructed. Land smoothing permits better distribution of water and more uniform stands and growth of rice. After smoothing, contour levees and borders are constructed on the fields to hold water at a uniform depth during the growing season.

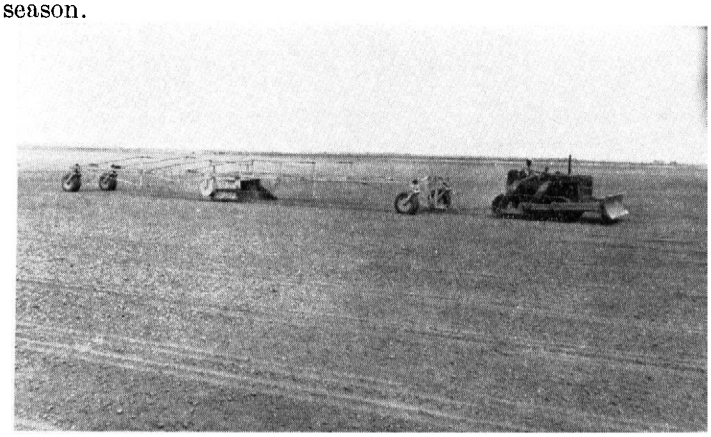

Figure 8.—**A 60-foot land plane smoothing a seedbed for rice on Morey silt loam.**

When rice is seeded in water, a different method of seedbed preparation may be used. In this method the surface is usually left rough, and water is applied to the fields. The land is then worked under water with a spike-tooth harrow before seeding the rice. Sprouted seed is dropped into the muddy water; after 12 to 18 hours, the field is drained. The seed is slightly covered by the silt that settles from the water.

Rice is planted between March 1 and the latter part of June. Most of the acreage is planted in April and May. The date of planting depends on the weather, method of seeding, soil physical condition, and the desired maturity date. The rate of seeding ranges from 60 to 160 pounds per acre. Rice is seeded by airplanes, grain drills, and broadcast seeders. The fields may be dry or flooded at time of seeding. When rice is dry planted, the fields are usually harrowed, and then flushed with water to promote germination. When it is water seeded, presoaked seeds are used.

Fertilizers of various types and amounts are used for growing rice. Normally, they are applied by airplanes; however, some are applied in irrigation water, and some by tractor-drawn distributors.

The soils on which rice is grown are covered with water to a depth of 4 to 6 inches throughout most of the growing season. Irrigation water is used not only to meet the high moisture needs of the crop, but also to help control weeds and grass in the ricefields. The amount of water that is needed is governed by temperature, humidity, evaporation rate, kind of soil, the watering practice used, and the amount and distribution of rainfall. Approximately 40 to 45 inches of water is used in this county to produce a crop of rice. Some of this water is from rains during the growing season. The rest is from irrigation.

Rice is generally ready for harvest when the heads have turned down and the kernels in the lower part of the head are in the hard-dough stage. It is harvested with self-propelled combines in this county.

Physical condition of riceland.—For best production, a soil must furnish needed amounts of moisture, fertility, and air to the growing plants. In addition, it must contain desirable micro-organisms.

Soil structure is often referred to as the key to soil productivity. The growth of plants in any soil depends as much upon soil structure as on soil fertility. The structure is the soil characteristic that determines the size and amount of pore spaces in the profile. The pore spaces, in return, affect the amount and movement of water and air in the soil. As a rule, the more granular the structure, the more pore spaces are present.

The population of soil organisms is a vital part of every productive soil. The various bacteria, fungi, earthworms, and other living residents in the soil use the remains of plants as food. They give off carbonic acid in the process of digesting the plant residue. This weak acid, in turn, works on the soil minerals and makes them available to plants. Certain organisms also gather nitrogen from the air and transfer it to the soil.

In their native state, the rice soils of the county supported a thick cover of grasses and legumes. The soils were moderate to high in organic matter. For the most part, the surface layer had a granular structure that contained many active organisms and could absorb and hold large amounts of water and air for plant growth.

Many changes have taken place since the soils have been used for rice. Now the soils are low to moderate in content of organic matter. For the most part, the structure of the surface layer is massive, and the population of desirable soil organisms has declined. The soils can still hold large amounts of water, but it is more difficult for the water to enter the soil. The amount of air space in the soil has been greatly reduced by cultivation.

Climatic conditions, soil characteristics, level topography, and farming methods have all contributed to the very poor structure in the upper 12 to 18 inches of soils used for rice. Farming practices, nearly all of them essential, that have helped to create a poor physical condition in soils are (1) working of soils when wet or extremely dry, (2) grazing the soils when wet, (3) reducing organic matter at a faster rate than it is being replaced, and (4) holding water on the surface (waterlogging soils) throughout the growing season.

Rice is one of the few cultivated crops that can be grown successfully on soils in poor physical condition. The quantity and quality of rice, however, are improved by improving the physical condition of the soil. When the soil is not farmed to rice, the methods used to improve the physical condition help provide other sources of income for farmers.

Slow to very slow internal drainage is an inherent characteristic of the soils used for rice. The characteristic is determined mainly by the texture and structure of the subsoil and lower horizons. Maintaining or improving soil physical condition in the surface layer will not affect the ability of the soil to restrict the movement of water downward through the profile.

A constant and progressive program for soil management and improvement is necessary to obtain maximum production. The better soil structure and conditions that existed under native vegetation cannot be maintained on soils used for rice. It is possible, however, to use soils for rice and, at the same time, keep their physical condition good and their productivity high.

Management practices that will supply as much organic matter to the soils as possible should be used. Organic matter, such as barnyard manure, green manure, or crop residue, is the most effective material for improving or maintaining the physical condition of the soil. The residue produced by rice alone is an important source of organic matter. Several thousand pounds of material per acre are left on the fields after each rice harvest. The material should be kept on or near the surface. The proper use of residue and the selection of plants should be of major concern to rice farmers.

Cropping systems and rotations

A cropping system is the kind and sequence of crops grown on a given area of soil over a period of time. It may be a regular rotation of different crops that follow a definite order on the soil, or it may be only one crop grown year after year on the same soil.

A good crop rotation on riceland, along with proper supporting management, will provide for a systematic return of organic matter to the soil. High yields of rice cannot be maintained by growing rice on the same land each year. Also, the growing of other cultivated crops in rotation with rice has not proven very successful in Jefferson County. The best cropping system for the county consists of grasses and legumes rotated with rice in a planned sequence. All legumes should be properly inoculated each time they are planted.

A rotation in which grasses and legumes are grown with rice has several advantages. It helps to keep the soil in good physical condition; that is, in good tilth and with better water-storage capacity. It provides plant nutrients by furnishing organic matter, especially when crops are turned under, and also adds considerable nitrogen if legumes are grown. This rotation provides high-quality roughage and pasture for livestock and a consequent return in manure. It helps to make possible the most effective use of fertilizers. By keeping the soil covered with crops, this rotation helps to control erosion and lower soil temperature. It changes the location of the feeding range of roots by alternating shallow-rooted and deep-rooted plants. It is a very important factor in controlling some plant diseases and insects. This rotation is also important in controlling undesirable grasses, broad-leaved weeds, and red rice. Finally, it improves the quality and increases quantity of rice produced on the soil.

A mixture of several different grasses and legumes provides more lasting results and greater improvement in fertility than one grass or legume planted separately. However, when the crop is to be harvested for seed and the seed sold on the market, it is often desirable to plant one grass or legume. A mixture of grasses and legumes will lower the purity of seed produced.

Rotations now in use vary considerably. Some farmers grow rice 1 or 2 years, then graze beef cattle 2 or more years. They depend entirely upon volunteer vegetation between the rice crops. Some farmers grow rice 1 or 2 years, then leave the volunteer vegetation ungrazed for several years before they plant rice again. Occasionally, a farmer may grow rice every other year and leave his land idle every other year. Because of the need for better pastures for beef cattle and the desirable effects of pasture plants on riceland, many farmers have established a rotation of rice and improved pasture. This system is referred to as a rice-pasture rotation or as rotation hay and pasture. The vegetation of the improved pasture consists primarily of perennial grasses and perennial or biennial legumes (fig. 9). These pastures are used not only for grazing and

***Figure 9.*—Santa Gertrudis cattle grazing Louisiana S-1 white clover and dallisgrass on Beaumont clay. A rotation of rice and improved pasture is used on this soil.**

for soil improvement but also for hay, seed production, and silage.

In a rice-pasture rotation, the most suitable plants and rotation depend upon several factors. These factors include (1) the type of soil and its present physical condition; (2) the past history of crops and the management practices that will be followed; and (3) the growing season and the use intended for the vegetation.

Rice should not be grown in the rice-pasture rotation more than 2 years in succession on the same soil. For best results, 3 or more years of pasture should be grown in the rotation. The longer the soil is in pasture, the better will be the results of soil conditioning and the yields of beef and rice.

Such annual crops as ryegrass and alyceclover can be used effectively in a rotation with corn and feed sorghum. They also can be used effectively in a rotation with rice. When annual crops are grown, the rotation is referred to as a rice-cover crop rotation. Annuals do not have the deep root system common to perennial and biennial plants. Furthermore, they are on the land for a much shorter time. More than one annual is needed in the rotation to produce enough organic matter for soil improvement. At least two cover crops should be returned to the soil between rice crops. If three cover crops are produced, one could be grazed, baled for hay, or used for silage (fig. 10). The other two could be returned to the soil. An example of a rice-cover crop rotation is as follows: (1) Rice grown in summer followed by ryegrass in winter months; (2) alyceclover the next summer followed by ryegrass in the winter months; (3) rice the next summer.

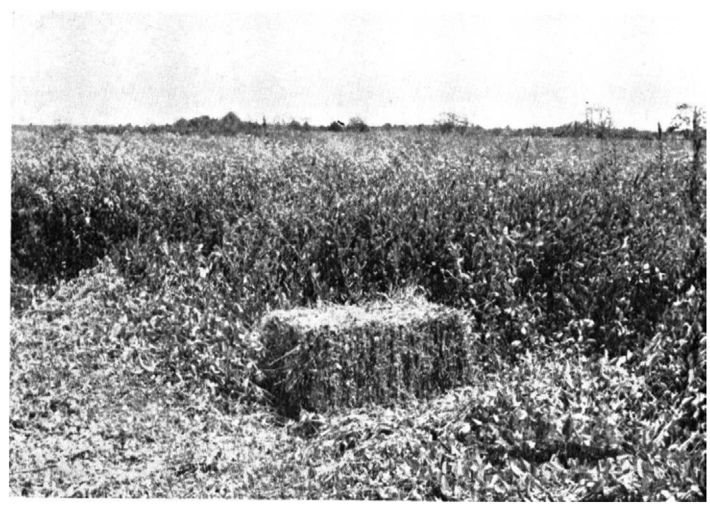

***Figure 10.*—Baling an excellent cover crop of alyceclover for hay. The crop is in a ricefield on Morey silt loam.**

In this rotation the alyceclover would be harvested, and the two crops of ryegrass returned to the soil. Or one crop of ryegrass could be cut, and the alyceclover and the other crop of ryegrass returned to the soil.

A cropping system would not be complete without the proper management of all crop residue produced. All crops grown in Jefferson County, except truck crops, are considered high-residue crops. Such crops are rice, corn, small grain, and feed sorghum. When properly managed, the residue from these crops will help improve the physical condition of the soil, increase organic matter, reduce erosion, and lower soil temperature. The residue has no value for soil improvement when it is burnt, heavily grazed, or removed from the land by some other means. At least 3,000 to 4,000 pounds of dry residue should be left on or near the surface of the soil each time a crop is grown in the rotation. When the crop does not include a legume, nitrogen fertilizer should be applied to the residue. This practice will help to compensate for a nitrogen deficiency in the crop that follows.

Pasture

The methods for establishing pasture are discussed in this section. Also, some suggestions for the management of soil for pasture are given.

PASTURE ESTABLISHMENT

Pastures can be established on ricefields without seedbed preparation. In this method, grasses and legumes may be seeded by airplane after the last drainage and about 10 days before the rice is harvested. After the rice has been harvested, seeding may also be done in the rice stubble by use of ground equipment or airplane. If this method is used, the grass and legumes are established in fall. They will start growing early in spring before the growth of volunteer grass and weeds. The levees and drains in the ricefields should be cleaned, opened, and used for draining the new pastures.

Planting pastures without seedbed preparation is not always practical, however. When ricefields are extremely rutted by equipment used for harvesting rice (fig. 11), the establishment and management of pastures are greatly hindered. Badly rutted fields restrict surface drainage and retard establishment and growth of improved grass and legumes. Mowing, baling, and seed harvesting are made more difficult, and the growth of water-loving weeds and grass is encouraged. A seedbed on fields in this condition should be prepared before the establishment of improved pasture. It should be prepared the same as for rice, except that the contour levees would be omitted. A well-prepared seedbed for improved pasture will lessen the expense and time required to prepare a seedbed for the next crop of rice.

***Figure 11.*—A badly rutted field on Beaumont clay, after rice harvest.**

Pasture grasses can occasionally become established in ricefields without any special management practices. In some parts of the county, the rice levees, roadbanks, and ditchbanks have an excellent cover of good grasses, such as bermudagrass, longtom, and vaseygrass. After the fields are drained and the rice harvested, these grasses spread by runners or by natural seeding into the ricefields and thus establish good pastures. This method is slower than seeding; normally, from 2 to 3 years are required for a complete stand of grass. These pastures can be improved by overseeding with a suitable legume. Drainage ditches should be cleaned, and management practices should be used as for other improved pastures.

Permanent pastures or hay meadows are often planted and are not rotated with cultivated crops. If the pasture is planted in rice stubble, the rice levees should be smoothed down before the seed is planted. The permanent pastures may be planted on old ricefields or on pasture land that has undesirable vegetation. A clean, firm seedbed that is free of competitive vegetation should be prepared at least 2 weeks before seeding. The seedbed is prepared the same as for planting rice, except that the contour levees are omitted.

PROPER USE OF PASTURE

A good management program for grasses and legumes is essential in a rice-beef cattle system of farming. Management of grasses and legumes is the same, whether on rotation cropland or in permanent pasture. The following discussion of proper management applies to pastures in rotation cropland and to permanent pasture.

Grass is the more important part of a grass and legume mixture. It is usually more permanent and has a deeper root system than the legumes, and it produces larger amounts of forage and organic matter. The legume also furnishes forage and produces organic matter, but its primary purpose is to furnish economically the nitrogen that increases production of grass. For this reason, the management of pastures is based on the grass and not the legume.

Management of pastures should be designed to promote growth and vigor of the plants and to maintain an adequate ground cover for protection against soil and water losses. Since older plants have less protein than young plants, insufficient grazing will reduce the quality of forage. Too much grazing will reduce the quantity of forage and will eventually eliminate the more desirable plants. Grasses differ as to their season and method of growth, as well as in the amount and quality of forage they will produce. Consequently, different grasses need different management. For example, tall fescue is an excellent grass for winter grazing; however, it should not be grazed during the hot, dry summer months. Livestock should be removed by the first of May and the plants allowed to make seed. This practice will help maintain the fescue and produce more vigorous plants for the next growing season.

Livestock should be removed from the pasture before the plants lose their vigor and the soil surface is exposed. This practice, called rotation grazing, will help maintain the desirable species and give the pasture a chance to recover. If growing conditions are favorable, and fertilization is adequate, the length of time needed for pastures to recover is short. If conditions are unfavorable, a long rest period may be necessary.

A more complete livestock grazing program can be provided by planting some areas to annual summer and winter crops. The annual plants can be used for supplemental summer and winter grazing. This program provides good grazing areas that can be used when the more permanent pastures are rested. If the supplemental pastures are not needed for grazing, they can be used for hay, silage, or seed production; or they may be left to improve the soil.

The size of areas that can be managed as one grazing unit depends on a number of things, such as available equipment and labor, number of livestock, kind of vegetation, and the management practices used. For best results, cross fences may be needed on some of the larger permanent pastures, and temporary fences on some of the larger fields. In addition, pastures should be mowed or sprayed to control weeds, and should be fertilized according to soil and plant needs. A fresh water supply, mineral supplements, and access roads should also be available to each area.

Other suitable crops

Rice is the principal crop grown in Jefferson County, as shown in table 16. It is not the only suitable crop, however. Several crops are grown to a limited extent or could be grown in the county.

Sugarcane and cotton have been successfully grown in the past on some of the better drained soils, such as Sabine loamy fine sand and Hockley silt loam, 1 to 3 percent slopes. Sugarcane was also produced on small areas of Lake Charles clay, Beaumont clay, and Crowley silt loam. Past records show that cane produced on the better drained soils yielded a higher quality sirup but that more cane was produced on the clayey soils. Cotton is suited to all soils in the coast prairie part of the county. By using improved varieties and a large amount of fertilizer, along with more intensive drainage and insect control, farmers could produce both sugarcane and cotton profitably in Jefferson County.

Small acreages of corn and sorghum are grown in the county. These crops are grown mostly on Hockley silt loam, 1 to 3 percent slopes. The crops would do well on Acadia silt loam, 0 to 1 percent slopes, Beaumont clay, Caddo-Pocomoke loamy fine sands, Crowley silt loam, Garner clay, Lake Charles clay, and Morey silt loam, if these soils were adequately drained. These crops are also well suited to other soils, such as Acadia silt loam, 1 to 5 percent slopes, Klej loamy fine sand, and Sabine loamy fine sand, which would not require artificial drainage. The production of these crops in Jefferson County could be increased by use of proper practices, including fertilization.

Vegetables have long been successfully grown in home gardens and on a commercial scale in a few areas. The climate of the county is well suited to the production of early vegetables. The lack of good drainage seems to be the chief drawback. Vegetables are best suited to the lighter textured, better drained soils, such as Sabine loamy fine sand; Klej loamy fine sand; Acadia silt loam, 1 to 5 percent slopes; and Hockley silt loam, 1 to 3 percent slopes. They would be well suited to Crowley silt loam; Acadia silt loam, 0 to 1 percent slopes; Caddo-Pocomoke loamy fine sands; and Morey silt loam, if these soils were intensively drained.

Sweetpotatoes and Irish potatoes are better suited to Hockley silt loam, Acadia silt loam, and Sabine loamy fine sand, though the other silty and sandy soils produce good yields in well-drained areas.

When very well drained, Morey silt loam, Lake Charles clay, and Beaumont clay are good soils for growing cabbage.

Tomatoes, watermelons, cantaloupes, squash, peas, beans, onions, lettuce, radishes, okra, peppers, and various other vegetables could be grown in much larger quantities than are now grown on the lighter textured soils. Intensive drainage of these areas would be of primary importance.

Blackberries and dewberries grow wild in great profusion on all the upland soils in the county. Tame varieties grow and produce well. Tame berries do best on the heavy clay soils where drainage is good, as along canal banks.

Tree fruits are grown to only a small extent in Jefferson County. Pears and peaches do well on the better drained soils. Figs are suited to all upland soils in the county. Orange trees do well on soils where drainage is good, but they would be damaged during some winters.

Drainage and irrigation systems

Drainage is a very important practice in the management of soils in Jefferson County.

Ricefields are drained once or twice during the growing season for the application of fertilizers and for helping control straighthead, blight, and water weeds. Drainage is also essential for the preparation of a desirable seedbed and for easier and better harvesting.

A drainage system should be designed to meet the needs of a rice crop and of all crops grown on soils that need drainage. A properly designed and functioning system is essential for better soil management. Until a drainage system can be installed, crops that can tolerate large amounts of water should be grown in the rotation on those soils that need drainage.

By removing surplus water, a drainage system improves the physical condition of the soil, increases production, and increases the efficiency of farming operations. Soils differ in the amount of water they can hold and in the rate that water enters their profile. Crops differ in the amount of water required and in the length of time they can withstand surplus water. For these reasons, the soil type, the physical condition of the soil, the crops to be grown, the amount and source of surplus water, and the topography should all be considered in designing a drainage system for each field.

Drainage systems should be designed by a competent engineer. Plans for maintaining the system should be made at the time of establishment. No system will function properly without regular maintenance.

Since water is so important in rice production, a great deal of time and study should be spent in planning a proper irrigation system. The system should be capable of furnishing the right amount of water at the exact time and place that it is needed. The uniformity and ease with which water can be applied to rice are also important. Where there are problems of salt-water intrusion or a low water supply at time of need, the system should include reservoirs or private wells to supplement the permanent water supply. The practice of land smoothing should be used on all soils to be irrigated.

The ability of a soil to hold water, its shrinking and swelling characteristics, the amount of land leveling needed, the topography of the land, the size of field to be irrigated, and the quantity and quality of available water should each be considered in designing an efficient, water-saving irrigation system for rice.

New irrigation systems should be designed by a competent engineer. Old irrigation systems that are not functioning properly should be checked and, if needed, reestablished. A regular check of the irrigation system should be made and needed repairs made.

The section "Engineering Interpretations of Soils" will be helpful in designing drainage irrigation systems.

Fertilizers

If the full advantages of a rotation and the supporting practices are to be realized, the soils must have nitrogen, phosphorus, potassium, and the other elements needed for vigorous growth of plants.

Nearly all soils in Jefferson County are deficient in nitrogen and phosphorus, and in some areas, potassium. In 1954 the total acreage that was fertilized was 99,093, and the amount of fertilizer applied was 10,907 tons. In 1959 the total acreage that was fertilized was 68,232, and the amount of fertilizer applied was 10,282 tons. The total acreage limed in 1954 was 390, and the total amount used was 445 tons. The total acreage limed in 1959 was 2,215, and the amount used was 2,931 tons.

Specific fertilizer recommendations for crops are not made in this report. Any suggestions as to the kinds and amounts of fertilizer to use are only general guides. Several laboratories make complete tests on soil samples and report to farmers the results of the tests and amounts of fertilizer to be applied in the cropping system. The county agricultural agent, local representatives of the Rice-Pasture Experiment Station, or the Soil Conservation Service should be consulted for soil sampling procedures and fertilizer recommendations.

Capability Groups of Soils

The capability classification is a grouping 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, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping 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 classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that 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 up to 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 close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, 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 confine their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, 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-1 or IIIe-1.

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 eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows.

Class I.—Soils that have few limitations that restrict their use.
- (None in Jefferson County.)

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe.—Soils subject to moderate erosion if they are not protected.
  - Capability unit IIe-1—Nearly level to gently undulating, well-drained prairie soils that have a friable subsoil and moderate susceptibility to erosion.
- Subclass IIw.—Soils that have moderate limitations because of excess water.
  - Capability unit IIw-1.—Level to nearly level, imperfectly or somewhat poorly drained prairie soils that have a moderately tight subsoil.
  - Capability unit IIw-2.—Level to nearly level, imperfectly or somewhat poorly drained prairie soils that have a very tight subsoil and a thick surface layer.

Class III.—Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.
- Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.
  - Capability unit IIIe-1.—Gently to moderately sloping, timbered soils that have a very tight subsoil and rapid runoff.

Subclass IIIw.—Soils that have severe limitations because of excess water.
Capability unit IIIw-1.—Level to nearly level, poorly drained soils that have a very tight subsoil.
Capability unit IIIw-2.—Level to nearly level, imperfectly to very poorly drained prairie soils that have a very tight subsoil and a thick surface layer.
Capability unit IIIw-3.—Level to nearly level, imperfectly drained, timbered soils that have a very tight subsoil.
Capability unit IIIw-4.—Level to nearly level, imperfectly to poorly drained, coarse-textured, timbered soils.
Subclass IIIs.—Soils that have severe limitations of moisture capacity or tilth.
Capability unit IIIs-1.—Level to gently sloping, moderately well drained to well drained, coarse-textured soils.
Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.
Subclass IVw.—Soils that have very severe limitations for cultivation, because of excess water.
Capability unit IVw-1.—Level to depressed, very poorly drained to moderately well drained soils.
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. (None in Jefferson County.)
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 VIw.—Soils severely limited by excess water and generally unsuitable for cultivation.
Capability unit VIw-1.—Level to rolling, very poorly drained, timbered, bottom-land soils that are frequently flooded.
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 VIIw.—Soils very severely limited by excess water.
Capability unit VIIw-1.—Level to depressed, very poorly drained, saline soils of the coast marsh.
Capability unit VIIw-2.—Level to nearly level, poorly drained, slightly elevated saline soils and land types of the coast marsh.
Capability unit VIIw-3.—Wet soils and land types that have a moderately stable subsoil.
Class VIII.—Soils and landforms that have limitations that preclude their use, without major reclamation, for commercial production of plants and that restrict their use to recreation, wildlife, water supply, or esthetic purposes.
Subclass VIIIw.—Extremely wet or marshy land.
Capability unit VIIIw-1.—Areas that have an unstable subsoil and are affected daily by tides.
Subclass VIIIs.—Rock or soil materials that have little potential for production of vegetation.
Capability unit VIIIs-1.—Excavations and other areas that do not support vegetation.

Management by capability units

In this section each capability unit is described, and the soils in it are listed. In addition, the use and management of each unit are discussed.

CAPABILITY UNIT IIe-1

The only soil in this unit is Hockley silt loam, 1 to 3 percent slopes. It is a nearly level to gently undulating, moderately well drained prairie soil that has a friable subsoil.

This soil is moderately productive and can hold moderate amounts of water and nutrients for plant use. Plant roots, moisture, and air easily penetrate. Drainage is not needed.

In cultivated areas the structure of the surface soil and the content of organic matter deteriorate rapidly. A surface crust and plowpan may form. Because of the slope, the hazard of erosion is moderate. The soil is moderately droughty in summer.

Corn, feed sorghum, supplemental pasture, improved permanent pasture, and truck crops are well adapted to this soil. It can be grazed when other soils are too wet. Because of its slope, it is not suitable for rice.

Crops on this soil respond to fertilizers containing nitrogen, phosphate, and potash, and usually to lime. In addition to fertilizers, a cover crop is needed to reduce runoff and erosion.

Crop rotations should include a legume cover crop at least once every 3 years. The residue from the legume should be left on the soil. In addition, large amounts of residue from other crops should be left on or near the surface. All crops should be farmed on the contour, and a system of terraces should be constructed. Where terracing is not practical, the soil should be kept under a continuous cover of legumes and other crops that produce much residue. In all areas, fertilizers should be applied.

Some grasses and legumes that are suitable for improved pasture or in cropping systems are bermudagrass (Coastal and common), dallisgrass, bahiagrass (Pensacola), sudangrass, oats, ryegrass, lespedeza, burclover, white clover, alyceclover, crimson clover, black medic, singletary peas, and vetch.

CAPABILITY UNIT IIw-1

The only soil in this unit is Lake Charles clay. It is a level to nearly level, imperfectly or somewhat poorly drained prairie soil that has a moderately tight subsoil.

This soil is moderate to high in fertility and is the most productive soil in the county. It holds large amounts of water, so moisture is available to plants during droughts.

Surface crusts and plowpans are common in cultivated fields. Where these occur, water frequently stands on the surface and plants are damaged in wet seasons. The soil needs artificial drainage.

Early in spring and after rains, this clay soil holds so much moisture that fieldwork may be delayed. More power is needed to work this soil properly than is needed for the silty soils. Land smoothing would benefit this soil, and the amount of material to be moved is small.

This soil is well suited to irrigation and the production of rice. It is also suited to corn, feed sorghum, supplemental pasture, including small grain for grazing, and improved pasture.

Soil tilth, internal drainage, and aeration can be improved by adding organic materials. Crops grown on this soil will respond to fertilizers containing nitrogen and phosphate.

When this soil is used for row crops, feed crops, or supplemental pasture, the cropping system should include a deep-rooted legume at least 1 year in 4. Crop residue should be used, the soil should be properly fertilized, and a complete drainage system should be installed.

When this soil is used for rice, a good cropping system is 1 or 2 years of rice and 3 or more years of improved pasture. Proper amounts of fertilizer should be applied, crop residue should be used, and pastures should be well managed. A complete drainage and irrigation system should be installed.

Some grasses and legumes that are suitable for improved pasture or in cropping systems are bermudagrass (common), dallisgrass, tall fescue, longtom grass, vaseygrass, johnsongrass, gordo bluestem, sudangrass, ryegrass, white clover, lespedeza, burclover, red clover, singletary peas, alyceclover, alsike clover, Hubam clover, and Persian clover.

CAPABILITY UNIT IIw-2

The only soil in this unit is Crowley silt loam. It is a level to nearly level, imperfectly or somewhat poorly drained prairie soil that has a very tight subsoil and a thick surface layer.

This soil is moderately productive and moderately fertile. Water, air, and plant roots readily enter the surface layer, and the soil can hold moderate amounts of water and nutrients for plant use.

Under cultivation surface structure and organic matter deteriorate rapidly, and surface crusts and plowpans are common. Shallow-rooted plants that grow in summer usually are damaged by lack of moisture. Deep-rooted crops are often damaged by too much moisture during wet seasons. This excess moisture is caused by a perched water table above the heavy subsoil. The heavy subsoil restricts the downward movement of the water that readily enters the surface layer. The soil needs artificial drainage.

This soil is well suited to irrigation and the growing of rice, corn, feed sorghum, temporary pasture, and improved pasture. It occurs on slightly higher elevations than other soils normally used for rice. Consequently, lift pumps may be needed for proper irrigation. Crops grown on this soil will respond to fertilizers containing nitrogen, phosphate, and potash. In many areas agricultural limestone is needed to make the soil less acid, especially where legumes are grown.

Cropping systems in which crops other than rice are grown should include a cover crop of legumes at least every 3 years. The legumes should be left on the land for soil improvement. Crop residue should be used, fertilizers applied, and a complete drainage system installed.

Cropping systems in which rice is grown should include 1 or 2 years rice, followed by 3 or more years of improved pasture. Supporting practices are proper use of crop residue, pasture, fertilizer, and irrigation and drainage systems.

Some grasses and legumes that are suitable for improved pasture or cropping systems are bermudagrass (Coastal and common), dallisgrass, bahiagrass (Pensacola), sudangrass, oats, ryegrass, lespedeza, burclover, white clover, alyceclover, crimson clover, black medic, singletary peas, and vetch.

CAPABILITY UNIT IIIe-1

The only soil in this unit is Acadia silt loam, 1 to 5 percent slopes. It is a gently to moderately sloping soil that has a very tight subsoil and rapid runoff.

This soil is used almost entirely for woodland. Commercial crops of timber can be greatly improved by use of proper management. (See the section "Management of Woodland.")

If cleared, the soil would also be suitable for cultivated crops and improved pasture. The tilth, however, would be poor because of the thin surface layer and tight clay subsoil. Much of the rainfall would be lost by runoff. Droughtiness and low fertility would also limit crop yields. Erosion would be another problem on a cleared area.

If the soil were cleared, early maturing, drought-resistant, and cool-season crops would be most suitable. Crops grown on this soil would respond to applications of fertilizer containing nitrogen, phosphate, and potash. Agricultural limestone would be needed.

Cropping systems should include a legume cover crop at least every 3 years. The legume should be left on the land for soil improvement. Large amounts of crop residue should be returned to the soil, and fertilizers should be applied. A complete terracing system that includes grassed waterways and contour farming would be needed for erosion control.

If the soil were cleared, some grasses and legumes that would be suitable for improved pasture or cropping systems are bermudagrass (Coastal and common), bahiagrass (Pensacola), weeping lovegrass, ryegrass, rye, lespedeza, vetch, and crimson clover.

CAPABILITY UNIT IIIw-1

In this unit are level to nearly level, poorly drained soils that have a very tight subsoil. They are—

- Beaumont clay.
- Garner clay.
- Morey silt loam.

The soils of this unit are moderately productive and fertile. They can hold large amounts of water and plant nutrients for crop use. The tight subsoil reduces the amount of water lost by downward movement.

Most of the rice produced in Jefferson County is grown on Beaumont clay and Morey silt loam. Garner clay is used almost entirely for timber.

Surface crusts and plowpans are common in cultivated fields. The poor physical condition of the surface soil and the tight subsoil restrict the movement of soil moisture, plant roots, and air and prevent maximum production of crops.

Morey silt loam is more droughty than Beaumont clay and Garner clay. When not irrigated for rice, it is best suited to drought-resistant or cool-season plants.

Beaumont clay and Garner clay tend to crack badly in hot, dry weather. Deep cracks create problems in irrigation. A great deal more water is needed to saturate a badly cracked field than a field without cracks. Cracking also causes loss of water in irrigation canals.

The clay soils in this unit (Beaumont and Garner) stay wet longer after drainage than the silt loam soil (Morey). Seedbed preparation and proper irrigation are more difficult when Beaumont clay and Morey silt loam are farmed in the same field. When Morey silt loam has the proper amount of moisture for preparing a seedbed and for irrigation, Beaumont clay is too wet. Also, when Beaumont clay has the proper amount of moisture for these practices, Morey silt loam is too dry. Since working the soil when too wet or too dry is detrimental to soil structure, seedbeds for each soil should be prepared at a different time if possible.

Low, sandy, circular mounds occur on Morey silt loam in many places. Salt spots, which contain enough salts to offset plant growth, are at the base of some of these mounds. When the soils are leveled or smoothed, these salt spots are exposed at the surface. The salty material should be removed from the field, and the dug-out areas filled with salt-free material. If these salt spots are not removed, the soils puddle and absorb water very slowly. They then become very hard when dry and do not support plant growth. Where removal of these spots is not practical, a continuous mulch of straw helps to establish vegetation.

Because of the sandy mounds and more irregular topography of Morey silt loam, the rice levees on this soil are more crooked and closer together than those on the other soils in the unit.

All of the soils of this capability unit should be smoothed when the seedbed is prepared. Less soil moving will be required on Beaumont clay and Garner clay than on Morey silt loam.

All crops grown in the county are adapted to the soils in this unit. Crops will respond to fertilizers containing nitrogen, phosphate, and in some areas, potash. Agricultural limestone may be needed in a few areas for top production.

If these soils are used for row crops, feed crops, or supplemental pasture, the cropping system should include, at least 1 year in 3, a deep-rooted legume to be plowed under. Crop residue should be properly used, the soils should be fertilized, and a complete drainage system should be installed.

If these soils are used for rice, the cropping system should include 1 or 2 years of rice and 3 or more years of improved pasture. All crops should be properly fertilized. Crop residues and pastures should be well managed. A complete drainage and irrigation system is also required for maximum production.

Some grasses and legumes that are suitable for improved pasture or in cropping systems are bermudagrass (common), dallisgrass, tall fescue, longtom grass, vaseygrass, johnsongrass, gordo bluestem, sudangrass, ryegrass, white clover, lespedeza, burclover, red clover, singletary peas, alyceclover, alsike clover, Huban clover, and Persian clover.

CAPABILITY UNIT IIIw-2

Only the Crowley-Waller complex is in this unit. This complex consists of level to nearly level, imperfectly to very poorly drained prairie soils that have a very tight subsoil and a thick surface layer.

The soils in this mapping unit are used almost entirely as range for beef cattle.

The Crowley soils are imperfectly or somewhat poorly drained, and the Waller soils are very poorly drained. Crowley silt loam occupies slightly higher areas and surrounds the depressed areas of Waller soils. The mixture of soils in this complex and their different drainage conditions add to problems of soil management, including the selection of suitable crops.

These soils can be used for rice and other cultivated crops, supplemental pasture, and improved pasture. However, a complete drainage system is needed. If rice is grown, both a complete drainage system and an irrigation system are needed.

Drainage ditches would have to be cut through the Crowley soil to drain the Waller soil, and this would require more cutting than is normal.

Land smoothing is needed for proper drainage and irrigation. In the smoothing process, a great deal of Crowley silt loam should be moved on top of the low-lying Waller soil. This makes an additional expense for land smoothing.

Crops other than rice need drainage and a rotation that provides a legume at least once every 3 years. Residue from the legume and from other crops should be left on the soil, and fertilizer applied as needed.

Rice needs a drainage and irrigation system and the cropping system needed is 1 or 2 years rice followed by 3 or more years of improved pasture. Also, pastures should be managed, crop residue used, and the proper amount of fertilizers applied.

Some grasses and legumes that are suitable for improved pasture or in cropping systems are bermudagrass (Coastal and common), dallisgrass, little bluestem, tall fescue, vaseygrass, ryegrass, burclover, white clover, singletary peas, and Persian clover.

CAPABILITY UNIT IIIw-3

Only one soil, Acadia silt loam, 0 to 1 percent slopes, is in this unit. It is a level to nearly level, imperfectly drained, timbered soil that has a very tight subsoil.

This soil is almost entirely in woodland, some of which is grazed. The soil is suitable for the commercial production of pine and responds to good woodland management. (See the section "Management of Woodland.")

If cleared for crops or improved pasture, this soil would have the same use, problems, and management as the soils in capability unit IIIw-1. It would need, however, heavy applications of agricultural limestone to reduce the acidity. It would also need larger amounts of nitrogen, phosphate, and potash than the soils in capability unit IIIw-1.

Because of its location, low natural fertility, and high acidity, this soil probably would not be suitable for rice.

If the soil were cleared, some of the grasses and legumes suitable for improved pasture or in cropping systems would be bermudagrass (Coastal and common), dallisgrass, tall fescue, vaseygrass, ryegrass, white clover, singletary peas, lespedeza, burclover, and Persian clover.

CAPABILITY UNIT IIIw-4

Only the complex Caddo-Pocomoke loamy fine sands is in this unit. This complex consists of level to nearly level, imperfectly to poorly drained, coarse-textured, timbered soils.

These soils are almost entirely in woodland. Some of the woodland areas are grazed. The soils are suitable for woodland and respond to good woodland management. If cleared, the soils would also be suitable for corn, feed sorghum, supplemental pasture, improved pasture, and truck crops.

The soils take up water readily and could be worked easily. The Caddo soils occur on slightly higher positions than the Pocomoke soils. Seepage water from the Caddo soils saturates the Pocomoke soils and causes a high water table.

If the soils in this complex are cleared for cultivation or improved pasture, some of the surplus water should be removed by artificial drainage. Their sandy texture limits the amount of moisture and plant nutrients that can be stored for plant use. Cultivated crops and improved pasture would respond to the application of fertilizers containing nitrogen, phosphate, and potash. Agricultural limestone would be needed to make the soils less acid and more suitable for optimum plant growth.

Cropping systems should include a close-growing crop for soil improvement every other year; for example, 1 year of a truck crop followed by 1 year of a small grain or ryegrass. Crop residue should be used, crops should be properly fertilized and limed, and a drainage system should be installed.

If these soils were cleared, some grasses and legumes suitable for improved pasture or in cropping systems would be bermudagrass (Coastal and common), bahiagrass (Pensacola), weeping lovegrass, rye, ryegrass, lespedeza, vetch, and crimson clover.

CAPABILITY UNIT IIIs-1

This unit consists of level to gently sloping, moderately well drained to well drained, coarse-textured soils. They are—

Klej loamy fine sand.
Sabine loamy fine sand.

These soils occur on higher positions and are better drained than the surrounding soils. Excess water is not a problem, and the soils are easily tilled. They are dry enough for grazing when most of the other soils in the county are wet. Plant roots and air move through them freely. Productivity is low to moderate.

Water is taken up readily but moves freely through these coarse-textured soils. The soils cannot hold enough water and plant nutrients to produce high yields of crops. Plants are generally damaged by lack of moisture during dry periods. Shallow-rooted crops that need much water may die from lack of moisture in the summer months. The organic matter deteriorates rapidly when the soils are cultivated. Wind and water erosion occur when the soils are not protected.

The soils are suitable for corn, feed sorghum, supplemental pasture, permanent pasture, and truck crops. They are not suitable for rice. Crops respond to fertilizers containing nitrogen, phosphate, and potash. Fertilizers are easily leached from these soils. Consequently, small quantities should be applied at frequent intervals during the growing season rather than large quantities at the beginning. Agricultural limestone is needed to reduce acidity on Klej loamy fine sand.

Cropping systems should include a close-growing crop for soil improvement every other year; for example, 1 year of a truck crop and 1 year of a small grain or ryegrass. Crop residue and fertilizer should be used.

Some grasses and legumes that are suitable for improved pasture or in cropping systems are bermudagrass (Coastal and common), bahiagrass (Pensacola), weeping lovegrass, rye, ryegrass, lespedeza, vetch, and crimson clover.

CAPABILITY UNIT IVw-1

The soils in this unit are level to depressed and very poorly to moderately well drained. They are—

Byars-Acadia complex.
Byars silt loam.
Byars-Klej complex.
Waller soils.

This unit consists mainly of soils in low, depressed areas. Surplus water from surrounding soils enters these areas as runoff or seepage. Consequently, the soils are better suited to plants that are highly water tolerant. Rice is grown on the Waller soils, but all of the other soils in the unit are used for timber.

Deep cuts through the higher lying, surrounding soils are usually needed to drain these soils adequately for crop production. This extra cutting increases drainage expenses. Land smoothing is also expensive and difficult on areas of these soils in the same field with soils of other capability units. Water, air, and plant roots penetrate these soils with difficulty. Surface crusts and plowpans are common in cultivated fields.

Crops grown on these soils respond to fertilizers containing nitrogen, phosphate, and potash. The application of agricultural limestone will be beneficial in places, particularly where legumes are grown.

When these soils are used for rice, a cropping system consisting of 1 or 2 years of rice and 3 or more years of pasture should be followed. Crop residue should be properly used, and crops should be fertilized. Irrigation and drainage systems should be installed.

Some of the grasses or legumes suitable for improved pasture or in cropping systems are bermudagrass (Coastal and common), dallisgrass, little bluestem, tall fescue, vaseygrass, ryegrass, burclover, white clover, singletary peas, and Persian clover.

CAPABILITY UNIT VIw-1

In this unit are level to rolling, poorly to very poorly drained, timbered bottom-land soils that are frequently flooded. They are—

Alluvial land.
Bibb clay loam.

This capability unit consists of alluvial soils that have moderate fertility and can hold large amounts of water for plant use. They are not suitable for cultivation, because they are very poorly drained and are flooded frequently.

These soils are used for woodland and some woodland grazing and are best suited to these uses.

Before these soils could be cultivated, they would need to be cleared, protected from overflow, and drained. Extensive land smoothing would be needed on Alluvial land. Permanent improved pasture could be established on cleared areas, but these could be grazed only seasonally. Bibb clay loam occurs in low-lying areas that would be difficult to drain without salt-water intrusion. They could be adequately drained by an extensive pump-off system of drainage.

If improved pasture is established on these soils, only water-tolerant plants should be included in the pasture mixture. Such pasture would respond to fertilizer containing nitrogen, phosphate, and potash.

If the soils were cleared, some grasses and legumes suitable for improved pasture would be bermudagrass (common), dallisgrass, tall fescue, vaseygrass, white clover, burclover, red clover, and lespedeza.

CAPABILITY UNIT VIIw-1

The only soil in this unit is Harris clay. It is a level to depressed, very poorly drained, saline soil of the coast marsh.

This soil is used for range and wildlife and is very desirable for these uses. Extensive reclamation would be needed before most of this soil could be farmed or used for improved pasture.

Rice is grown on a few acres. A lot of fresh water is needed to remove salt from the surface before rice can be grown successfully. A permanent dike or levee system is needed around the fields to prevent salt-water intrusion, and a pump-off drainage system is needed to remove surplus water. When these practices are neglected, this soil will revert to native grasses.

Management for range and wildlife is discussed under "Management of Rangeland" and "Management of Wildlife."

CAPABILITY UNIT VIIw-2

This unit consists of level to nearly level, poorly drained, slightly elevated saline soils and land types of the coast marsh. They are—

Coastal land.
Harris clay, shallow over sand.
Made land.

These soils are too saline, too poorly drained, and too frequently damaged by storms and high tides to be suitable for cultivation or improved pasture. They are well suited to range and wildlife.

Management for these uses is given under "Management of Rangeland" and "Management of Wildlife."

CAPABILITY UNIT VIIw-3

In this unit are wet soils and land types that have a moderately stable subsoil. They are—

Galveston fine sand.
Salt water marsh.
Swamp.

The soil and land types in this unit are affected by excessive fresh or brackish water or by daily salt sprays. Therefore, they cannot be used for cultivation or improved pasture unless reclaimed extensively.

Swamp is used for woodland, and Salt water marsh and Galveston fine sand are used for limited grazing. All are valuable for wildlife. Galveston fine sand is excellent for camping.

Management for woodland, rangeland, and wildlife is given elsewhere in this section.

CAPABILITY UNIT VIIIw-1

The land type in this unit, Tidal marsh, consists of areas that have an unstable subsoil and are affected daily by salt-water tides. In addition, the water table is permanently high and the area is soupy or unstable and will not support the weight of livestock. The thick cover of vegetation on Tidal marsh makes it valuable for wildlife. Major reclamation would be needed before the area would be suitable for any other use.

Management practices for wildlife are given in the section "Management of Wildlife."

CAPABILITY UNIT VIIIs-1

In this unit are land types consisting of excavations and other areas that have no vegetation. They are—

Borrow pits.
Oil-waste land.

The miscellaneous land types in this unit are not suitable for cultivation, improved pasture, woodland, or rangeland. Some Oil-waste land may be reclaimed in time.

Borrow pits may be used to supply water for livestock and wildlife. Both miscellaneous land types are of some benefit to wildlife.

Yield Predictions

The predicted average yields that can be expected from crops grown on soils of Jefferson County under two levels of management are given in table 2. The estimates of yields in columns A and B are based on information gathered through interviews with farmers, county agricultural workers, and others who have observed or maintained yield records under different types of management in the county.

In columns A are average yields obtained by farmers who use a few, rather than all, of the management practices that have proved best for producing good yields. In columns B are average yields obtained by using all the management practices discussed in the sections "General Management of Cropland and Improved Pasture" and "Management by Capability Units." Rice yields are given in pounds (162 pounds equal 1 barrel, the normal unit of measure for rice). Corn is given in bushels, and forage sorghum is given in tons of dry forage.

Yields of woodland for the county are given in the section "Management of Woodland," and yields of range grasses for each range site in the section "Management of Rangeland."

Management of Rangeland[1]

The grazing of native rangeland is an important land use in the county. Approximately one-fourth of the

[1] This section was prepared with the help of R. J. PEDERSON, range conservationist, Soil Conservation Service.

TABLE 2.—*Predicted average acre yields of principal crops under two levels of management*

[Soils not listed in this table are used mainly for native range or woodland]

Soil	Rice		Corn		Forage sorghum	
	A	B	A	B	A	B
	Lb.	*Lb.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Beaumont clay	2, 750	4, 050	12	30	2. 0	3. 0
Crowley silt loam	2, 590	3, 880	15	45	1. 5	3. 0
Crowley-Waller complex	2, 200	3, 000	12	30	1. 5	2. 0
Hockley silt loam, 1 to 3 percent slopes			15	50	2. 0	3. 5
Lake Charles clay	3, 280	4, 250	20	45	2. 0	3. 5
Morey silt loam	2, 750	4, 050	15	50	1. 5	3. 0
Sabine loamy fine sand			15	40	1. 5	2. 0
Waller soils	2, 200	3, 000	10	20	1. 0	1. 5

county is rangeland. Native range, improved pasture, riceland, and woodland furnish grazing for more than 40,000 cattle in the county. The cattle are principally crosses of Brahman and English breeds. Stockers and veal calves are the major classes marketed.

Rangeland alone does not furnish high-quality forage all year long. To improve their grazing and feeding programs, ranchers normally use supplemental pasture and improved permanent pasture, and they feed supplements to the cattle. Management practices for permanent and supplemental pastures are discussed in the sections "General Management of Cropland and Improved Pasture" and "Management by Capability Units."

There are two major types of rangeland in Jefferson County: (1) Marsh range in the coast marsh section of the county, and (2) Prairie range in the coast prairie section.

Marsh range.—This is by far the most extensive and important type of rangeland in the county. It covers an area of more than 150,000 acres. The largest area borders the Gulf of Mexico and extends on both sides of the Gulf Intracoastal Waterway across the entire southern part of the county. Other areas are along the Neches River and major bayous in the county. These are low, wet areas that are covered by water most of the time. The water is generally a mixture of fresh and salt water. The soils are saline, and the vegetation consists primarily of salt-tolerant grasses and sedges adapted to water and saturated soils.

The usual grazing period of marsh range is from mid-October to mid-April. Except during severe storms or cold, wet weather, cattle do well on the range in winter. In summer, mosquitoes make it necessary to move cattle from a large part of the marsh range to ricefields, improved pasture, or woodland.

Some hazards on marsh range are insects, excess flooding, diseases, lack of shelter, unstable soils where cattle bog, and storms or wet, freezing weather. Inadequate distribution of grazing, rapidity of fence deterioration, inadequate stock water, wildfires, and difficulty of access or travel are additional problems.

Marsh range is divided into four range sites: (1) Salt Marsh range site, (2) Salt Prairie range site, (3) Deep Marsh range site, and (4) Fresh Marsh range site.

Prairie range.—This type of range is of minor extent and is the less important of the two types. It occurs on soils of the coast prairie and consists mostly of small areas scattered throughout the central part of the county. Nearly all soils in Prairie range are suitable for rice production. For this reason, most of the native grassland has been plowed and farmed to rice at one time or another. Since the acreage in rice production has been controlled, some of these soils are now being converted back to native range and to improved permanent pasture.

Prairie soils are low in available phosphorus, and prairie grasses produced on these soils do not contain enough phosphorus for optimum livestock production. Livestock need mineral supplements when on prairie range. The forage generally lacks enough protein for a balanced diet during fall and winter. Accessibility and insects are not serious problems on Prairie range.

Prairie range is divided into four range sites: (1) Coastal Sand range site, (2) Blackland range site, (3) Loamy Prairie range site, and (4) Sandy Prairie range site.

Range site and condition

Rangeland is classified according to the kind and amount of native vegetation that grows on the soil in any given climate. Soils in their natural condition support more than one kind of vegetation. The combination of plants that originally grew on a soil is called the potential vegetation. Potential vegetation is the most productive combination of native plants on any given range site. Range site refers to an area of range that is sufficiently uniform in kind of soil, water levels, and other characteristics to produce a certain kind and amount of potential vegetation. For example, Salt Marsh site can produce a large volume of cordgrass and associated plants, but the potential vegetation on Sandy Prairie site is bluestems and associated plants. A range site usually has in it more than one type of soil, but all soils in the site have about the same potential for producing native plants. In some places one range site may be converted to another, as in areas where changes in water depth or salinity have occurred.

The condition of the range is determined for each site by comparing the present vegetation on the site with the original, or potential, vegetation. Condition is classified as *excellent, good, fair*, or *poor*. By determining the condition, a rancher may measure the approximate deterioration of the plant cover and have a basis for determining the amount of improvement needed.

Livestock constantly seek and graze the more palatable and nutritious plants in a grazing area. If grazing is not managed, the better plants will be grazed so heavily that they will decrease. These high-quality, original native plants are referred to as *decreasers*. When the more palatable plants decrease in a pasture, the second-choice plants tend to increase. These plants are referred to as *increasers*. If heavy grazing continues, the amount of second-choice plants will be reduced, and low-growing or ungrazable plants will take their place. These poor-quality plants are referred to as *invaders*. This process in range deterioration can be reversed by practicing grazing management.

The eight range sites in Jefferson County are next discussed.

SALT MARSH RANGE SITE

The only soil in this site is a deep, saline clay. The soil is Harris clay.

This is the major range site in the county. It occurs in nearly level or depressed areas on the coastal marsh. Elevations ranges from sea level to 4 feet above. Many natural lakes, small drains, and large waterways are adjacent to the site. Water ranging from salty to fresh is on the site most of the year. It is usually 2 inches above to 2 inches below the surface; at times, however, it is from 2 feet above to 4 feet below. The salt water comes on the site from high tides and gulf storms, and the fresh water from rainfall and inland drainage.

The major potential grass is marshhay cordgrass, but there are smaller amounts of seashore saltgrass, common reed, and big cordgrass. Bushy sea oxeye is an important half shrub in the more salty areas. Smooth cordgrass is abundant in localized, small areas where sea water is present. Seashore saltgrass increases where the other grasses decrease because of overuse. Under heavy use and uncontrolled burning, olney, saltmarsh, California and softstem bulrushes, needlegrass rush, and seashore paspalum will increase and invade the site in varying amounts. These plants have invaded some areas in small, scattered stands and others in large, solid stands.

Because of the abundance of water on this site, salt-tolerant vegetation grows profusely. The excessive growth is susceptible to wildfires in dry periods. There is excellent grazing on this site during the late fall, winter, and spring months. The cordgrass stays green during this period.

In summer, grazing on this site is limited by insects. In winter, livestock would benefit if shelters were placed at appropriate intervals for protection from cold, wet storms. In some areas of this site, excavated pits and wells are needed for a reliable water supply. Cattle walkways are also very beneficial.

If this site is in good to excellent condition, the air-dry herbage produced during average years is approximately 10,000 pounds per acre. Production of forage is reliable, and it varies little from year to year.

SALT PRAIRIE RANGE SITE

The mapping units in this site are deep, saline clays and stratified clayey and loamy materials. They are as follows—

Harris clay, shallow over sand.
Coastal land.
Made land.

This site occurs on elevations ranging from sea level to 8 feet above. Low-lying ridges, elevated, broad flats, or short, steep embankments make up the surface. Because of the slightly higher elevation, there is more runoff from this site than from any other in the coast marsh. The site is affected by salt water from tides and storms and by fresh water from rainfall.

When the site is in excellent condition, gulf cordgrass makes up three-fourths of the vegetation. Smaller amounts of switchgrass, little bluestem, longtom, and knotroot bristlegrass occur. In areas where the soil salinity is too high for prairie grasses, the vegetation is nearly all gulf cordgrass. In areas where heavy use and burning occur, the prairie grass decreases, and a few annual grasses and weeds invade the site.

Because of its slightly higher elevation, this site is important in the marsh area. It provides natural walkways and resting grounds for livestock when other sites of the marsh are under water. Because of its higher elevation, however, this site is more susceptible than other marsh sites to harmful overgrazing and to wildfires that cause deep burns.

If the site is in good to excellent condition, the total air-dry herbage produced during average years is approximately 9,500 pounds per acre. Variations in growth from year to year are not great.

DEEP MARSH RANGE SITE

Salt water marsh is the only mapping unit in this site. It is a deep, permanently wet miscellaneous land type that has 16 to 36 inches of organic peat and muck over clay or silty clay material.

The site occurs in low, depressed areas near the Neches River and in natural drains in the southern marshes of the county. The elevation ranges from sea level to 6 feet above. Water covers the site most of the year and ranges from salty to fresh. The salt water comes from high tides and gulf storms and the fresh water from rainfall and inland drainage.

Because some areas are more frequently influenced by salt water, and others by fresh water, the potential vegetation is variable. The climax vegetation on the site consisted of common reed, marshhay cordgrass, smooth cordgrass, and olney bulrush. When water is more saline than fresh, the cordgrasses are the dominant vegetation.

The control of salinity and water depth are important management practices on this site. Ditches should not be cut into the site, unless structures are used to control inflow of salt water. Open ditches allow intrusion of more salt water than is normal for the site. On the other hand, obstructions that keep out salt water increase the amount of fresh water to above normal. When the water is kept fresh, the site becomes a Fresh Marsh site. Then the potential vegetation is paille finegrass, giant cutgrass, common reed, and cattail bulrush.

If the site is in good to excellent condition, the total air-dry herbage produced during average years is approximately 8,500 pounds per acre. Production on this site varies only a little from year to year.

FRESH MARSH RANGE SITE

This site occurs in level or depressed areas where fresh water stands most of the year. It is of minor extent in Jefferson County.

The soils are not named for Fresh Marsh site, as the existence of the site depends more on maintaining fresh water than on soil characteristics. For this reason, small, isolated areas in the site should be determined locally.

As has been stated, it is possible to convert one range site to another. The soil characteristics or the environment for plants must be altered, however. For example, the surface soil becomes less saline when only fresh water is permitted on Salt Marsh site. The lower salinity plus the fresh water on the surface create an environment for fresh-water vegetation, but a fresh-water supply must be on or near the surface to maintain the site. When the soils are drained or the surface water becomes salty, the

Fresh Marsh site will take on the characteristics of another site.

Fresh-water marsh provides green forage in midsummer and in droughty seasons. Generally, giant cutgrass, paille finegrass, and common reed are the main potential, or decreaser, plants. Smartweed, alligatorweed, rattlebox, and bultongue increase and invade when the better plants are burned or overgrazed. The kind of potential plants on this site, however, are largely determined by the averages and extremes in the depth and salinity of the surface water. Consequently, the plants produced vary considerably from place to place. Plant growth, however, is reliable on this site, and drought has only a small effect on the volume produced.

COASTAL SAND RANGE SITE

The only soil in this site is Sabine loamy fine sand. It is a deep loamy fine sand that holds a small amount of available moisture for plant use.

This site occurs on low ridges in the southern part of the county. It is about 3 to 8 feet higher than surrounding range sites of the marsh area. The site is affected primarily by fresh water from rainfall and occasionally by salt-water sprays during gulf storms. Water enters the soil readily, and standing surface water is not a problem.

Potential vegetation is primarily little bluestem, Indiangrass, and gulf dune paspalum. Small amounts of gulf cordgrass and marshy cordgrass occur near the outer edges of the site. Annual weeds, bermudagrass, carpetgrass, and smutgrass invade the site when little bluestem is grazed out. Under continued heavy grazing, waxmyrtle and weeds invade the site.

Because of its elevation and location, this is a valuable range site. It provides higher grounds for livestock when the adjacent marsh ranges are covered with water. Rainfall enters the soil readily, and small showers wet the soil deeply. The soil warms early in spring; therefore it has an early growth of forage. Grazing should be reduced in spring and fall to allow the tall-growing grasses to establish a deep-root system. Thus the tall grasses will have better growth and quality and the short grasses will invade less during the hot, dry summer months.

Usually, wells are needed to supply water for livestock. Dug pits are not reliable on the sandy soil. If the site is in good to excellent condition, the total air-dry herbage produced during average years is approximately 5,250 pounds per acre. Seasonal or longer drought may lower production 20 percent.

BLACKLAND RANGE SITE

This site consists of deep, moderately productive, strongly acid to mildly alkaline clays. The following soils are in this site—

Beaumont clay.
Lake Charles clay.

The site occurs on level to nearly level areas throughout the coast prairie part of the county. The soils in the site hold large amounts of available water for plant growth. Runoff is slow to very slow, and internal drainage is slow to very slow.

Potential vegetation consists of a tall-grass prairie type that includes Indiangrass, switchgrass, little bluestem, big bluestem, and eastern gamagrass. There are also minor amounts of Florida paspalum, longtom, brownseed paspalum, Scribner panicum, and cordgrasses. Some valuable, broadleaf forbs that also grow on the site are button snakeroot, Maximilian sunflower, and several species of herbaceous legumes. Invaders are annual weeds and grasses, waxmyrtle, rattle-box, carpetgrass, and bermudagrass.

When the soils of this site are full of water, plants will grow for long periods without additional rainfall. At the start of the growing season, the soils are normally full of water and produce excellent vegetation for summer range. When they are dry, small rains are not effective in aiding regrowth. Grazing should be reduced in fall, so that plants can regain vigor and store food for the next growing season. Heavy use of the soils of this site during wet periods causes hoof pans, or soil compaction. The amount of water that can enter the soil is reduced by compaction, and production is lowered. Livestock should therefore be moved to higher, drier ranges during wet weather.

Natural depressed areas, drainage ditches, and irrigation canals normally supply adequate drinking water for livestock on this site.

If the site is in good to excellent condition, the total air-dry herbage produced during average years is approximately 7,250 pounds per acre. Seasonal or longer droughts may lower production as much as 50 percent.

LOAMY PRAIRIE RANGE SITE

This site consists of deep, acid, poorly to very poorly drained loamy soils. The following soils are in this site—

Crowley-Waller complex (Waller soils only).
Morey silt loam.
Waller soils.

This site occurs throughout the coast prairie part of the county. It occurs on nearly level to depressed areas that are affected only by fresh water. Water enters the site as rainfall or as runoff from other prairie soils. These soils hold moderate amounts of available moisture for plant use. Runoff is ponded to very slow, and internal drainage is very slow. Some low sandy, circular mounds occur on this site.

The potential vegetation consists of little bluestem, Indiangrass, switchgrass, brownseed paspalum, and several kinds of panicum. When grazed heavily, bluestems and Indiangrass decrease, and brownseed paspalum and panicum increase. Carpetgrass invades and becomes dominant on the range when the taller grasses are overgrazed. Other invaders are waxmyrtle, annual weeds, and rattlebox.

After heavy rains, water stands on the surface of the soils of this site for long periods. Livestock graze on the sandy mounds while other parts of the site are under water. As a result, grazing is uneven, and invaders soon take over the mounds. Grazing on this site should be restricted in spring to allow the plants to produce a vigorous growth and a deep root system that will help maintain them during the hot summer months. The soils of this site crust severely when not protected by vegetation.

Natural depressed areas, drainage ditches, and irrigation canals normally supply adequate drinking water for livestock. If the site is in good to excellent condition, the total air-dry herbage produced during average years is approximately 6,500 pounds per acre. Growth may be reduced in dry years as much as 50 percent.

SANDY PRAIRIE RANGE SITE

This site consists of deep, strongly to medium acid soils that have a thick sandy loam surface layer and a clayey subsoil. This site consists of the following soils—

Crowley silt loam.
Crowley-Waller complex (Crowley soil only).
Hockley silt loam, 1 to 3 percent slopes.

The site occurs on nearly level to gently undulating areas throughout the coast prairie part of the county. It is at higher elevations than the other range sites. The soils in the site absorb water readily and can hold moderate amounts of moisture for plant use.

Potential vegetation consists primarily of little bluestem, Indiangrass, switchgrass, big bluestem, brownseed paspalum, and several kinds of panicum. Brownseed paspalum, several kinds of low-growing panicum, and gulf muhly increase as little bluestem and Indiangrass decrease. Invaders that become major plants on deteriorated range are carpetgrass, bermudagrass, annual weeds and grasses, waxmyrtle, and smutgrass.

This site is better drained than most range sites and provides higher ground for livestock when other ranges are wet. Water from rainfall enters the soils readily, and small showers wet it deeply. These soils produce an early growth of forage, because they warm early in spring. The forage on this site is deficient in phosphorus all year and is low in protein during fall and winter. Livestock gains are best in spring and early summer. Wells are usually needed for livestock water on this site.

If the site is in good to excellent condition, the total air-dry herbage produced during average seasonable years is approximately 6,000 pounds per acre. Seasonal or longer drought may lower production as much as 50 percent.

Management practices

Good production of livestock and forage on rangeland is obtained primarily by managing the time of grazing and limiting the amount of growth removed. The green parts of plants manufacture food for growth and store part of it for regrowth and seed production. Management practices that are used in a grazing program should permit this process to take place.

Proper range use.—This is the regulation of grazing so that approximately one-half, or more, of the yearly growth is left. This practice helps keep the plants healthy and vigorous.

Deferred grazing.—This is the deferment or restriction of grazing until the better plants have completed most of their seasonal growth or have made seed. It is one way to help keep the plants healthy and vigorous. Frequent use of deferred grazing permits plants that have been depleted to increase.

Fresh water supply.—Providing good water for livestock is a part of range management. Marsh water is not always fresh, as most of the natural lakes and drains in the area are affected by water from the gulf. Therefore, fresh water from wells, dug pits, and ditches is necessary. Pits dug in spoil banks along canals and walkways can be used to trap and hold rain or fresh water draining from inland areas. Watering places should be provided for stock at various points in the grazing area. This decreases grazing near any one watering place and makes the grazing of the entire range more uniform.

Cattle walkways.—These are small, earth ridges built into the marsh areas that are least grazed (fig. 12). They are used to provide more uniform grazing, to provide bedding grounds for livestock, to facilitate ranching operations, and to make the marsh more accessible to livestock, ranchers, and hunters. In constructing walkways, the borrow pits should be staggered to prevent drainage of the marsh and to permit cattle to enter the grazing area on both sides of the embankment. The pits will also hold some fresh water for livestock and wildlife.

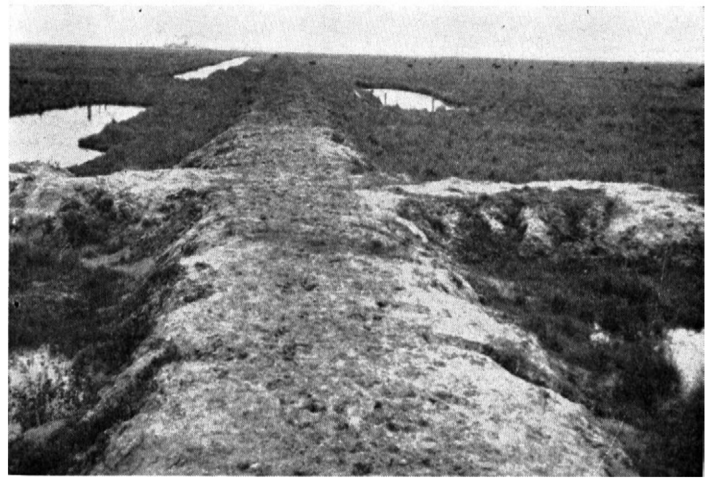

***Figure 12.*—Cattle walkways with staggered borrow pits will provide more uniform use of marsh range.**

Water depth and salinity.—The depth and the salinity of water on marsh range greatly influence the amount and kind of vegetation produced and increase the problems of range management. If salt water is kept from an area, and fresh water is applied in large amounts, vegetation tends to revert from salt-tolerant plants to bultongue, cattails, and bulrush. These plants are less desirable for grazing and greatly decrease the value of the range.

Care should be taken when roads, ditches, dikes, and other structures are built in the marsh. Structures should be built so as to insure the natural flow of water and to control the water levels. Some water-gate structures are now used to maintain optimum water depth and salinity. Good methods for improving and maintaining marsh areas include the use of watergates and changing the location of misplaced dikes and levees.

Fires on rangeland.—Stockmen sometimes burn off the heavy, mature cover of marsh vegetation to provide new, succulent growth for cattle and waterfowl (fig. 13). Fires are also started by trappers, sportsmen, and other people for various reasons, or from carelessness. If the soil is dry and fire reaches the crowns and roots of plants, it can damage the vegetation severely. Marsh fires also destroy much of the original organic surface layer. Plants die extensively when water stands on the range following a deep burn. Once the range is burnt, grass should be allowed to grow 10 inches high before it is grazed again. Cattle walkways and canals can be used to isolate and control marsh fires.

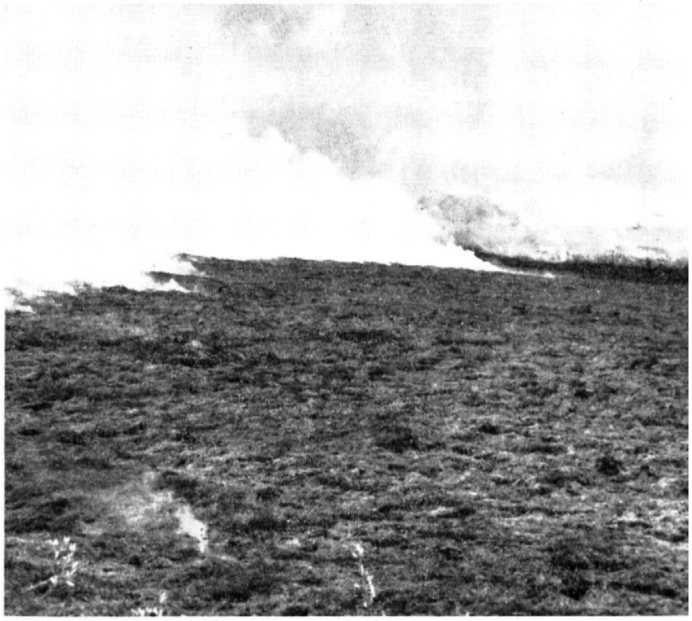

Figure 13.—**Burning marsh range destroys organic matter on the soil and may cause reduction of desirable plants.**

Management of Woodland [2]

The commercial forests of Jefferson County are primarily on the soil associations of the East Texas timberlands (Garner-Byars-Acadia association) and of the flood plains (Bibb-Alluvial land association). In a few places, trees have encroached on the heavy, tight soils of the coast prairie. The largest areas of timber in the county extend across the northern boundary in a narrow band that includes the upper part of the Neches River. One large, isolated area is in the west-central part of the county near Fannett. Smaller areas are located along some of the natural drains and bayous in the county.

The major forest types in the county are loblolly-shortleaf pine, oak-gum-cypress, oak-pine, and small areas of longleaf pine. The virgin stands of timber have been cut, and the second-growth stands are used for timber production under varying degrees of management.

Properly managed woodlands are valuable not only for cash crops but also for recreation, seasonal grazing of livestock, and habitats for wildlife.

The management planned for each woodland tract is based on the characteristics of the tract, the kinds of trees on the tract, and the wishes of the landowner. Assistance in woodland management is available through the Coastal and Trinity Bay Soil Conservation Districts, the county agricultural agent, and the Texas Forest Service.

[2] This section was prepared with the help of E. C. WILBUR, woodland conservationist, Soil Conservation Service.

Woodland suitability groups

The soils of the county suitable for woodland have been placed in eight woodland suitability groups. This grouping helps landowners plan the use of their soils for woodland. The soils in a particular group have essentially the same productivity and produce the same kinds of wood crops. They also respond to similar management. Each woodland suitability group is discussed separately on the following pages. A summary of the average site index, species priority, and the more important ratings for each group is given in table 3.

TABLE 3.—*Summary of average site index, species priority, and ratings for woodland suitability groups*

[See text for names of soils in each group and description of the group]

Woodland suitability group	Average site index [1] for—			Species priority	Plant competition	Equipment limitation	Seedling mortality	Windthrow hazard	Erosion hazard
	Slash pine [2]	Loblolly pine	Longleaf pine						
1	(3)	86	76	Loblolly and longleaf pine	Moderate	Moderate to severe.	Slight to moderate.	Slight	Slight.
2	92	92	82	Loblolly, slash, and longleaf pine	Severe	Moderate	Slight	Slight	Slight.
3	85	85	(3)	Loblolly and slash pine; sweet and black gums.	Moderate	Slight	Moderate	Slight	Slight.
4	90	90	(3)	Loblolly and slash pine; white and red oak; sweetgum.	Severe	Severe	Moderate	Slight	Slight.
5	94	94	(3)	Loblolly and slash pine; white and red oak; sweetgum.	Severe	Severe	Severe to moderate.	Slight	Slight.
6	82	82	(3)	White and red oak; loblolly and slash pine.	Severe	Severe	Moderate to severe.	Slight to moderate.	Slight.
7	90	90	(3)	Loblolly and slash pine; white and red oak; sweetgum.	Severe	Severe	Moderate	Slight	Slight.
8	(4)	(4)	(4)	Various kinds of hardwoods, such as cypress, sweetgum, and white oak.	Severe	Severe	Slight	Slight	Slight.

[1] Site index is total height of dominant trees at 50 years of age and indicates potential productivity. The site index for each group varies ±5 feet.
[2] It is assumed that the growth of slash pine will be equal to that of loblolly pine on the same soils.
[3] Species not present in the woodland group.
[4] Site varies according to species of hardwood produced.

The information in this section is based on growth-rate studies (site-index measurements) and on the judgment of woodland conservationists familiar with the area. The terms and the ratings used in table 3 and in the woodland suitability groups are discussed in the following paragraphs.

Site index.—This indicates the productivity of forest soils (see table 3). In this county the site index refers to the height of dominant trees at 50 years of age. For example, a site index of 90 means that the dominant trees should be 90 feet tall when they are 50 years old.

Plant competition.—This refers to the degree of competition and rate that undesirable species invade different soils when adequate sources of seed from invaders are present. The ratings are (1) *slight*—competition from other plants is no special problem; (2) *moderate*—plant competition develops but generally does not prevent an adequate stand from becoming established; (3) *severe*—plant competition prevents trees from restocking naturally.

Equipment limitations (also known as trafficability).—These limitations refer to soil characteristics that restrict or prohibit the use of equipment commonly used in tending and harvesting the trees. Wetness is one of the dominant factors. The ratings are (1) *slight*—no restriction in the kind of equipment or in the time of year it is used; (2) *moderate*—seasonal restriction of less than 3 months in the use of equipment, and the equipment is likely to cause some damage to the roots of trees; (3) *severe*—seasonal restriction of more than 3 months in the use of equipment, and the equipment is likely to cause severe damage to the roots of trees.

Seedling mortality.—This refers to the expected degree of mortality of seedlings as influenced by kinds of soil. The ratings are (1) *slight*—ordinarily adequate natural regeneration will take place; (2) *moderate*—natural regeneration is not always reliable for adequate and immediate restocking; (3) *severe*—much replanting, special seedbed preparation, and superior planting techniques needed for adequate restocking.

Windthrow hazard.—This is an evaluation of soil characteristics that control the development of tree roots and thus affect windfirmness. The ratings are (1) *slight*—no special problem is recognized; (2) *moderate*—root development of designated species is adequate for stability, except for periods of excessive wetness and of greatest wind velocity; (3) *severe*—depth of tree rooting does not give adequate stability.

Erosion hazard.—This refers to the hazard when the area is managed according to currently acceptable standards. The ratings are (1) *slight*—no special management practices needed to control erosion; (2) *moderate*—some preparation needed to control erosion on roads, skid trails, and fire lanes; (3) *severe*—special management needed to control erosion on roads, skid trails, and fire lanes.

Hazards from forest pests are the expected damage or mortality of stands caused by such pests as Texas leaf-cutting ants and gophers, insects, and fungi, and physiological disturbances that are associated with certain soils. The ratings are (1) *slight*—little damage from pests is likely; (2) *moderate*—damage from pests is likely; some replanting or pest control may be necessary for full stocking; (3) *severe*—pest control is necessary before planting, and complete replanting may be necessary if pests are not controlled.

722-425—64——3

WOODLAND SUITABILITY GROUP 1

In this group are deep soils with a silty surface layer and a very tight subsoil that restricts the movement of water, air, and plant roots. The soils are—

(AcA) Acadia silt loam, 0 to 1 percent slopes.
(AcB) Acadia silt loam, 1 to 5 percent slopes.

Plant competition does not prevent desirable species from becoming established but may delay natural regeneration and initial growth of trees. Special seedbed preparation will help produce an adequate stand of desirable trees. Hardwood trees on the soils of this group are usually inferior species that have little or no commercial value.

Equipment limitation is moderate to severe. Logging is usually limited to the dry seasons. During rainy seasons logging operations will cause considerable damage to tree roots.

Seedling mortality is slight to moderate. Losses influenced by the soil may be as great as 20 to 40 percent of the planted seedlings, particularly during dry periods.

Windthrow is generally not a problem. Individual trees are likely to remain standing when released on all sides.

The erosion hazard is not serious if adequate cover is maintained.

WOODLAND SUITABILITY GROUP 2

Only one complex of soils—Caddo-Pocomoke loamy fine sands (Cp)—is in this group. This complex consists of deep soils with a thick surface layer and a friable subsoil that permits good movement of water, air, and plant roots. The soils supply extra moisture for growth of trees.

These soils have a high moisture-supplying capacity, so plant competition is severe. Special management—such as controlled burning, use of chemicals, and deadening—are usually needed for adequate restocking with pines.

Equipment limitations are moderate. Logging is difficult and damages tree roots if done during rainy seasons.

Seedling mortality is slight for both planted and natural seedlings. Restocking from initial plantings or by natural regeneration is likely to be satisfactory.

Windthrow is not a problem. Individual trees are likely to remain standing when released on all sides. Trees on these soils can be cut without future windthrow losses, except those caused by abnormally high winds.

Erosion is not a hazard if adequate cover is maintained.

WOODLAND SUITABILITY GROUP 3

The only soil in this group is Klej loamy fine sand (Kf). It is a deep sandy soil that takes up water readily and has a moderately high water table. The soil does not have capacity to hold much moisture, but the moderately high water table supplies some extra moisture for tree growth.

Plant competition does not prevent the establishment of desirable species. It may delay natural regeneration of trees and their initial growth, however. Special preparation of seedbeds will help to obtain an adequate stand of desirable trees.

Equipment limitation is slight. Work can be done at any time during the year except just after heavy rains.

Seedling mortality is a moderate problem because of the low available moisture in the surface layer and the depth to the water table. Loss of 25 to 35 percent of planted seedlings is likely. Some replantings are usually needed to fill in openings.

Windthrow causes little loss of trees. Individual trees are likely to remain standing when released on all sides. Cutting can be done without future windthrow losses, except those caused by abnormally high winds.

If adequate cover is maintained, erosion is not a problem. Forest pests, such as leaf-cutting ants and gophers, are a hazard when pine seedlings are planted. Where these pests occur, control practices should be carried out before planting.

WOODLAND SUITABILITY GROUP 4

The only soil in this group is Garner clay (Gc). It is a deep heavy clay that cracks when dry and swells when wet. The soil holds large amounts of moisture for plant roots, but the movement of water, air, and plant roots in the profile is restricted.

This soil has a high moisture-supplying capacity, so plant competition is severe. Natural regeneration is not always reliable. Special site preparation, such as controlled burning, use of chemicals, deadening, and possibly underplanting, is needed in many places. There is usually a high percentage of willow, water, and white oaks and other hardwood trees on the soils of this group.

Equipment limitation is severe. Tree roots are seriously damaged and logging is difficult if the work is done during rainy periods. Water control may be beneficial.

Seedling mortality is moderate. Losses may reach 25 to 50 percent of the planted seedlings. Natural regeneration is not always reliable for immediate restocking.

Windthrow is not a problem. Individual trees are likely to remain standing when released on all sides.

Erosion is not a problem.

WOODLAND SUITABILITY GROUP 5

Only the Byars-Klej complex (By) is in this group. The soils in this complex are deep and very poorly drained to moderately well drained. They have a thick surface layer and can hold moderate amounts of moisture for plant use. Some areas of both soils are flooded occasionally, and water stands on or near the surface of the Byars soil for long periods.

A large percentage of the woodland stand consists of water-tolerant hardwoods, such as water, willow, white, and red oaks. These soils normally do not produce shortleaf and longleaf pines. They are highly productive of some hardwoods of better quality. Ridges and mounds on the Klej soil are very productive of loblolly pine. Some areas can be managed entirely for hardwoods, but others can be managed for mixed stands of pines and hardwoods.

Plant competition is severe. Natural regeneration cannot be relied on to restock these soils adequately. Special management, such as controlled burning, use of chemical sprays, girdling, and other practices, are needed to prepare the sites.

Equipment limitation is severe. Unless use of equipment is restricted during rainy and wet seasons, tree roots will be considerably damaged and logging will be difficult.

Because of the long, wet periods, seedling mortality of natural or planted seedlings is severe to moderate.

Windthrow hazard is slight. Individual trees are likely to remain standing when released on all sides.

Erosion is not a significant hazard.

WOODLAND SUITABILITY GROUP 6

In this group are deep, imperfect or somewhat poorly drained to very poorly drained soils. These soils have characteristics that restrict the movement of water, air, and plant roots. Water stands on or near the surface most of the year. The soils are—

(Br) Byars silt loam.
(Bx) Byars-Acadia complex.

Hardwoods are the principal trees on soils of this group. Water-tolerant hardwoods grow on the Byars soil, and pines grow primarily on the Acadia soil. Areas in pine are moderately productive.

Plant competition is severe. Natural regeneration will not provide an adequate stand of desirable trees. Controlled burning, girdling, clearing, use of chemicals, and other special practices are needed to prepare the site.

Since water stands on or near the surface of these soils most of the year, the use of logging equipment is severely limited.

Seedling mortality is severe on the Byars soil and is moderate on the Acadia. Natural regeneration of pine is not reliable. If the site were managed mainly for pine, controlled surface drainage or other special seedbed preparations would be needed.

The Byars soil in this complex is saturated for extended periods, so that the trees are shallow-rooted and poorly anchored. Windthrow is therefore a moderate problem. It generally is not a problem on the Acadia soil.

Erosion is not a significant problem on the soils of this group.

WOODLAND SUITABILITY GROUP 7

In this group are deep, poorly drained, coast prairie soils. They will hold large amounts of water for plant use, but the movement of water, air, and plant roots in the profile is restricted. The soils are—

(Ba) Beaumont clay.
(Md) Morey silt loam.

The soils of the coast prairie normally are not suitable for trees and are not used for them. Where coast-prairie soils join the more acid soils of the East Texas timberlands, however, trees have encroached and are now producing good wood products.

These soils have a high moisture-supplying capacity, and plant competition is severe. Natural regeneration is not always reliable. Special site preparation, such as controlled burning, use of chemicals, deadening, and possibly underplanting, are needed in many places.

Equipment limitation is severe. During wet periods equipment is generally difficult to use and causes severe damage to tree roots and soil structure.

Seedling mortality is moderate. As much as 25 to 50 percent of planted seedlings may be lost.

There are no particular problems of erosion, windthrow, or soil-associated forest pests on these soils.

WOODLAND SUITABILITY GROUP 8

The soils in this group are poorly drained to very poorly drained and are frequently flooded. They occur on the lower lying flood plains of the Neches River and Pine Island Bayou. Water is either above or slightly below the surface soil throughout the year. The soil and miscellaneous land types are—

(Bb) Bibb clay loam.
(Ad) Alluvial land.
(Sw) Swamp.

Because these soils occur in depressed positions or in low areas on the flood plains, they are subject to extensive flooding and normally cannot be planted to pine. A few scattered pines grow on Alluvial land. Cypress trees are dominant on Swamp; some, however, grow on Alluvial land and Bibb clay loam. Other water-tolerant hardwoods grow on all soils of the group. Unless major reclamation is used to correct water problems, the soils in this group should be managed for hardwoods.

The use of equipment is restricted to dry periods. Establishing desirable species is a problem because of flooding and wetness.

Erosion is not a significant problem on the soils of this group.

Woodland practices

Protection of woodland from wildfires, harmful grazing, insects, diseases, and erosion is the first requirement for woodland management.

The Texas Forest Service provides fire protection on private lands. Management practices that woodland owners can use to help prevent destructive wildfires are maintenance of access roads, construction of firebreaks, and the use of controlled burning.

Grazing should be regulated to prevent damage to pine stands.

Management that insures healthy, even-growing trees will generally control insects and diseases. Outbreaks of insects and diseases should be reported to the Texas Forest Service, which can provide assistance in their control.

Erosion is not generally a problem on well-managed woodlands. Fire, excessive grazing, excessive cutting, and improper locations of roads are practices that may cause erosion on woodland.

Dense, overstocked stands should be thinned or given improvement cutting (fig. 14). Thinning provides adequate space for the remaining trees to grow. Improvement cutting removes overmature, diseased, and other unproductive trees and allows the high-quality trees left in the stand to grow better. Woodlands that contain mostly poor or undesirable species should be gradually converted to stands of more valuable trees (fig. 15).

***Figure 14.*—This improved stand of loblolly pine on Garner clay is the result of proper thinning and good management.**

***Figure 15.*—Overcutting pine on Garner clay allowed hardwoods to take over the site.**

Harvest cutting removes the mature trees, provides for natural reproduction of desirable species, and helps eliminate the hazards of insects and diseases.

Woodland productivity

If the site index of a given soil is known, yields of wood expressed in terms of cords, cubic feet, or board feet can be determined, as the site index expresses the total height of dominant trees at a definite age. The dominant trees are the larger trees, whose crowns join the general level of the forest canopy and occasionally extend beyond it.

Table 4, which is based on published research, shows how site index can be converted readily into total merchantable volume. By adjusting the values in table 4, yields from understocked stands can be estimated.

Management of Wildlife

The water areas and soils in the county provide wintering grounds for several million ducks and geese and permanent habitats for many furbearing animals, particularly muskrats.

Important species of wildlife in the county are ducks, geese, prairie chickens, quail, doves, raccoons, mink, squirrels, nutria, muskrats, and deer. There are many other less important species, including blackbirds and meadowlarks. The county is a winter home for ducks, geese, rails, coots, cranes, and many other birds.

The Neches River and the many fresh-water, brackish, and saline lakes, ponds, canals, and bayous produce tons of fish, oysters, and shrimp. An important commercial and sport-fishing industry is based on the harvest and sale of seafood. There are also small numbers of alligators, turtles, and crayfish.

Some soils are suitable only for wildlife and should be managed for that use. Soils that are suitable for woodland, cropland, and rangeland may also be used entirely for wildlife. Some soils may be managed for woodland, cropland, or rangeland and for wildlife at the same time.

All kinds of wildlife need food, cover, and water, though no two kinds have exactly the same needs.

Assistance on wildlife problems can be obtained from employees of the Soil Conservation Service assisting the Coastal and Trinity Bay Soil Conservation Districts, from the Texas Agricultural Extension Service, and from the Texas Parks and Wildlife Commission.

In the first part of this section, the soils in the county are placed in six wildlife suitability groups. In the second part, general management practices for waterfowl, muskrats, and other wildlife are discussed.

TABLE 4.—*Stand and yield information per acre for well-stocked, unmanaged, normally growing stands of loblolly, longleaf, and slash pines*

[Statistics in this table were compiled from United States Department of Agriculture Miscellaneous Publication No. 50 (*21*)]

LOBLOLLY PINE

Site index	Age of stand	Total merchantable volume			Height of average, dominant trees	Average diameter at breast height	Basal area at breast height	Trees per acre
	Years	*Cu. ft.*	*Cords*	*Board ft. (Scribner)*	*Feet*	*Inches*	*Sq. ft.*	*Number*
80	20	2, 350	22	700	43	5. 0	129	950
	30	4, 000	38	6, 500	59	7. 4	147	510
	40	5, 300	51	14, 800	72	9. 2	156	345
	50	6, 150	60	21, 700	80	10. 7	162	255
	60	6, 650	66	26, 400	85	12. 0	165	210
	70	7, 000	70	29, 500	89	13. 1	168	185
	80	7, 300	73	31, 550	92	14. 0	170	160
90	20	2, 850	27	1, 000	48	5. 6	133	790
	30	4, 700	46	10, 700	67	8. 2	152	420
	40	6, 200	61	20, 550	81	10. 2	162	290
	50	7, 200	71	28, 250	90	12. 0	167	220
	60	7, 800	78	33, 100	96	13. 4	171	180
	70	8, 200	82	36, 600	100	14. 6	174	150
	80	8, 550	85	39, 100	103	15. 6	176	135
100	20	3, 300	32	2, 750	54	6. 1	138	690
	30	5, 400	53	14, 800	74	9. 0	158	375
	40	7, 150	71	26, 700	90	11. 2	168	255
	50	8, 400	84	35, 050	100	13. 1	174	190
	60	9, 150	92	41, 000	107	14. 6	178	155
	70	9, 600	96	44, 750	112	15. 9	181	135
	80	9, 950	100	47, 400	115	17. 1	182	115

LONGLEAF PINE

Site index	Age of stand	Cu. ft.	Cords	Board ft. (Scribner)	Feet	Inches	Sq. ft.	Number
70	20	1, 500	14	200	36	3. 8	92	1, 150
	30	2, 700	28	2, 000	52	5. 5	113	730
	40	3, 800	39	6, 100	62	6. 8	127	515
	50	4, 750	48	11, 400	70	7. 9	138	415
	60	5, 600	55	16, 400	77	8. 8	145	355
	70	6, 200	62	20, 400	82	9. 6	150	305
	80	6, 800	67	23, 700	86	10. 3	153	270
80	20	2, 050	20	550	41	4. 3	102	1, 050
	30	3, 500	36	3, 800	59	6. 1	124	655
	40	4, 900	49	10, 800	71	7. 6	140	465
	50	6, 000	61	17, 600	80	8. 8	152	375
	60	7, 000	70	23, 500	87	9. 8	160	315
	70	7, 850	78	28, 300	93	10. 6	166	270
	80	8, 550	85	32, 100	98	11. 5	169	240
90	20	2, 550	26	1, 000	46	4. 7	109	910
	30	4, 250	43	6, 500	66	6. 7	134	575
	40	5, 800	59	15, 800	80	8. 3	150	405
	50	7, 150	72	24, 100	90	9. 6	162	330
	60	8, 350	84	31, 000	98	10. 7	170	275
	70	9, 400	94	36, 200	105	11. 6	176	240
	80	10, 250	103	40, 600	110	12. 5	180	210

TABLE 4.—*Stand and yield information per acre for well-stocked, unmanaged, normally growing stands of loblolly, longleaf, and slash pines*—Continued

SLASH PINE

Site index	Age of stand	Total merchantable volume			Height of average, dominant trees	Average diameter at breast height	Basal area at breast height	Trees per acre
	Years	*Cu. ft.*	*Cords*	*Board ft. (Scribner)*	*Feet*	*Inches*	*Sq. ft.*	*Number*
80	20	3, 400	35	900	48	4. 9	148	1, 090
	30	4, 850	48	7, 300	63	7. 0	158	610
	40	5, 850	58	15, 150	73	8. 7	161	380
	50	6, 900	65	20, 350	80	10. 0	163	295
	60	7, 150	69	23, 600	85	10. 8	164	250
90	20	4, 050	41	2, 750	54	5. 6	149	835
	30	5, 550	54	12, 300	71	8. 0	159	470
	40	6, 650	66	20, 600	83	10. 0	163	295
	50	7, 850	73	25, 900	90	11. 4	165	220
	60	8, 100	78	29, 600	95	12. 5	166	195
100	20	4, 600	46	5, 050	61	6. 4	150	625
	30	6, 100	59	16, 850	79	9. 1	160	365
	40	7, 350	72	25, 450	92	11. 4	164	225
	50	8, 700	81	31, 250	100	13. 1	166	175
	60	8, 950	86	35, 400	106	14. 2	167	150

Wildlife suitability groups

In this section the soils and miscellaneous land types in Jefferson County are placed in six wildlife suitability groups. The soils of one group are similar in topography, drainage, water supply, and kind and amount of vegetation they produce.

Since each kind of wildlife has special requirements for food and cover, the soils in a given wildlife suitability group are good habitats for some kinds of wildlife but poor habitats for others.

In the descriptions of the wildlife suitability groups that follow, the vegetation and cover provided, and the wildlife that prefer it, are mentioned. Information about management of wildlife is given in the section "Management of Habitats for Major Kinds of Wildlife."

WILDLIFE SUITABILITY GROUP 1

The soils in this group are coast prairie soils that have slow to very slow internal drainage and slow to very slow runoff. They occupy depressed to nearly level areas. They are—

Beaumont clay.
Crowley silt loam.
Crowley-Waller complex.
Lake Charles clay.
Morey silt loam.
Waller soils.

These soils usually have enough low areas, canals, and ditches to furnish a dependable supply of water for wildlife. Rice and other food plants are normally available for ducks and geese. Odd areas and ditchbanks furnish protection for quail, rabbits, and other types of upland wildlife. A few fur bearers, such as mink, nutria, and muskrats, may be trapped on these soils.

These soils are especially suitable for planting duck food or for flushing with irrigation water to make existing seed available.

WILDLIFE SUITABILITY GROUP 2

The soils in this group are coast prairie soils that have medium to rapid internal drainage and medium to very slow runoff. They occur on slightly elevated areas. They are—

Hockley silt loam, 1 to 3 percent slopes.
Sabine loamy fine sand.

These soils are well drained. They do not hold much moisture for plant growth. Water for wildlife is limited. The soils are suitable as nesting areas for quail, dove, prairie chickens, rabbits, and other upland wildlife. The position of the soils protects wildlife from high water. These soils are not well suited to ducks, as they produce only a small quantity of duck food, and extra water is not available.

Oats, ryegrass, and clover may be planted for supplemental feeding of geese.

WILDLIFE SUITABILITY GROUP 3

The soils and miscellaneous land types in this group have little or no internal drainage and runoff. They occupy flat to depressed positions in the marsh area. In this group are—

Harris clay.
Salt water marsh.
Swamp.
Tidal marsh.

The natural characteristics of these soils make them well suited to fur bearers. Water is slightly below or slightly above the surface most of the year, and many natural lakes and watercourses occur. Swamp supports fresh-water vegetation and wildlife, mainly raccoons, opossums, and some mink and squirrels. Tidal marsh is affected daily by salt-water tides, and water control is not practical. Muskrats and some ducks are well suited to this area, however.

Harris clay and Salt water marsh are well suited to muskrats. They are also well suited to ducks and can be managed effectively for geese. The water level and salinity can be controlled on these soils.

WILDLIFE SUITABILITY GROUP 4

In this group are soils and miscellaneous land types that have no internal drainage to rapid internal drainage and very slow runoff. They occur on slightly elevated positions in the marsh area. In this group are—

Galveston fine sand.
Harris clay, shallow over sand.
Coastal land.
Made land.

The position of these soils makes them well suited to geese. Normally there is not enough water to make them suitable as feeding areas for ducks. Because these soils are generally too high, the water depths and salinity cannot be regulated for the production of muskrat food.

Care must be taken when burning on these soils for control of vegetation. When other soils in the marsh are wet enough to burn, these soils are too dry, and burning will greatly damage plant crowns and roots. The soils in this group should therefore be burnt independently of the other soils, and water should be on the surface before the fire is lit.

WILDLIFE SUITABILITY GROUP 5

In this group are soils of the East Texas timberland that have very slow to rapid internal drainage and very slow to rapid runoff. The soils occupy level to gently sloping areas. They are—

Acadia silt loam, 0 to 1 percent slopes.
Acadia silt loam, 1 to 5 percent slopes.
Caddo-Pocomoke loamy fine sands.
Garner clay.
Klej loamy fine sand.

These soils support a mixed stand of pines and hardwoods. Usually, there are enough low areas to furnish watering facilities for wildlife. These soils do not have much excess surface water and can be used by upland wildlife during wet seasons. Deer and squirrels do well on this site. Some of the small, open-water areas can be made suitable for ducks.

Tall fescue, ryegrass, and other winter vegetation may be planted along pipelines and in open areas to provide supplemental grazing for wildlife.

WILDLIFE SUITABILITY GROUP 6

In this group are miscellaneous land types and soils of the East Texas timberland that have slow to very slow internal drainage and very slow runoff. They occupy depressed to nearly level areas. In this group are—

Alluvial land.
Bibb clay loam.
Byars silt loam.
Byars-Klej complex.
Byars-Acadia complex.

These soils are affected by extra water from floods or runoff from other soils. This characteristic makes them hazardous for upland wildlife during wet seasons.

These soils support trees that provide excellent food for squirrels. They are used by raccoons, opossum, and some mink, and by deer in dry periods. Ducks often visit the open-water areas, and duck food is available in the woodland. Some of these soils support only hardwood species; others support both hardwood and pine.

Management of habitats for major kinds of wildlife

Management of the soils of the county as habitats for major kinds of wildlife is next discussed. Management practices are given for the major kinds of waterfowl, ducks and geese, and for the principal fur-bearing animal, the muskrat. Practices helpful to other wildlife are mentioned.

WATERFOWL

Migratory waterfowl in Jefferson County include nearly all species of geese and ducks. Some areas are nesting grounds for the resident, mottled ducks and fulvous tree ducks.

Most waterfowl concentrate in the area from October through March. Management practices should be used that improve the food supply during this period and also maintain water levels that will make the food available.

Both overgrazing and undergrazing by cattle may reduce the value of given areas for use by waterfowl. In many places overgrazing eliminates duck food. Light grazing late in the season may benefit waterfowl by opening up dense vegetation and by giving the birds ready access to the shattered seeds and other available food.

Properly stocked ranges and properly constructed cattle walkways benefit waterfowl. Areas of Borrow pits along the walkways help to regulate grazing and may hold fresh water for waterfowl when other sources have dried up.

Ducks.—Ducks are heavy eaters and feed mainly on the seeds of plants. Most seeds need to be in water to be available. Therefore, the proper plants for food should be provided, and the water level should be regulated to some extent.

Olney and saltmarsh bulrushes are fair food for ducks and can be encouraged in brackish and salt marshes. (See "Muskrats" for management practices.) Moderate to heavy grazing in fresh-water marshes will reduce the amount of paille finegrass, giant cutgrass, and common reed which are poor food for ducks, and will increase the growth of smartweed, barnyardgrass, and other plants, which are good food.

In Jefferson County ricefields are one of the most important feeding grounds for ducks (fig. 16). Rice farmers generally consider that from 1 to 3 barrels (1 barrel is 162 pounds) of rice per acre are lost in harvesting. Besides domestic rice, ducks also eat the seed of many plants considered to be pests in ricefields. Some of these plants are jungle-rice, barnyardgrass, red rice, knotgrass, water paspalum, flatsedge, spikesedge, brownseed paspalum, signalgrass, and fall panicum.

Adding water to the fields after rice harvest is one of the easiest and most profitable practices for duck management. Only dirt plugs or simple water-control structures are needed to hold water in the levees. The fields should be flooded with 1 to 6 inches of water. If the rice stubble is tall and dense, openings should be made with a drag or disk. Water should be kept on the field until March or April to make food available to ducks all winter. Thus, the ducks will go north to their breeding grounds in good condition.

Figure 16.—**Concentration of wild ducks on a ricefield during winter months in Jefferson County.**

On inland areas where water levels can be controlled, such plants as smartweed, barnyardgrass, and browntop millet may be planted for duck food.

Marsh-buggies, marsh plows, and draglines may be used to create openings for ducks in areas covered by extremely dense vegetation. This practice will help make duck food available when desirable plants are present. If food is not present, it will provide resting places and drinking water for ducks.

Geese.—Geese spend the winter season in the marsh area, where they dig roots and tubers and graze sprouts and tender green forage. They prefer to feed in open areas having vegetation no more than a few inches high. They also feed heavily on waste rice, young rice plants, and other vegetation in ricefields. These fields need not be covered by water to encourage geese.

Natural marshes may be improved for geese by burning, which removes tall vegetation and makes roots, tubers, and sprouts available. If burning is done only when the ground is thoroughly moist, it will not damage the roots of marsh plants. It is best to burn selective areas beginning in October and to burn additional areas every week or two. In this way, geese will rotate their grazing areas, and heavy damage will be prevented.

Geese that feed in salt-marsh areas fly to fresh water daily for drinking and roosting.

MUSKRATS

An abundance of food plants and a water depth that makes the food available are needed for profitable and dependable production of muskrats.

Olney and saltmarsh bulrushes, referred to as three-cornered bulrushes or three-cornered grasses, are the most important plants for muskrats in this county. Olney bulrush grows in marsh areas where the salt content of the soil and water is from 0.5 to 2 percent. Saltmarsh bulrush grows in areas where the salt content is from 2 to 3 percent. Marshhay cordgrass is a subdominant plant. Muskrats also feed on fresh-water plants, such as paille finegrass and cattails. However, yields of muskrats are not so great on the fresh-water marshes as on the salt-water ones.

Management for muskrats consists of practices that will develop or maintain water depths and salinity at levels favorable to the animal and its food supply. Some of these practices are discussed in the following paragraphs.

Burning.—Fire is important in maintaining or improving desirable vegetation on muskrat marshes. Burning should be done between mid-October and mid-February to improve olney bulrush, and between mid-February and mid-April to improve saltmarsh bulrush. The marsh should never be burnt when dry, as the food supply will be destroyed. For best results, water should be slightly above ground level.

Grazing.—Generally, cattle and muskrats do not go well together. Cattle trample the muskrat houses and runways and frequently damage the trap sets. Heavy grazing destroys the three-cornered bulrushes and causes other plants to increase in the marsh. When muskrat marshes are grazed, cattle should be removed at the first sign of damage to the bulrushes.

Water level control.—Maintaining proper water levels is very important, as muskrat populations are affected more by rapid changes in water levels than by changes in the type of marsh plants. Extreme fluctuation damages both muskrats and their food supply. Simple water-control structures should be designed, so that water levels can be raised or lowered, as needed. Structures in drains or small levees may be used. For best results, the water table should be controlled so that it ranges from 2 inches above to 2 inches below the ground surface.

Salinity control.—Controlling salinity in muskrat marshes is often more difficult than regulating water depth. Too much salinity on muskrat marshes causes vegetation to change to seashore saltgrass and smooth cordgrass. Not enough salinity causes vegetation to change to plants, such as cattails, sawgrass, and cutgrass. These plants lower the value of the marsh for muskrats.

Natural rainfall and runoff from inland areas are the main sources of fresh water in the marsh. In some places, free-flowing or pumping wells can be used to supply more fresh water, when needed.

Salt water from the Gulf of Mexico is supplied to the marshes by level ditches, tides, and natural drains. Level ditches with control structures (fig. 17) are the most

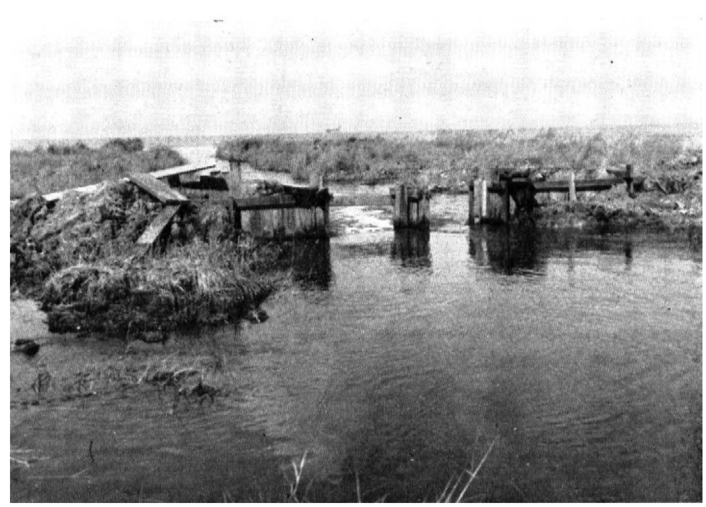

Figure 17.—**Level ditches and water-control structures help control water levels and salinity in muskrat marshes.**

practical way to control salinity in the marshes and to make them more accessible to trappers. The structures are opened when salt water is needed and are closed when water is not needed. The ditches should be carefully constructed to prevent a general lowering of the water table on which the desirable plants depend.

Eatout.—An overpopulation of muskrats soon destroys the food supply. This is called an eatout. Successful muskrat management under natural conditions requires that the annual crop be harvested at the right time for maximum returns and for sustained yields. Eatouts may kill the desired vegetation and may lower the carrying capacity of the marsh.

Muskrat population cannot be carried over from year to year to build a large crop for a single season (fig. 18).

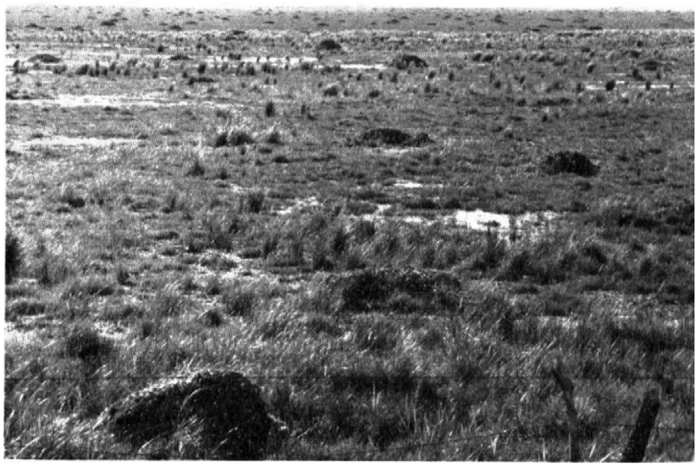

***Figure 18.*—Excessive grazing by livestock and a high muskrat population cause an eatout and a low muskrat population the next year.**

Marshes should be heavily trapped when populations are high. The water level should be lowered, preferably during the season following the eatout. This practice permits the bulrush seeds to sprout and forces the remaining muskrats to leave the area.

OTHER WILDLIFE

Land used for cropland, pasture, or woodland can also provide an excellent home for such wildlife as doves, quail, prairie chickens, raccoons, mink, squirrels, rabbits, and deer.

Cropland.—Planned crop rotations will help increase useful wildlife on cropland. Such rotations should include (1) use of grasses and legumes, (2) fertilizing and liming, (3) use of cover crops, (4) use of crop residue, (5) spring plowing, and (6) leaving small areas of unharvested grain next to good cover.

Some harmful practices on cropland consist of burning, clean fall plowing, and indiscriminate use of insecticides and weed killers.

Pasture.—Management practices helpful to useful wildlife on pastureland include proper grazing, liming and fertilizing, and reseeding or renovating.

Some harmful practices on pastureland are burning, heavy grazing, and complete clean mowing early in the season.

Woodland.—The following management practices will help useful wildlife increase in woodland: (1) Protection of the woodland from fire and overgrazing, (2) selective cutting, (3) leaving two or more den trees per acre and a few mast-bearing trees when cutting timber, (4) piling brush near the edge of woods, (5) leaving fallen, hollow logs, (6) clear cutting small areas in large woodlands, and (7) planting suitable plants for winter grazing along pipelines and in other openings.

Some harmful practices on woodland are uncontrolled burning, heavy grazing, clear cutting on large areas, and cutting out all den trees.

Engineering Interpretations of Soils [3]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, irrigation systems, and sewage disposal systems. The properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and pH. Depth to water table, salinity, and topography are also important.

This section presents information about the engineering properties of soils. In addition to the information in this section, engineers will be interested in the section "Analyses of Three Representative Soils."

It is not intended that this report will eliminate the need for on-site sampling and testing of sites for design and construction of specific engineering works. The interpretations in this report should be used primarily in planning more detailed field investigations to determine the condition of soil material in place at the proposed site for engineering work.

In general, the information in this section can be used to:

1. Make soil and land-use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, and irrigation systems.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway, airport, pipeline, and cable locations and in planning detailed investigations at the selected locations.
4. Locate probable sources of sand and other construction materials.
5. Correlate performance of engineering structures with soil mapping units to develop information for overall planning that will be useful in designing and maintaining certain engineering practices and structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and aerial photographs

[3] This section was prepared with the help of GEORGE H. FOLLETT engineer, Soil Conservation Service.

to make maps and reports that can be used readily by engineers.

8. Develop other preliminary estimates for construction purposes.

Some of the terms used by the soil scientists may not be familiar to the engineer; others, though familiar, have special meanings in soil science. Most of the terms used in the table and other special terms used in the report are defined in the Glossary.

Engineering Classification Systems

The system of the United States Department of Agriculture for classifying soil texture is used by agricultural scientists (*22*)[4]. In some ways this system of classifying soil texture is comparable to the two systems used by engineers for classifying soils. The two systems used by engineers are explained briefly as follows.

The American Association of State Highway Officials (AASHO) has developed a classification based on the field performance of soils (*1*). Most highway engineers classify soils in accordance with this system. In the AASHO system, soil materials are classified in seven principal groups. The groups range from A-1 (gravelly soils having high bearing capacity) to A-7 (clayey soils having low strength when wet). Within each group the relative engineering value of the material is indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses, following the soil group symbol, in the next to last column in table 7.

The Unified system of soil classification was established by the United States Army, Corps of Engineers (*23*). This system is based on the identification of soils according to their texture and plasticity and on their performance as engineering construction materials. In the Unified system the symbols SM and SC represent sands with fines of silt and clay; ML and CL, silts and clays of low liquid limit; MH and CH, silts and clays that have a high liquid limit; and GP and GM, gravel and gravel-sand mixtures. The soils of this county have been classified only in the ML, CL, CH, SM, SP, SW, OH, and Pt classes of material. Some soil materials have characteristics that are in a border zone between the major classes and are given a borderline classification, as ML-CL.

Soil Properties Significant to Engineering

The estimated physical properties of soils in Jefferson County that affect their use for engineering are summarized in table 5. The map symbols in the table are the symbols used to identify the soils on the aerial photographs in the back of the report. The soil names and a brief description of each soil are also given.

The physical properties are estimated for the major horizons (layers) for each typical soil profile. In most soils the soil profile consists of several significant horizons. The depth of each horizon is given in inches. More complete descriptions of soil profiles are given in the sections "Descriptions of the Soils" and "Genesis, Classification, and Morphology of Soils."

Table 5 also gives the textural classification used by the U.S. Department of Agriculture and estimates of the Unified and AASHO classifications. In this table the grain size, permeability, available water capacity, reaction, dispersion, and shrink-swell potential have been generalized from laboratory tests of some of the soils and have been estimated for the others.

The column headed "Permeability" gives the estimated rate, in inches per hour, that water percolates through soil material that is not compacted.

The column headed "Available water capacity" gives the amount of water that the soil can hold, expressed in inches of water per inch of soil depth. It is the approximate amount of capillary water in the soil when it is wet to field capacity.

In the column headed "Reaction" the intensity of the acidity or alkalinity of the soil is expressed in pH value. A notation of pH 7.0 is neutral. A lower value indicates an acid soil, and a higher value indicates alkalinity.

The ratings in the column headed "Dispersion" give the degree and rapidity with which the soil material slakes in water and the soil structure breaks down. Dispersion is expressed as high, moderate, and low. High dispersion means that the soil structure breaks down readily. In this report, dispersion refers to the breaking up of soil aggregates in the field by rain.

The ratings for the column headed "Shrink-swell potential" indicate volume change to be expected of the soil material with changes in moisture content. The potential is expressed as low, moderate, high, or very high. In general, soils classed as CH and A-7 have high or very high shrink-swell potential, and soils classed as SP or SM have a low shrink-swell potential.

Interpretations of some of the engineering properties of the soils are given in table 6. The data are based on the information given in table 5, on actual test data from table 7, and on field experience and performance. The names of the series and land types and the map symbols are shown in the first column of table 6.

Only the surface soil was considered in rating soils as a suitable source of topsoil. To be a good source of topsoil for slopes, road shoulders, and elsewhere, a soil material should have characteristics that will promote the growth of desirable vegetation. Factors considered in the ratings were natural fertility, permeability, water-holding capacity, erosion susceptibility, and the capacity to respond to applications of fertilizers and water.

The suitability for road fill depends largely on the natural moisture content and the texture of the soil. The plastic soils with high moisture content, such as Beaumont clay, are difficult to handle, to compact, and to dry to the desired moisture content. Therefore, they are rated "Poor." The sandy soils are difficult to place but contain enough binding material to be rated "Good." Organic peats and mucks are not suitable for road fill.

The best soils for highway location are those that have adequate strength, good compaction characteristics, adequate drainage, and low shrink-swell potential. Most of the characteristics that make a soil undesirable for highway location can be compensated for by proper construction methods. Some characteristics may be so undesirable, however, that it would be more economical to relocate the road on more suitable soils than to overcome the problem.

[4] Italic numbers in parentheses refer to Literature Cited, page 70.

722-425—64——4

TABLE 5.—*Brief descriptions of soils*

Map Symbol	Soil	Brief soil description	Depth from surface	Classification: USDA texture
			Inches	
AcA AcB	Acadia silt loam, 0 to 1 percent slopes. Acadia silt loam, 1 to 5 percent slopes.	About 12 inches of silt loam over 4 to 5 feet of clay and silty clay loam; underlain by sandy and clayey parent material; imperfectly or somewhat poorly drained; rapid runoff on slopes; dominant slopes of 0 to 1 percent; some short slopes of 5 percent; small sandy mounds are present.	0–12 12–32 32–62	Silt loam Silty clay loam and clay Silty clay and clay
Ad	Alluvial land	A land type composed of alluvial soils so mixed in texture, drainage characteristics, and flooding hazards that they were not mapped separately. Depth, texture, and engineering classification not included because of variability.		
Ba	Beaumont clay	About 5 feet of clay underlain by parent material of acid to alkaline clay, poorly drained; occurs on broad flats with slopes less than 0.4 percent; calcium carbonate concretions are normally present below 32 inches; krotovinas (earth-filled animal burrows) are common.	0–32 32–44 44–60	Clay Clay Clay
Bb	Bibb clay loam	About 4 feet of clay loam over parent material of sandy and clayey alluvium; poorly drained; frequently flooded; dominant slopes are less than 0.5 percent; stratified sandy loam to clay is common below 45 inches; in places deep beds of sand occur at that depth.	0–26 26–46 46–56	Clay loam Clay loam Stratified clay loam, silt loam, and fine sandy loam.
Bp	Borrow pits	A land type consisting of various kinds of materials that are being or have been excavated for different uses; pits range from 5 to 15 feet in depth; soil material removed ranges from clay to sand. Depth, texture, and engineering classification not included because of variability.		
Br	Byars silt loam	About 2 feet of silt loam over 2 to 4 feet of clay loam and clay; underlain by parent material of sandy clay and clay; very poorly drained; occupies depressed areas with slopes of less than 0.2 percent.	0–23 23–37 37–55 55–65	Silt loam Clay loam Clay Sandy clay
Bx	Byars-Acadia complex	Consists of 50 to 70 percent Byars silt loam in depressed areas and 20 to 40 percent Acadia silt loam on low mounds or ridges. For estimated physical properties, see Byars silt loam and Acadia silt loam.		
By	Byars-Klej complex	Consists of 60 percent Byars silt loam and 40 percent Klej loamy fine sand; Byars silt loam occupies depressed areas, and Klej loamy fine sand occupies ridges or mounds 1 to 5 feet higher than Byars silt loam. For estimated physical properties, see Byars silt loam and Klej loamy fine sand.		
Cp	Caddo-Pocomoke loamy fine sands:			
	Caddo loamy fine sand.	Makes up 60 to 80 percent of the complex; occupies gently undulating positions; consists of about 2 feet of loamy fine sand over 4 to 5 feet of sandy clay loam; underlain by sandy and clayey parent material; iron-manganese concretions are common.	0–26 26–50	Loamy fine sand Sandy clay loam
	Pocomoke loamy fine sand.	Makes up 20 to 40 percent of the complex; occupies depressions; consists of about 3 feet of loamy fine sand over 1 foot of sandy clay loam; underlain by sandy clay loam parent material; sandy substratum common at 40 to 50 inches; receives seepage from Caddo loamy fine sand.	0–34 34–42 42–50	Loamy fine sand Sandy clay loam Loamy fine sand
Cs	Coastal land	A land type consisting of materials that have been deposited or reworked by salt water from storms in the Gulf of Mexico; soil materials are deposited in layers that have different textures; one layer may be a sand, another a loam, and another a clay; the upper layer may change texture during a storm; thickness of the various layers ranges from 1 to 36 inches. Depth, texture, and engineering classification not included because of variability.		

and their estimated physical properties

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200					
					Inches per hour	*Inches per inch of depth*	*pH*		
CL or ML	A-4	100	90–100	80–90	0. 8–2. 5	0. 10–0. 12	4. 5–6. 0	Moderate	Low.
CL or CH	A-7	100	90–100	80–85	0. 05–0. 2	0. 13–0. 17	4. 0–5. 0	Low	Moderate to high.
CH	A-7	100	90–100	80–95	0–0. 05	0. 15–0. 18	4. 0–5. 0	Low	High.
CH	A-7	90–100	80–100	55–75	0. 05–0. 2	0. 2–0. 23	5. 0–6. 4	Low	Very high.
CH	A-7	95–100	90–100	65–80	0–0. 5	0. 18–0. 2	5. 2–8. 0	Low	Very high.
CH	A-7	95–100	90–100	80–90	0–0. 05	0. 16–0. 18	5. 2–8. 0	Low	Very high.
CL	A-6	100	90–100	80–90	0. 05–0. 2	0. 18–0. 2	4. 5–5. 5	Moderate	Moderate.
CL	A-6	100	90–100	80–90	0–0. 05	0. 18–0. 2	4. 5–5. 5	Moderate	Moderate.
CL	A-6	100	90–100	80–90	0. 2–0. 8	0. 10–0. 18	5. 0–6. 0	Moderate	Moderate.
CL or ML	A-4	100	90–100	89–90	0. 20–0. 80	0. 10–0. 12	5. 0–5. 5	Moderate	Low.
CL or CH	A-6 or A-7	100	90–100	75–85	0. 05–0. 20	0. 12–0. 14	5. 0–5. 5	Moderate	Moderate to high.
CL or CH	A-6 or A-7	100	90–100	80–90	0–0. 05	0. 13–0. 18	5. 0–5. 5	Low	Moderate to high.
CL or CH	A-6 or A-7	100	90–100	80–90	0. 05–0. 20	0. 12–0. 14	5. 0–6. 0	Moderate	Moderate to high.
SM	A-2	100	90–100	10–20	5–10	0. 07–0. 09	4. 5–5. 5	High	Low.
CL or CH	A-6 or A-7	95–100	90–100	70–80	0. 2–0. 8	0. 07–0. 09	4. 5–5. 5	Moderate	Moderate to high.
SM	A-2	100	90–100	10–20	5–10	0. 07–0. 09	5. 0–6. 0	High	Low.
CL or ML	A-6	100	90–100	70–80	0. 2–0. 8	0. 08–0. 1	5. 0–6. 0	Moderate	Moderate.
SM	A-2	100	90–100	10–20	5–10	0. 07–0. 09	4. 5–5. 5	High	Low.

TABLE 5.—*Brief descriptions of soils and*

Map Symbol	Soil	Brief soil description	Depth from surface	Classification: USDA texture
			Inches	
Ct	Crowley silt loam	About 22 inches of silt loam over 24 inches of clay and silty clay; underlain by parent materials of sandy clay; imperfectly or somewhat poorly drained; dominant slopes are 0 to 1 percent.	0–22 22–40 40–54	Silt loam Clay Sandy clay
Cw	Crowley-Waller complex	Consists of 30 to 60 percent Crowley silt loam and 40 to 70 percent Waller soils; Crowley soils occupy ridge positions ranging from 30 to 125 feet in width; Waller soils occupy depressed areas. For estimated physical properties, see Crowley silt loam and Waller soils.	-------	-------
Ga	Galveston fine sand	About 4 feet of fine sand that consists of only slightly weathered sandy marine deposits; occurs at or near sea level in level or dunelike position; shells, as much as 2 inches in diameter, are common.	0–50	Fine sand
Gc	Garner clay	About 5 feet of clay underlain by parent material of weakly calcareous clay; poorly drained; occurs on slopes of less than 1 percent; calcium carbonate concretions, as much as 2 inches in diameter, are common below 36 inches.	0–26 26–54 54–60	Clay Clay Clay
Ha	Harris clay	About 5 feet of clay underlain by clayey parent material of old alluvium and marine sediments; saline, very poorly drained, and in level or depressed positions from 0 to 4 feet above sea level; 5 inches of organic matter is common on the surface; in places sandy material occurs below 60 inches; saturated with water for long periods and subject to salt water flooding during gulf storms.	0–20 20–38 38–60	Clay Clay Clay
Hs	Harris clay, shallow over sand.	About 12 to 30 inches of clay underlain by 3 to 4 feet of fine sand; parent material is clayey old alluvium and marine sediments deposited over sandy material; a saline, very poorly drained soil that occurs in level positions 1 to 4 feet above sea level; in places sandy layer contains streaks of silty clay.	0–24 24–60	Clay Fine sand
HtB	Hockley silt loam, 1 to 3 percent slopes.	About 28 inches of silt loam over 2 feet of silty clay loam and silty clay; developed from unconsolidated sandy clay and clay; moderately well drained; slopes dominantly 1 to 3 percent; included are some areas with slopes less than 1 percent and as much as 5 percent; iron-manganese concretions are common in the profile.	0–22 22–30 30–50 50–60	Silt loam Silty clay loam Silty clay Clay
Kf	Klej loamy fine sand	About 4 to 6 feet of loamy fine sand developed from acid sandy earths; moderately well drained soil on slopes ranging from 0 to 3 percent; in places sandy clay loam or clay occurs 48 to 72 inches below the surface.	0–72	Loamy fine sand
La	Lake Charles clay	About 5 feet of clay underlain by parent material of alkaline to calcareous clay; imperfectly or somewhat poorly drained; dominant slope is less than 0.4 percent; few krotovinas (earth-filled animal burrows) in lower horizons; few calcium carbonate concretions throughout the profile.	0–28 28–48 48–60	Clay Clay Clay
Ma	Made land	A land type consisting of materials that have been excavated from canals, ditches, and waterways; the material is dominantly clay, but in places it is a mixture of clay loam, sand, and shells; the surface may be smooth or rough. Depth, texture, and engineering classification not included because of variability.	-------	-------
Md	Morey silt loam	About 12 inches of silt loam over 3 feet of silty clay loam; underlain by parent material of acid to alkaline clay and silty clay; a poorly drained soil on slopes of less than 1 percent; small sandy mounds are present in places; calcium carbonate concretions are common in lower horizons.	0–12 12–36 36–60	Silt loam Silty clay Silty clay loam

their estimated physical properties—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200					
					Inches per hour	*Inches per inch of depth*	*pH*		
CL or ML	A-4	95-100	90-100	65-95	0. 8-2. 5	0. 12-0. 13	5. 0-6. 0	Moderate	Low.
CL or CH	A-7	91-100	90-100	70-90	0. 05-0. 2	0. 15-0. 18	5. 0-6. 0	Low	Moderate to high.
CL or CH	A-7	95-100	90-100	85-95	0. 2-0. 8	0. 15-0. 18	5. 0-7. 4	Low	Moderate to high.
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SP-SM, SM	A-2 or A-3	90-100	80-100	5-15	10-15	0. 03-0. 04	6. 0-8. 0	Low	Low.
CL or CH	A-6 or A-7	90-100	70-95	60-85	0. 05-0. 2	0. 20-0. 23	4. 5-6. 2	Low	Moderate to high.
CL or CH	A-6 or A-7	90-100	70-100	70-95	0-0. 05	0. 18-0. 20	6. 0-7. 0	Low	Moderate to very high.
CL or CH	A-7	90-100	80-100	80-95	0-0. 05	0. 16-0. 18	7. 0-8. 0	Low	Very high.
CH or OH	A-7	90-100	80-90	70-80	0. 05-0. 20	0. 23-0. 25	7. 0-8. 0	Low	High.
CH	A-7	100	90-100	80-90	0-0. 05	0. 20-0. 23	8. 0+	Low	High.
CH	A-7	100	90-100	85-95	0-0. 05	0. 16-0. 18	8. 0+	Low	High.
CL or CH	A-6 or A-7	95-100	80-90	70-80	0. 05-0. 20	0. 23-0. 25	7. 0-8. 0	Low	High.
SM	A-2	95-100	90-100	10-20	10-15	0. 03-0. 04	6. 5-8. 0	Low	Low.
CL or ML	A-4	95-100	90-100	80-90	0. 8 -2. 5	0. 12-0. 13	5. 5-7. 0	Moderate	Low.
CL or CH	A-7	95-100	90-100	70-80	0. 2 -0. 8	0. 13-0. 17	5. 5-7. 0	Moderate	Moderate to high.
CL or CH	A-7	95-100	90-100	70-80	0. 05-0. 2	0. 15-0. 18	4. 5-7. 0	Low	Moderate to high.
CL or CH	A-6 or A-7	95-100	90-100	70-85	0. 2 -0. 8	0. 15-0. 18	4. 5-7. 0	Moderate	Moderate to high.
SM	A-2 or A-4	100	90-100	20-40	5-10	0. 07-0. 09	4. 5-5. 2	High	Low.
CH	A-7	95-100	90-100	60-70	0. 05-0. 20	0. 23-0. 25	6. 8-7. 2	Low	Very high.
CH	A-7	95-100	90-100	70-80	0. 05-0. 20	0. 20-0. 23	7. 0-8. 0	Low	Very high.
CH	A-7	95-100	90-100	80-90	0-0. 05	0. 16-0. 18	7. 5-8. 0	Low	Very high.
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CL or ML	A-4 or A-6	95-100	90-100	70-90	0. 2-0. 8	0. 12-0. 14	5. 0-6. 2	Moderate	Low.
CL	A-6 or A-7	90-100	89-100	70-90	0-0. 05	0. 17-0. 18	5. 0-7. 2	Low	Moderate.
CH	A-7	90-100	75-100	60-85	0-0. 05	0. 16-0. 18	6. 5-8. 0	Low	High.

TABLE 5.—*Brief descriptions of soils and*

Map Symbol	Soil	Brief soil description	Depth from surface	Classification
				USDA texture
			Inches	
Ow	Oil-waste land	A land type consisting of areas where oil and sulfur wastes have accumulated; it includes slush pits and adjoining areas of land that have been affected. Depth, texture, and engineering classifications not included because of variability.		
Sa	Sabine loamy fine sand	About 5 feet of loamy fine sand developed from sandy marine deposits; a well-drained soil on slopes of dominantly less than 1 percent but as much as 2 percent; a stratification containing shell fragments is common at 40 inches or more.	0–60	Loamy fine sand
Sm	Salt water marsh	A land type consisting of about 16 to 36 inches of partly decomposed roots, twigs, and stems over 2 to 3 feet of silty clay that is high in organic matter; water table ranges from 6 inches above the surface to 6 inches below.	0–20 20–48	Peat and muck Silty clay
Sw	Swamp	A land type consisting of 4 to 20 inches of woody peat and muck over 20 to 30 inches of sandy clay; occupies level to depressed areas; has permanently high water table.	0–12 12–42	Woody peat and muck Sandy clay
Tm	Tidal marsh	A land type consisting of a mixture of clay, sand, organic soils, and shell islands; lies at or near sea level and is covered daily by tidal waters from the Gulf of Mexico. Depth, texture, and engineering classification not included because of variability.		
Wa	Waller soils	About 6 inches of fine sandy loam over 3 to 4 feet of light sandy clay loam or silt loam; underlain by parent material of sandy clay; very poorly drained soils occupying depressed areas; water stands on or near the surface most of the year.	0–6 6–36 36–54	Fine sandy loam Sandy clay loam Sandy clay

TABLE 6.—*Interpretation of*

Soil and map symbol	Suitability as source of—		Soil features affecting	
	Topsoil	Road fill	Highway location	Levees, embankments, and canals
Acadia (AcA, AcB)	Good	Poor to fair	Fair to poor shear strength; medium to very high compressibility; highly plastic subsoil; somewhat poor drainage.	Fair to poor shear strength; fair to poor compaction; very slow permeability.
Alluvial land[1] (Ad)				
Beaumont (Ba)	Poor	Poor	Poor shear strength; high to very high compressibility; high plasticity; poor drainage; very high shrink-swell potential.	Poor shear strength; fair to poor compaction; very slow permeability; cracks when dry.
Bibb (Bb)	Fair	Poor	Fair shear strength; medium compressibility; poor drainage; frequent floods.	Fair shear strength; fair to good compaction; sandy substratum; generally wet.
Borrow pits[1] (Bp)				
Byars (Br)	Fair	Poor to fair	Fair to poor shear strength; medium to very high compressibility; very poor drainage.	Fair to poor shear strength; good to poor compaction; very slow permeability; generally wet.
Byars-Acadia (Bx)	Fair	Poor to fair	Fair to poor shear strength; medium to very high compressibility; poor to very poor drainage; highly plastic subsoil in places.	Fair to poor shear strength; good to poor compaction; very slow permeability; some generally wet areas.

See footnote at end of table.

their estimated physical properties—Continued

Classification—Continued		Percentage passing sieve—			Permea-bility	Available water capacity	Reaction	Dispersion	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200					
					Inches per hour	*Inches per inch of depth*	*pH*		
SM	A-2	95–100	90–100	10–20	5–10	0. 07–0. 09	6. 0–8. 0	High	Low.
Pt		0	0		5–15	0. 6–1. 0	4. 5–5. 5	Low	Low.
CH	A-7	100	95–100	85–95	0–0. 05	0. 20–0. 23	6. 5–8. 0	Low	High.
Pt					5–15	0. 6–1. 0	4. 0–5. 5	Low	Low.
CL	A-6	100	90–100	60–70	0–0. 05	0. 20–0. 23	5. 0–6. 0	Low	Moderate.
ML	A-4	100	100	50–60	0. 2–0. 8	0. 12–0. 13	5. 5–6. 5	Moderate	Low.
CL	A-6	100	100	60–70	0. 05–0. 2	0. 13–0. 17	6. 0–6. 5	Moderate	Moderate.
CL	A-6	100	100	60–70	0. 05–0. 2	0. 13–0. 17	6. 0–8. 0	Moderate	Moderate.

engineering properties of soils

engineering practices

Reservoir area	Drainage and irrigation	Foundations	Septic tanks
Very slow permeability	Very slow permeability; moderate water-holding capacity; nearly level relief; few sandy mounds.	Poor to good bearing value; somewhat poor drainage on level areas; very slow permeability.	Very slow permeability in subsoil; slopes as much as 5 percent.
Very slow permeability	Very slow permeability; high water-holding capacity; level relief.	Fair to poor bearing value; poor drainage; very slow permeability; very high shrink-swell potential.	Very slow permeability; level relief; poor drainage.
Slow permeability; sandy substratum.	Slow permeability; moderate water-holding capacity; sandy substratum; frequent floods.	Good to poor bearing value; poor drainage; frequent floods; slow permeability; sandy substratum.	Slow permeability; level relief; poor drainage; frequent floods; sandy substratum.
Very slow permeability	Very slow permeability; moderate water-holding capacity; depressed areas.	Poor to good bearing value; very poor drainage; very slow permeability.	Very slow permeability; depressed areas; very poor drainage.
Very slow permeability	Very slow permeability; moderate water-holding capacity; level and depressed areas; few sandy mounds.	Poor to good bearing value; poor to very poor drainage; very slow permeability.	Very slow permeability; level and depressed areas; poor to very poor drainage.

TABLE 6.—*Interpretation of*

Soil and map symbol	Suitability as source of—		Soil features affecting	
	Topsoil	Road fill	Highway location	Levees, embankments, and canals
Byars-Klej (By)	Fair	Fair to good	Poor to good shear strength; very high to low compressibility; highly plastic subsoil in places; some very poorly drained areas.	Poor to good shear strength; poor to good compaction; rapid and very slow permeability; some generally wet areas.
Caddo-Pocomoke (Cp)	Fair	Good above 2 to 3 feet; poor to fair below.	Good to poor shear strength; low to high compressibility; some seepage; some areas with high water table.	Good to poor shear strength; good to poor compaction; rapid and moderate permeability; areas with sandy substratum; high water table and some seepage.
Coastal land [1] (Cs)				
Crowley (Ct)	Fair	Poor to fair	Fair to poor shear strength; medium to high compressibility; somewhat poor drainage.	Fair to poor shear strength; poor to good compaction; very slow permeability in subsoil.
Crowley-Waller (Cw)	Fair	Poor to fair	Fair to poor shear strength; medium to high compressibility; somewhat poor to very poor drainage.	Fair to poor shear strength; good to poor compaction; very slow permeability; some areas generally wet.
Galveston (Ga)	Poor	Good	Good shear strength; very low compressibility; near sea level.	Not suitable; rapid permeability
Garner (Gc)	Poor	Poor	Fair to poor shear strength; medium to very high compressibility; high plasticity; poor drainage; very high shrink-swell potential.	Fair to poor shear strength; fair to poor compaction; very slow permeability; cracks when dry.
Harris (Ha)	Poor	Poor	Poor shear strength; high to very high compressibility; near sea level; high plasticity; very poor drainage; high shrink-swell potential; high in content of organic matter.	Poor shear strength; fair to very poor compaction; very slow permeability; cracks when dry; generally wet.
Harris, shallow over sand (Hs).	Poor	Poor	Fair to good shear strength; medium to low compressibility; near sea level; highly plastic clay over sand; very poor drainage; high shrink-swell potential in surface layer.	Fair to good shear strength; fair to good compaction; generally wet; sandy substratum.
Hockley (HtB)	Good	Fair	Fair to poor shear strength; medium to high compressibility; moderately good drainage; gentle slopes.	Fair to poor shear strength; good to poor compaction; slow permeability.
Klej (Kf)	Fair	Good	Good to fair shear strength; low compressibility; moderately good drainage; gentle slopes.	Not suitable; rapid permeability.
Lake Charles (La)	Poor	Poor	Poor shear strength; high to very high compressibility; high plasticity; very high shrink-swell potential.	Poor shear strength; fair to poor compaction; slow permeability; cracks when dry.
Made land [1] (Ma)				
Morey (Md)	Fair	Fair; poor below 3 feet.	Fair to poor shear strength; medium to high compressibility; poor drainage.	Fair to poor shear strength; fair to poor compaction; very slow permeability.
Oil-waste land [1] (Ow)				
Sabine (Sa)	Fair	Good	Good to fair shear strength; low compressibility; good drainage; subject to hurricane damage.	Not suitable; rapid permeability.

See footnote at end of table.

engineering properties of soils—Continued

engineering practices

Reservoir area	Drainage and irrigation	Foundations	Septic tanks
Rapid and very slow permeability.	Rapid and very slow permeability; moderate to low water-holding capacity; depressions, low ridges, and sandy mounds.	Poor to good bearing value; very poor to moderately good drainage; rapid and very slow permeability.	Rapid to very slow permeability; depressions and low ridges; moderately good to very poor drainage.
Rapid and moderate permeability; areas with sandy substratum and seepage.	Rapid and moderate permeability; moderate to low water-holding capacity; depressed and level relief; areas with sandy substratum and seepage.	Good to poor bearing value; imperfect to poor drainage; moderate to rapid permeability; areas with sandy substratum and seepage.	Rapid to moderate permeability; depressions and low ridges; high water table and some seepage.
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Very slow permeability	Very slow permeability; moderate water-holding capacity; nearly level relief; few sandy mounds.	Good to very poor bearing value; somewhat poor drainage; very slow permeability.	Very slow permeability of subsoil; somewhat poor drainage; nearly level areas.
Very slow permeability	Very slow permeability; moderate water-holding capacity; depressed and nearly level areas; few sandy mounds.	Good to very poor bearing value; somewhat poor to very poor drainage; very slow permeability.	Very slow permeability; somewhat poor to very poor drainage; depressed and nearly level areas.
Rapid permeability	Rapid permeability; low water-holding capacity; near sea level; mounds.	Good to poor bearing value; near sea level; rapid permeability.	Rapid permeability; near sea level.
Very slow permeability	Very slow permeability; high water-holding capacity; level relief.	Good to poor bearing value; poor drainage; very slow permeability; very high shrink-swell potential.	Very slow permeability; poor drainage; level relief.
Very slow permeability	Very slow permeability; high water-holding capacity; high water table; depressed relief; salinity; near sea level.	Fair to very poor bearing value; very poor drainage; very slow permeability; high shrink-swell potential; near sea level.	Very slow permeability; depressed relief; very poor drainage; high water table; near sea level.
Very slow permeability at surface; sandy substratum.	Very slow permeability; moderate to low water-holding capacity; high water table; salinity; sandy substratum; near sea level.	Good to very poor bearing value; very poor drainage; very slow permeability; sandy substratum; high shrink-swell potential; high water table.	Very slow permeability at surface; very poor drainage; sandy substratum; high water table; near sea level.
Slow permeability	Moderate permeability; 1 to 3 percent slopes; moderate water-holding capacity.	Good to very poor value; modately good drainage; gentle slopes; slow permeability.	Slow permeability; moderately good drainage; gentle slopes.
Rapid permeability	Rapid permeability; low water-holding capacity; level to gentle slopes.	Good to poor bearing value; moderately good drainage; gentle slopes; rapid permeability.	Rapid permeability; moderately good drainage; level and gentle slopes.
Slow permeability; cracks when dry.	Slow permeability; high water-holding capacity; level relief.	Fair to poor bearing value; slow permeability; imperfect or somewhat poor drainage; very high shrink-swell potential.	Slow permeability; imperfect or somewhat poor drainage; level relief.
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Very slow permeability	Very slow permeability; moderate water-holding capacity; level relief; some sandy mounds.	Good to very poor bearing value; poor drainage; very slow permeability.	Very slow permeability in subsoil; poor drainage; level relief.
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Rapid permeability	Rapid permeability; low water-holding capacity.	Good to poor bearing value; good drainage; rapid permeability.	Rapid permeability; good drainage.

TABLE 6.—*Interpretation of*

Soil and map symbol	Suitability as source of—		Soil features affecting	
	Topsoil	Road fill	Highway location	Levees, embankments, and canals
Salt water marsh (Sm)	Poor	Unsuitable	Not suitable in present condition; organic material; near sea level; permanently high water table.	Not suitable in present condition; organic layers; permanently wet.
Swamp (Sw)	Poor	Unsuitable	Not suitable in present condition; organic material; depressed areas; frequent floods; permanently high water table.	Not suitable in present condition; organic layers; permanently wet.
Tidal marsh [1] (Tm)				
Waller (Wa)	Fair	Poor to fair	Fair shear strength; medium compressibility; very poor drainage; high water table.	Fair shear strength; good to poor compaction; very slow permeability; generally wet.

[1] Because of the variability of soil material, no interpretations were made.

The main features that determine suitability of a soil for construction of levees, embankments, and canals are permeability, shear strength, and ease of compaction. These and some other features are rated in the column headed "Levees, embankments, and canals."

Permeability is the most important soil feature to consider in selecting soils for reservoir areas. In general, the less permeable the material, the better it is for water storage. Shallow depths of water may be stored on very slowly permeable material that is underlain by freely permeable material. The more permeable soils may be used in reservoir areas where downward movement is desirable, as those used for oil and industrial waste.

Soil features affecting use of the soils for drainage and irrigation systems are permeability, infiltration, water-holding capacity, and smoothness of the land surface. The extent of drainage and the type of irrigation system will depend primarily upon the use of the land. Larger amounts of water will need to be removed from industrial and residential areas than from agricultural land. Nearly all residential and industrial sites, regardless of soil permeability, will benefit from drainage. Row crops need more drainage than rice or pasture crops. Nearly all crops and improved pasture on slowly and very slowly permeable soils in Jefferson County will benefit from drainage. Tile drains are suitable for use on permeable soils. Open-field ditches are suitable where gravity flow is adequate. Pump-off systems are normally used where gravity flow will not provide adequate drainage or where outside water is a problem.

Sprinkler irrigation systems can be used on all soils; but as a general rule, they are better suited to the more permeable ones. Slowly permeable and very slowly permeable soils are well suited to the flood-type systems of irrigation, as are used in the production of rice. Irrigation water should percolate into the soil more deeply in areas used for row crops than in those used for rice. Therefore, the slowly permeable to moderately permeable soils are more suitable for row-crop irrigation. When irrigation and drainage systems are both needed, the two systems should be planned together to insure adequate functioning of both.

Soil features affecting the use of the soils for foundations are permeability, drainage, character of the substratum, shrink-swell potential, and consolidation. Whether a soil will be a suitable foundation depends largely on the type of structure and its use. A soil may be entirely satisfactory for one type of construction but may need special treatment for other types. Clayey soils that have a high shrink-swell potential are a problem in home construction and small buildings. Cracks in foundations, slabs, and walls often develop in homes built on these soils.

The proper functioning of septic tanks and sewage disposal systems depends largely on the rate at which the effluent moves into and through the soil. Other characteristics, such as ground-water level, types of underlying material, slope of the land surface, and proximity to streams or lakes, are also important. Because of their slow permeability, drainage characteristics, and water table, most soils in Jefferson County are not suited or are poorly suited to septic-tank filter systems. Consequently, a competent engineer should be consulted before a sewage system is installed. In some areas the absorption field may be enlarged to offset the slow permeability. In some places the septic-tank effluent may be disposed of through a seepage pit rather than through a filter field of subsurface tile.

Engineering Test Data

Engineering test data for seven different soil types are given in table 7. Laboratory tests of samples of the horizons of these soils were made by the Texas State Highway Department. A brief discussion of the data in table 7 follows.

As moisture leaves a soil, the soil shrinks and decreases in volume in proportion to the loss in moisture until equilibrium is reached and shrinkage stops, although additional moisture is removed *(18)*. The point of moisture content where shrinkage stops is called the *shrinkage limit* of the soil. It is reported as the moisture content, in relation to oven-dry weight of the soil, at the time when shrinkage stops.

engineering properties of soils—Continued

engineering practices

Reservoir area	Drainage and irrigation	Foundations	Septic tanks
Organic material; permanently high water table.	Very slow permeability; permanently high water table; organic layer; near sea level; high water-holding capacity.	Not suitable in present condition; very poor drainage; high water table; organic layer; near sea level.	Very slow permeability; very poor drainage; organic layer; near sea level; high water table.
Organic material; permanently high water table.	Very slow permeability; permanently high water table; organic layer; high water-holding capacity; frequent floods.	Not suitable in present condition; poor drainage; high water table; frequent floods; organic layer.	Very slow permeability; very poor drainage; organic layer; frequent floods; high water table.
Very slow permeability____	Very slow permeability; moderate water-holding capacity; depressed relief.	Good to very poor bearing value; very poor drainage; very slow permeability.	Very slow permeability; very poor drainage; depressed relief.

Clay is the main soil fraction that causes shrinkage. The shrinkage limit of a soil is therefore a general index of clay content and will, in general, be low in soils that contain a great deal of clay. The shrinkage limit of a sand that contains little or no clay is close to the liquid limit and is called insignificant. Sands containing some silt and clay have a shrinkage limit of about 14 to 25, and the shrinkage limit of clay ranges from about 6 to 14. The load-carrying capacity of a soil is at a maximum when the moisture content is at or below the shrinkage limit. This rule does not apply to sand. If confined, sand has a uniform load-carrying capacity within a considerable range in moisture content.

The *shrinkage ratio* of a soil is the ratio between its volume change and the corresponding change in water content above the shrinkage limit. Theoretically, the shrinkage ratio is also the apparent specific gravity of the dried soil pat.

The *field moisture equivalent* is the minimum moisture content at which a smooth surface of a soil in its natural state will absorb no more water in 30 seconds when the water is added in individual drops. It is the moisture content required to fill all the pores in sand and to approach saturation in cohesive soils in their natural state.

The engineering soil classifications in table 7 are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. Mechanical analyses were made by combined sieve and hydrometer methods. The percentage of clay obtained in the test by the hydrometer method is not suitable for determining USDA textural classes of soils.

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

Genesis, Classification, and Morphology of Soils

This section presents the outstanding morphologic characteristics of the soils of Jefferson County and relates them to the factors of soil formation. A brief discussion of the geology of the county is given in the first part of this section. The factors of soil formation and the classification and morphology of soils are next discussed. The results of analyses of three representative soils are also given in this section.

Geology of Jefferson County [5]

Arrangement of the geologic formations near the Gulf of Mexico (including those of Jefferson County) is complicated, and theories concerning the origin and history of these formations are controversial. Much of the past investigation is summarized by Bernard [6] and Doering (*8*). A concensus of the views of the most recent and active workers in the area is given in this section.

The sediments exposed in the county can be divided into two groups, those of the Pleistocene and those of Recent time. Recent time began approximately with the vanishing of the large continental ice sheets which were characteristic of Pleistocene time. Roughly, the soils of the flood plains and those of the coast marshes and the beaches along the gulf are on Recent deposits. The soils of the coast prairie and those of the East Texas timberlands are on Pleistocene deposits.

The older Pleistocene sediments have been placed by Bernard [7] and by Kane (*10*) in the Prairie formation, the type locality of which is in Louisiana. Earlier workers

[5] Prepared by SAUL ARONOW, associate professor, Department of Geology, Lamar State College of Technology, Beaumont, Tex.

[6] BERNARD, H. A. QUATERNARY GEOLOGY OF SOUTHEAST TEXAS. 1950 [Unpublished doctor's thesis submitted to La. St. Univ.]

[7] See footnote 6.

TABLE 7.—*Engineering*

Soil	Texas report number	Depth	Horizon	Shrinkage		Field-moisture equivalent
				Limit	Ratio	
Acadia silt loam:		*Inches*				
0.6 mile southeast of U.S. Highway No. 69 bridge crossing Pine Island Bayou in Beaumont. (Modal profile.)	61–42–R	7–13	A3	16	1. 79	18
	61–43–R	18–31	B22	13	1. 93	34
	61–44–R	31–62	C	12	1. 97	31
10 miles northwest of Beaumont. (Thin surface.)	61–85–R	2–6	A2	18	1. 69	19
	61–86–R	9–20	B21	12	1. 96	38
	61–87–R	35–48	C	12	2. 00	28
Beaumont clay:						
3.25 miles southwest of Spindletop Oilfield near Beaumont. (Modal profile.)	61–27–R	0–24	A	10	1. 99	35
	61–28–R	24–44	AC	10	1. 98	36
	61–29–R	44–60+	C	9	2. 06	39
3.3 miles south and 1.7 miles east of Nome. (Dark variation.)	61–48–R	0–28	A	10	2. 03	38
	61–49–R	28–48	AC	8	2. 07	38
	61–50–R	48–72	C	11	2. 06	41
1 mile west-southwest of Cheek. (AC variation.)	61–51–R	0–8	A1	10	2. 00	37
	61–52–R	8–24	AC	8	2. 05	36
	61–53–R	60–84	C	10	2. 08	36
Crowley silt loam:						
1 mile east and 4 miles north of China. (Modal profile.)	61–36–R	3–11	A1	20	1. 67	24
	61–37–R	36–47	B21	16	1. 82	33
	61–38–R	58–65+	C	12	1. 95	29
2.85 miles north of Jefferson-Chambers County Line on Farm Road 1406 and 1.53 miles west on Willis Road. (Mound variation.)	61–73–R	0–24	A11	22	1. 64	26
	61–74–R	50–64	B21	17	1. 77	24
	61–75–R	74–90	C	12	1. 99	32
6 miles northwest of Hamshire. (Thin-surface variation.)	61–76–R	0–9	A11	24	1. 56	26
	61–77–R	27–47	B22	12	1. 96	30
	61–78–R	47–63	C	12	2. 00	26
Garner clay:						
North of Beaumont U.S. Highway No. 69, then 1.1 mile east and 100 feet south of Lawrence Drive. (Modal profile.)	61–45–R	12–26	A12	14	1. 88	28
	61–46–R	48–54	AC	11	2. 03	34
	61–47–R	54–60	C	12	1. 98	30
North of Beaumont on U.S. Highway No. 69, and 1.1 mile east and 400 feet south of Lawrence Drive. (Clay loam variation.)	61–67–R	2–8	A12	18	1. 75	24
	61–68–R	20–44	AC	13	1. 91	26
	61–69–R	44–60	C	12	1. 99	29
North of Beaumont on U.S. Highway No. 69, then 1.1 mile east and 200 feet south of Lawrence Drive. (Thin-surface variation.)	61–70–R	2–11	A12	13	1. 90	32
	61–71–R	11–36	AC	12	1. 94	33
	61–72–R	36–60	C	11	2. 03	33
Harris clay:						
4.2 miles northwest of Sabine Pass and 200 yards west of Texas State Highway No. 87. (Modal profile.)	61–24–R	0–20	A1	14	1. 86	32
	61–25–R	20–38	AC	14	1. 90	33
	61–26–R	38–60	C	14	1. 91	37
Hockley silt loam:						
5 miles east of Fannett; 1700 feet southeast of intersection of Farm Road 365 and LaBelle Road. (Modal profile.)	61–39–R	0–8	A11	23	1. 56	30
	61–40–R	36–46	B2	17	1. 79	35
	61–41–R	58–82	C	12	1. 96	28
3 miles northeast of Fannett. (Heavy subsoil variation.)	61–79–R	0–9	A11	20	1. 64	24
	61–80–R	27–37	B2	13	1. 88	34
	61–81–R	47–63	C	13	1. 92	28
4 miles west of Amelia. (Thin-surface variation.)	61–82–R	0–13	A1	20	1. 67	23
	61–83–R	17–40	B21	16	1. 82	32
	61–84–R	53–69+	C	10	2. 06	30

See footnotes at end of table.

test data[1]

Mechanical analyses[2]									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—						
1½ in.	¾ in.	No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.			AASHO[3]	Unified[4]
				100	89	79	20	17	22	6	A-4(8)	ML-CL.
			100	89	84	79	50	46	50	27	A-7-6(17)	CL.
		100	98	90	86	79	46	43	55	34	A-7-6(19)	CH.
			100	99	84	61	13	8	19	2	A-4(8)	ML.
			100	87	83	79	58	55	62	36	A-7-6(20)	CH.
			100	97	92	86	53	48	55	36	A-7-6(20)	CH.
		100	99	69	67	66	48	43	60	35	A-7-6(18)	CH.
			100	74	72	70	51	45	60	37	A-7-6(19)	CH.
		100	99	88	86	85	66	60	84	58	A-7-6(20)	CH.
	100	98	84	58	57	56	44	37	67	42	A-7-6(15)	CH.
	100	99	93	79	78	77	75	56	78	52	A-7-6(20)	CH.
		100	99	94	93	92	79	65	86	59	A-7-6(20)	CH.
		100	99	73	70	69	51	43	62	39	A-7-6(19)	CH.
	100	99	98	70	67	66	50	44	72	49	A-7-6(18)	CH.
		100	98	87	85	84	67	59	77	53	A-7-6(20)	CH.
			100	99	91	76	18	14	26	5	A-4(8)	ML-CL.
			100	91	86	75	43	40	47	26	A-7-6(16)	CL.
		100	99	97	93	83	44	39	52	35	A-7-6(18)	CH.
		100	99	98	72	52	8	6	26	4	A-4(7)	ML-CL.
			100	99	86	66	29	27	39	22	A-6(13)	CL.
		100	98	97	86	82	51	48	69	48	A-7-6(20)	CH.
			100	99	71	53	9	7	30	7	A-4(7)	ML-CL.
			100	95	79	73	45	43	54	35	A-7-6(20)	CH.
				100	88	70	39	36	46	31	A-7-6(17)	CL.
	100	99	92	74	70	61	38	33	43	24	A-7-6(13)	CL.
			100	98	95	94	59	51	71	51	A-7-6(20)	CH.
			100	96	93	91	57	49	58	38	A-7-6(20)	CH.
			100	93	77	83	43	33	34	18	A-6(11)	CL.
			100	93	89	83	51	42	43	25	A-7-6(15)	CL.
		100	99	94	91	88	53	45	51	33	A-7-6(18)	CL.
		100	97	72	68	64	40	36	50	27	A-7-6(15)	CL.
	100	98	94	70	68	64	43	41	56	31	A-7-6(17)	CH.
	100	96	95	93	90	88	47	32	65	46	A-7-6(20)	CH.
	100	99	84	79	76	75	48	43	72	48	A-7-6(20)	CH.
		100	99	97	82	84	49	44	62	43	A-7-6(20)	CH.
			100	95	91	89	55	48	72	51	A-7-6(20)	CH.
			100	99	80	54	9	5	31	5	A-4(8)	ML.
		100	99	91	80	70	48	45	50	25	A-7-6(16)	CL.
			100	99	76	64	33	32	39	20	A-6(12)	CL.
			100	99	88	71	13	8	26	5	A-4(8)	ML-CL.
		100	98	78	74	69	38	35	51	28	A-7-6(18)	CH.
		100	99	84	81	75	36	34	54	34	A-7-6(20)	CH.
		100	97	94	85	69	14	12	26	5	A-4(8)	ML-CL.
		100	98	75	72	66	35	33	50	29	A-7-6(17)	CL.
		100	97	83	82	81	50	43	64	44	A-7-6(20)	CH.

TABLE 7.—*Engineering*

Soil	Texas report number	Depth	Horizon	Shrinkage		Field moisture equivalent
				Limit	Ratio	
Morey silt loam:						
2 miles north and 4.5 miles west of Port Arthur. (Modal profile.)	61-33-R	0-12	A1	21	1.63	28
	61-34-R	12-26	B2	17	1.77	28
	61-35-R	36-60+	C	11	2.00	29
4 miles southwest of Hamshire. (Yellow variation.)	61-54-R	0-8	A1	16	1.75	26
	61-55-R	18-36	B22	11	1.99	32
	61-56-R	36-72	C	11	2.00	28
7 miles southwest and 0.5 mile north of Port Acres. (Red variation.)	61-57-R	0-8	A1	18	1.66	29
	61-58-R	20-36	B22	10	2.01	34
	61-59-R	36-64	C	10	2.02	32
1 mile east and 1.3 mile north of China. (Neutral surface variation.)	61-30-R	0-10	A	15	1.82	24
	61-31-R	18-34	B2	13	1.92	25
	61-32-R	40-72	C	12	1.95	26
3 miles northeast of Fannett. (Light-textured variation.)	61-60-R	0-7	A1p	19	1.70	25
	61-61-R	18-28	B2	15	1.85	25
	61-62-R	28-48	Bca	13	1.93	24
	61-63-R	48-84	C	14	1.89	25
1 mile west-southwest of Cheek. (Cca variation.)	61-64-R	0-13	A1	20	1.67	28
	61-65-R	19-43	B2	13	1.93	29
	61-66-R	43-60	Cca	14	2.08	27

[1] Tests performed by the Texas Highway Department in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*).

[2] Mechanical analyses according to the AASHO Designation T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diam-

and some current ones refer to these Pleistocene sediments as Beaumont clay (not to be confused with the soil type). The Prairie formation was probably deposited during Wisconsin time, the last stage of the Pleistocene. Barton (*4*) was among the first to point out that the surface Pleistocene deposits of this county were laid down as an extensive deltaic plain of the Trinity River, which is now west of the county. This deltaic plain was similar to the delta of the Mississippi River. Except for Caddo-Pocomoke loamy fine sands, all the soils of the coast prairie and East Texas timberlands probably developed on material deposited in channels, on flood plains, on levees, and in backswamps, and on interfingering marine and lagoonal deposits. These deposits are similar to those on present deltaic plains. The numerous remnants of old stream channels, such as Lovell Lake, are evidence of this mode of origin.

Caddo-Pocomoke loamy fine sands seem, for the most part, to have formed on remnants of a group of barrier islands of Pleistocene time, known as the Ingleside shoreline. The features of this shoreline are similar to those along the present coast of Texas (for example, Padre and Galveston Islands). This group of older barrier islands has been traced from the southwestern side of Corpus Christi Bay to an area south of Lake Charles, La. (*19*). Near Fannett, Tex., in the west-central part of Jefferson County, the ridge-and-swale beach relief can be easily seen on aerial photographs.

During the several glaciations of Pleistocene time, sea level was probably lowered as much as 400 feet, as water was locked up in the glaciers. During the interglacial intervals, when most of the ice melted, the sea level rose. The Wisconsin stage has been divided into several substages, each of which marks separate advances of the ice. During each substage the sea level dropped when the ice was formed and rose when the ice melted.

The deltaic plain of the Trinity River may have been laid down during one of these substages, about the middle of the Wisconsin stage. This plain covers most of the county. The Ingleside shoreline may have been deposited during the last major interglacial interval, just before the Wisconsin stage, or it may have been deposited during an interval of higher sea level between one of the substages of the Wisconsin. Since their deposition, the Pleistocene sediments have been tilted gulfward. The slope of their surface is slightly greater than that of the Recent deposits, which overlap them along the margin of the gulf.

When the sea level dropped during the latter part of the Wisconsin stage, the mouth of the combined Neches and Sabine Rivers was extended seaward. Upstream from the mouth, these streams and their tributaries (for example, Pine Island and Taylor Bayous) deepened their *test data*[1]—Continued

Mechanical analyses[2]									Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—					AASHO[3]	Unified[4]
1½ in.	¾ in.	No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.05 mm.	0.002 mm.				
--------	--------	100	98	92	82	71	25	18	31	8	A-4(8)	ML-CL.
--------	--------	100	91	75	70	66	71	27	38	20	A-6(11)	CL.
--------	--------	100	99	82	76	72	51	37	55	36	A-7-6(19)	CH.
--------	--------	100	98	93	75	66	28	25	35	18	A-6(11)	CL.
--------	--------	100	99	96	86	79	51	48	67	47	A-7-6(20)	CH.
--------	--------	--------	100	98	83	74	45	41	56	38	A-7-6(20)	CH.
--------	100	97	93	83	74	62	44	24	40	19	A-6(11)	CL.
--------	--------	100	99	86	79	73	46	43	56	34	A-7-6(19)	CH.
--------	--------	--------	100	86	80	76	50	46	58	38	A-7-6(20)	CH.
--------	--------	--------	100	99	89	79	29	25	34	17	A-6(11)	CL.
--------	--------	100	99	96	86	79	34	31	41	25	A-7-6(14)	CL.
100	99	97	96	91	82	73	36	32	48	31	A-7-6(18)	CL.
--------	--------	100	96	92	85	68	20	17	34	12	A-6(9)	ML-CL.
--------	100	99	97	92	86	74	30	20	39	23	A-6(13)	CL.
100	98	84	81	80	73	65	30	24	37	22	A-6(16)	CL.
--------	100	96	93	90	84	75	33	29	44	27	A-7-6(16)	CL.
--------	--------	100	91	81	74	62	20	17	35	13	A-6(9)	ML-CL.
100	99	96	89	73	68	62	29	26	48	30	A-7-6(16)	CL.
100	88	79	73	67	62	53	24	22	46	28	A-7-6(13)	CL.

eter. In the SCS soil survey procedure the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions.

[3] Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-49 (*1*).

[4] Based on the Unified Soil Classification System, Technical Memorandum No. 3-357, Volume 1, Waterways Experiment Station, Corps of Engineers, March 1953 (*23*).

channels as much as 120 feet below the present sea level (*10*). The sea level rose again after the last of the Wisconsin ice melted and flooded the lower reaches of the entrenched streams. It continued to rise until about 5,000 years ago and has remained more or less stationary since that time (*14* and *15*).

During and after the last rise in sea level, alluvial deposits in the lower reaches of the streams provided the parent material for soils of the flood plains and for swamps bordering the Neches River and Pine Island and Taylor Bayous. Also, during and after the rise in sea level, much of the coast has been building seaward as coastal marshes and beaches. The deposits are the sources of the parent materials for Harris soils and the soils of the Sabine-Coastal land soil association.

In the southeastern part of the county, accretions to the coast have converted the drowned mouths of the combined Sabine and Neches Rivers from an open bay to the enclosed estuary, Sabine Lake (*10*). Coastal building, however, has not been uniform in the county. The area of active shoreline extends south of the community of Sabine Pass; yet the area along the shore approximately west of Clam Lake has been actively eroded for the past few hundred years. Beach deposits are being pushed landward over Recent coastal-swamp deposits (*15*).

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent materials; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the soil material.

Climate and living organisms, especially vegetation, are active factors of soil genesis. They act on the parent material that has accumulated and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and in extreme cases determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. It may be much or little, but some time is always required for horizon differentiation. Usually a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made about the effect of one unless conditions are specified for the other four. Many of the processes of soil development are unknown. The five factors of soil formation, as they relate to the soils of this county, are discussed next.

Parent materials.—Old alluvium and marine sediments laid down by ancient streams and the Gulf of Mexico are the chief parent materials of most soils in the county. The materials consist primarily of clay and sandy clay mixed with some clay loam, silt, and sand. They originated from a multitude of soils, rocks, and unconsolidated sediments that existed throughout the flood plains of the ancient streams. Recent sandy and silty alluvium derived from the more highly weathered soils of East Texas constitutes the parent materials of soils along the flood plains of the Neches River and Pine Island Bayou.

Some soils in Jefferson County have a rather wide range of texture in the parent material because of their mode of origin. Textural differences are accompanied by some differences in chemical and mineralogical composition. Sandier sediments generally are higher in quartz than those of intermediate or fine textures, but they are lower in feldspars and ferromagnesian minerals. Sandier sediments are characteristically more siliceous and lower in bases.

The parent materials were segregated to some extent when they were deposited by the ancient streams and the gulf. The segregation was probably accomplished much the same as on present deltas. As rivers flood their channels, water spreads out over the flood plain, and the coarser sediments are dropped first. As the floodwaters continue to spread, they move more slowly and deposit finer sediments, such as silt. After the flood has passed, and still water is left standing in the lower areas of the flood plains, the finer sediments, or clays, settle out. As the materials were deposited, the stream channels cut back and forth across much of their flood plain and sometimes cut out natural levees previously laid down. Sometimes they deposited sands on top of clays, or clays on top of sands. After the materials were deposited, they were probably modified to some extent by wind and water.

The parent materials of Hockley silt loam and Crowley silt loam consist of fragments of old channels and their sandy levees. The level to very gently sloping silty sediments were the parent materials of Morey silt loam, Waller soils, Acadia silt loam, and Byars silt loam. The clayey sediments in the lower parts of the ancient flood plains were the parent materials of Beaumont clay, Lake Charles clay, Garner clay, and to some extent, Harris clay. Sandy marine deposits were the parent materials of such soils as Caddo-Pocomoke loamy fine sands, Sabine loamy fine sand, Galveston fine sand, Coastal land, and Tidal marsh. Bibb clay loam, Alluvial land, and Swamp have developed from more recent silty alluvium in the present flood plains of the Neches River and Pine Island Bayou.

After the parent materials were deposited and reworked by wind and water, other soil-forming processes developed the soils in Jefferson County.

Climate.—Jefferson County has a mixture of tropical and temperate climate. Over the county, climate has been a uniform factor in soil development but has made only a slight impression on the soils (see table 10).

Generally, regions with a humid, warm-temperate climate have strongly weathered, leached, acid soils with low fertility. The soils of Jefferson County are geologically young, however, and time has not yet permitted strong weathering of the sediments in place. The parent materials have come mainly from sections of the country where weathering was not intense. Thus, the kinds of soils normally associated with a warm-temperate, humid climate do not occur in this county.

Plant and animal life.—Although native vegetation has been the principal living influence in soil formation in Jefferson County, earthworms and other forms of life in and on the soil have also contributed. Among the changes caused by living organisms are gains in content of organic matter and nitrogen in the soil, gains or losses in nutrients, and changes in structure and porosity.

In this county the soils have developed under several different types of vegetation. The differences in native vegetation seem to have been associated mainly with variations in drainage and salinity. Swampy areas of the flood plains were covered with cypress trees and water-tolerant grasses and sedges. These areas have fresh water and a permanently high water table, and they are seldom dry more than 1 foot below the surface. As a result, the soils have developed a high content of organic matter and have an accumulation of peat and muck on the surface.

Bibb clay loam and other soils of the flood plains are developing chiefly under species of oak and gum trees. They are normally too wet and too frequently flooded for pine trees to be established but are not swampy. These soils are very young and are still receiving fresh deposits of soil materials. For these reasons, vegetation has had very little effect on their development.

The soils of the East Texas timberlands (see fig. 3), such as Acadia silt loam and Caddo loamy fine sand, have developed under pure stands of pine and mixed stands of pine and hardwood trees. Generally, the soils developed under this type of vegetation are low in bases, and they are acid to a greater depth than the soils developed under grass. The decaying forest litter causes the formation of organic acids. These acids hasten the leaching of bases and encourage eluviation, a process responsible for the development of A2 horizons.

The soils of the coast prairie and coast marsh (see fig. 2) have developed under thick stands of grass. The soils contain more organic matter and are darker to a greater depth than soils developed under trees. Likewise, they are not so acid and are not leached of bases to so great a depth as the forest soils. The soils of the coast marsh, such as Harris clay, are darker in color and higher in content of organic matter than similar soils of the coast prairie, such as Beaumont clay. These conditions are probably caused by the larger quantities of vegetation that are produced and preserved on the wetter, saline soils.

Man has had an important effect on the direction and rate of soil development in Jefferson county. He has drained the land and has cultivated the soils. He has also introduced new species of plants, added fertilizer, built levees for flood and storm protection, and irrigated the crops. The results of these changes on soil genesis will not be evident for many centuries.

Relief.—Relief, or lay of the land, in Jefferson County (see figs. 2 and 3) has influenced soil formation, primarily by its effect upon drainage and runoff.

This county is mostly a flat, featureless plain that has very little dissection by streams. The highest elevation, 46 feet above sea level, is in the northwestern corner near Nome. From this point, the surface slopes very gradually in a southern and southeastern direction to a position level with the Gulf of Mexico. Slopes are generally less than one-half percent. Steeper slopes occur near salt domes, on banks leading to the flood plains of the Neches River and Pine Island Bayou, and along some of the old natural levees of ancient streams.

Most soils in the county drain slowly because of the flatness. Water moves into the main channels with difficulty. It moves slowly or very slowly through the soils; therefore, drainage problems are increased.

The mode of origin and deposition of parent materials are responsible for most of the relief in the county. Regardless of whether the transporting agent was salt water, fresh water, or wind, the more sandy materials were deposited on slightly elevated ridges throughout the county. These areas were well enough drained and sandy enough to permit the leaching of excess lime and the movement of some clay from the surface into the subsoil by the downward percolation of rainwater.

The combination of sandy parent material and slight relief helped develop such soils as Hockley silt loam, Crowley silt loam, and Caddo loamy fine sand. The soils are acid, and their surface soil and subsoil have pronounced differences in texture. Beaumont clay, Lake Charles clay, Garner clay, and such soils have developed from the clayey sediments that were deposited in the lower levels of the ancient flood plains. Because of the nearly level relief and the resistance of the clayey parent material to soil-forming processes, these soils have developed under very slow runoff and slow to very slow internal drainage. They have developed no textural profiles; however, some free lime has been leached downward from their surface soil and has made the surface horizon acid to neutral. Some differences among these soils probably result from the amount of calcium that was in the original parent material, the vegetation under which the soils have developed, and the length of time that they have been in place.

The more silty parent materials of such soils as Acadia silt loam and Morey silt loam were deposited between the sandy ridgetops and the clayey flats. The relief of these areas is only slightly higher than that of the clayey flats. The soils have developed under slow to very slow runoff and very slow internal drainage. Internal drainage was probably better in the past than it is now, as some clay has moved from the surface to lower horizons. Nearly all of the free lime has been leached from the Acadia soils, but only part has been leached from the Morey soils. The major differences in the two soils were probably caused by the vegetation under which they have developed. The length of time that the two soils have been in place and the calcium content of the original parent material may have caused some differences.

Waller soils and Byars silt loam have developed under very slow to ponded runoff and very slow internal drainage. These soils occupy shallow depressions throughout the county and have probably developed from parent materials similar to those of Acadia silt loam and Morey silt loam. Very poor drainage has limited the amount of profile development.

Alluvial soils and soils of the coast marsh are developing from more recent deposits than the soils of the coast prairie and East Texas timberlands. The major influence in development is the kind and amount of vegetation that grows and has accumulated on and in the soils; however, minor differences in relief are also influencing development. The soils in depressed areas where Swamp and Salt water marsh are developing are permanently wet, and aeration has been prevented. These areas are better protected from fire and overgrazing and are thus higher in content of organic matter than areas of such soils as Harris clay and Bibb clay loam. Relief has some influence on the amount and effect of flooding in these areas. Minor differences in elevation also influence the accumulation and removal of harmful salts in soils of the coast marsh.

Time.—Time is required for soil formation. Some soils, as those being formed from alluvial sediments in flood plains, may require a short time. Some may require a relatively long time, as the soils of the uplands. When other factors are equal, the age of soils is reflected in the distinctness of the horizons in the profile. The importance of time as a factor in soil formation always depends on its combination with the other factors.

There is little evidence that time has been the cause of many of the differences among soils in Jefferson County. It has been an important factor, however, in the development of differences between the alluvial and marsh soils and the other soils in the county. Some soils of the uplands may be older than others, but the effective differences seem small. The differences among these soils are mainly caused by parent material and relief.

Classification and Morphology of Soils

Soils are placed in narrow classes for the organization and application of knowledge about their behavior within farms, ranches, or counties. They are placed in broad classes for study and comparisons of large areas, such as continents. In the comprehensive system of soil classification followed in the United States (*3*), the soils are placed in six categories, one above the other. Beginning at the top, the six categories are order, suborder, great soil group, family, series, and type.

In the highest category, the soils of the whole country are grouped into three orders; whereas, thousands of soil types are recognized in the lowest category. The suborder and family categories have never been fully developed and thus have been little used. Attention has been given largely to the classification of soils into soil types and series within counties or comparable areas and to the subsequent grouping of series into great soil groups and orders. Soil series, type, and phase are defined in "How Soils are Mapped and Classified" and in the Glossary. Subdivisions of soil types into phases provide finer distinctions significant to use and management.

Classes in the highest category of the classification scheme are the zonal, intrazonal, and azonal orders (*20*). The zonal order comprises soils with evident, genetically related horizons that reflect the dominant influence of climate and living organisms in their formation. The intrazonal order comprises soils with evident, genetically related horizons that reflect the dominant influence of one or more local factors of parent material or topography, over the effects of climate and living organisms. The azonal order comprises soils that lack distinct, genetically related horizons, commonly because of youth, resistant parent material, or steep topography.

The classification of soil series in this county into great soil groups and orders follows. Following this classification is a discussion of each soil series and a description of a typical soil profile. Symbols following the names of colors in the typical profile are Munsell color notations, indicating hue, value, and chroma. Unless otherwise specified, colors are for dry soil.

SOIL SERIES CLASSIFIED BY ORDER AND GREAT SOIL GROUP

ZONAL ORDER:
- Brunizems:
  - Sabine
- Reddish Prairie soils:
  - Hockley
- Red-Yellow Podzolic soils:
  - Caddo

AZONAL ORDER:
- Alluvial soils:
  - Bibb
- Regosols:
  - Galveston
  - Klej

INTRAZONAL ORDER:
- Grumusols:
  - Beaumont
  - Garner
  - Harris
  - Lake Charles
- Planosols:
  - Acadia
  - Crowley
  - Morey
- Low-Humic Gley soils:
  - Byars
  - Pocomoke
  - Waller

Acadia series.—This series consists of light-gray, acid soils with a mottled claypan subsoil. These soils have developed in acid to weakly alkaline sandy and clayey, old alluvium of Pleistocene time. The Acadia soils are intrazonal, forested Planosols within the zone of Red-Yellow Podzolic soils. The native vegetation is mixed pines and hardwoods.

The Acadia soils occupy nearly level to gentle slopes that are as much as 5 percent in places. The steeper areas of these soils are on narrow, short slopes leading into existing drainageways. These soils occupy higher positions than the Garner and Byars soils. The more level areas of the Acadia soils are only slightly lower than the Caddo soils.

These soils are imperfectly or somewhat poorly drained. Surface drainage is slow in the level areas and rapid on the short slopes. Internal drainage is slow.

The Acadia soils are associated with the Byars soils but are more mottled with brighter colors and have better surface drainage. They have a distinct B2 horizon, whereas the Byars do not. The Acadia soils have a textural profile, but the Garner soils are clay throughout.

The Acadia soils are not extensive and occur primarily in the northern part of the county. They are used almost entirely for woodland.

Typical profile of Acadia silt loam, 0 to 1 percent slopes (0.8 mile north on Main Street from Jefferson County courthouse at Beaumont, to Calder Avenue, then west 1.7 miles to 11th Street, then north 7.25 miles to Voth Cutoff, then 0.25 mile north on Broussard Road to Hillcrest Street, then north on Hillcrest 50 yards, then north of road 70 feet into pine timber):

A1—0 to 2 inches, gray (10YR 5/1) silt loam, dark gray (10YR 4/1) when moist; contains much organic matter; weak, granular structure; hard when dry, very friable when moist; common to many, fine, fibrous roots; few worm casts; pH 5.5; clear boundary.

A2—2 to 8 inches, very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) when moist; few, medium, faint mottles of yellowish brown; massive (structureless); hard when dry, friable when moist; common, fine pores and fibrous roots; few, fine, dark, semihard concretions of ferromanganese; pH 5.0; clear, wavy boundary.

A3—8 to 12 inches, very pale brown (10YR 7/4) silt loam, light yellowish brown (10YR 6/4) when moist; common, medium, or few, fine, faint mottles of brownish yellow; massive (structureless) but porous; hard when dry, friable when moist; few, fine, fibrous roots; pH 4.5; clear, wavy boundary.

B21—12 to 18 inches, brownish-yellow (10YR 6/6) silty clay loam, yellowish brown (10YR 5/6) when moist; many, medium, distinct mottles of red; weak, blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; common fine and few medium pores; pH 4.5; clear, wavy boundary.

B22—18 to 32 inches, clay mottled with yellow (10YR 7/6; 6/6, moist), very pale brown (10YR 7/3; 6/3, moist), and red (10YR 4/6, dry and moist); weak, blocky structure; firm when moist, sticky and plastic but stiff when wet; few fine pores; few, fine, fibrous roots; pH 4.5; gradual boundary.

C—32 to 62 inches +, light-gray (10YR 7/2) silty clay, light brownish gray (10YR 6/2) when moist; common to many, prominent, medium mottles of red; common, fine, faint mottles of brownish yellow; common, prominent dark-red streaks and coatings along the voids; massive (structureless); sticky and plastic when wet; few very fine roots and root channels; pH 4.5.

The A horizon ranges from 2 to 18 inches in thickness but is dominantly 12 inches. It ranges from light gray to dark gray in color and from 5.0 to 6.0 in pH. In a few places the texture is very fine sandy loam. In some places the wavy B horizon is exposed at the surface. In such places the A2 and A3 horizons are absent, and the boundary between the A and B horizons is abrupt. The proportion of red mottles in the B horizon ranges from 15 to 60 percent, and the size from medium to coarse. The pH of the B horizon ranges from 4.0 to 5.0.

Low, sandy circular mounds are on some areas of these soils. These mounds occupy less than 10 percent of the total soil area. They range from 15 to 25 feet in diameter, and from 1 to 2 feet above the normal ground level. Their A horizon ranges from 14 to 24 inches in thickness and from light gray to light yellowish brown in color. Their B and C horizons are essentially the same as those described for the typical profile.

Beaumont series.—This series consists of deep, moderately dark, acid soils. The soils have a clay texture and lack eluvial and illuvial horizons. They have a high coefficient of expansion and contraction. This characteristic helps to develop a microassociation of dark- and light-colored profiles. The Beaumont soils are nearly level but have shallow, enclosed microdepressions known as gilgai, or hogwallows, alternating with slightly higher microknolls. They are intrazonal soils of the Grumosol great soil group. They have developed from alkaline but noncalcareous Quaternary clay under grass vegetation, mostly species of *Andropogon, Sorghastrum,* and *Paspalum.*

The Beaumont soils occupy broad level to nearly level areas with slopes of less than 0.4 percent. In position, they are only slightly higher than Waller and Harris soils and are lower than the Morey soils. They occur in essentially the same position as the Lake Charles soils.

These soils are poorly drained. Runoff and internal drainage are very slow.

The Beaumont soils are lighter colored, less granular (more compact), and less well drained than the Lake Charles soils. They are also more mottled and more acid.

They differ from the Morey soils in having no textural profile. The Beaumont soils are darker and have less bright mottles than the Garner soils. They are not so acid in the upper few inches. In the southern part of the county, the Beaumont soils are associated with the Harris soils but have more mottles and less organic matter. They are also more acid and less saline.

These soils are the most extensive in the county. They occur in large, broad flats throughout the coast prairie part. They are used chiefly for rice and tame pasture. Small areas of native rangeland still exist. Pine and hardwood timber have encroached on some areas, which are used for production of wood.

Typical profile of Beaumont clay (0.8 mile west of county courthouse at Beaumont on Franklin Street, then south by west on Avenue A 2.2 miles, then south on West Port Arthur Road 2.4 miles, then west 0.6 mile on Hillebrandt Road, 300 yards north of road in idle ricefield):

A1p—0 to 8 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; common, fine and medium, faint, brownish-yellow and common, distinct, fine and medium, dark-brown mottles; massive (structureless); sticky and plastic but stiff when wet; many root channels and ped surfaces are coated with dark reddish brown; pH 5.2; abrupt boundary.

A12—8 to 14 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; common, fine and medium, faint, brownish-yellow mottles and few distinct, strong-brown mottles; moderate, medium, blocky structure with few coarse blocks; sticky and plastic but stiff when wet; few fine roots and pores; some are coated with dark reddish-brown stains; most brownish-yellow mottles are inside the peds; pH 5.0; clear boundary.

A13—14 to 32 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; many, fine and medium, faint, brownish-yellow and few, distinct, strong-brown mottles; moderate, medium, blocky structure; sticky and plastic but stiff when wet; few fine pores and root channels; some root channels have dark reddish-brown coatings; pH 5.0; gradual, wavy boundary.

AC—32 to 44 inches, gray (10YR 6/1) clay, dark gray (10YR 4/1) when moist; many, fine and medium, yellowish-brown and few, medium, distinct, strong-brown mottles; approximately 60 percent of the mass is gray; moderate, medium and coarse, blocky structure; very sticky and plastic when wet, hard when dry; very few fine roots and pores; gray clay krotovinas about 1 inch in diameter and 8 to 10 inches apart; pH 5.5; gradual, wavy boundary.

C—44 to 60 inches +, clay, coarsely mottled yellowish brown (10YR 5/5) and light gray (2.5Y 6/1) when moist; massive (structureless); very sticky and plastic when wet, hard when dry; gray clay krotovinas about 1 inch in diameter and 8 to 10 inches apart; very few fine roots and pores; pH 7.5.

The A horizon ranges from gray to dark gray in color; the hue ranges from 10YR or 2.5Y in places. The thickness ranges from 4 inches on the microknolls to 36 inches in the microdepressions. The pH ranges from 5.0 to 6.4. The structure of the upper few inches of the A horizon ranges from moderate, medium, granular in undisturbed areas to massive in plowed fields. Mottles make up from 0 to 20 percent of the mass. The mottles in the AC horizon make up from 15 to 50 percent of the mass. The pH of the AC and C horizons ranges from 5.2 to 8.0.

Bibb series.—This series consists of gray, acid, frequently flooded Alluvial soils of the azonal order. The parent materials consist of sediments washed from Red-Yellow Podzolic soils of the East Texas timberlands, mixed with sediments from the more clayey soils of the gulf coast prairie. The native vegetation consists of water-tolerant hardwoods.

These soils occur on level to nearly level areas where slopes are less than 0.5 percent. They are from 1 to 2 feet higher than the miscellaneous land type, Swamp.

The Bibb soils are poorly drained. Runoff and internal drainage are very slow.

The Bibb soils occur in association with Swamp and Alluvial land. Near the flood plain of the Neches River, the Bibb soils join the Byars and Klej soils, which occupy low terraces. The Bibb soils are more clayey throughout, occupy lower positions, and are more poorly drained than the Klej soils. They have less profile development, are more frequently flooded, and have a less clayey subsoil than the Byars soils.

The Bibb soils occur in large areas along the Neches River and Pine Island Bayou in the northern and northeastern parts of the county. They are used almost entirely for the production of hardwoods. They are also used to some extent for wildlife habitats and for recreation.

Typical profile of Bibb clay loam (north of Beaumont, Tex., on U.S. Highway No. 96 to Voth, Tex., then 0.8 mile west on the extreme northernmost road in the county, then north on Tram Road to Pine Island Bayou, then 100 yards west in overflow bottom):

A—0 to 2 inches, dark-gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) when moist; few, fine, faint mottles of yellowish brown; weak, blocky structure; hard when dry, firm when moist, sticky and plastic when wet; common, fine, woody roots; pH 5.0; clear boundary.

AC—2 to 26 inches, light-gray (10YR 6/1) clay loam, gray (10YR 5/1) when moist; many, fine, faint, yellowish-brown mottles and common, fine, faint, brownish-yellow mottles; the brownish-yellow mottles have dark, yellowish-brown centers; massive (structureless); hard when dry, firm when moist, sticky and plastic when wet; few, medium, woody roots; pH 4.5; gradual boundary.

C—26 to 46 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) when moist; common, fine and medium, faint, brownish-yellow mottles; few, dark yellowish-brown stains along the root channels; massive (structureless); very hard when dry, sticky and plastic when wet; pH 4.5; diffuse boundary.

D—46 to 56 inches +, light-gray (5Y 7/1), stratified sandy clay loam, fine sandy loam, and clay, gray (5Y 6/1) when moist; few, fine, distinct, yellowish-brown mottles; massive (structureless); very hard when dry, slightly sticky and plastic when wet; pH 6.0.

The A horizon ranges from gray to dark grayish brown in color and from 2 to 10 inches in thickness. In a few places, the texture of the surface soil is silty clay loam. The AC and C horizons range in color from light gray to light brownish gray. The C horizon is stratified with light-gray silt loam and silty clay in places. The depth to the C horizon ranges from 18 to 38 inches. The water table is probably at this horizon most of the year. In places the D horizon is white fine sand. The pH for all horizons ranges from 4.5 to 5.5. Mottles range from few to many throughout the profile.

Byars series.—In this series are deep, gray, acid Low-Humic Gley soils of the intrazonal order. They have developed from acid sandy clays and clays of Pleistocene time. The native vegetation consists chiefly of water-tolerant hardwoods and a few, scattered pines.

The Byars soils occupy low, depressed areas that are apparently in old natural drainageways. Slopes are less than 0.2 percent. The Byars soils are 2 to 4 feet lower than the Caddo and Pocomoke soils and are 1 to 2 feet lower than the Garner and Acadia soils.

These soils are very poorly drained. Runoff is very slow to ponded, and internal drainage is very slow.

The Byars soils are less mottled, are more poorly drained, and have a more friable upper B horizon than the Acadia soils. They are more poorly drained, are grayer, and have fewer bright mottles than the Caddo soils. The Byars soils have a textural profile, but the Garner soils are clay throughout.

The Byars soils are extensive in forested areas. They are used primarily for hardwood production, though a few areas produce pine timber.

Typical profile of Byars silt loam (north of Amelia, Tex., on Farm Road No. 364 to intersection with State Highway No. 105, then west about 8 miles on State Highway No. 105, then 1 mile north on shell road, 150 feet east of road in hardwood flat):

A11—0 to 5 inches, gray (10YR 6/1) silt loam, gray (10YR 5/1) when moist; common, fine, faint mottles of dark gray and yellowish brown; common light-gray very fine sandy loam pockets and lenses; massive (structureless); hard when dry, slightly sticky and plastic when wet; many, fine woody roots; pH 5.5; gradual boundary.

A12—5 to 23 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) when moist; common, fine and medium, distinct yellowish-brown and strong-brown stains along root channels; some pockets of white very fine sandy loam; massive (structureless); hard when dry, slightly sticky and plastic when wet; common fine, vesicular pores; pH 5.5; diffuse boundary.

B1—23 to 37 inches, light-gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) when moist; few, fine, distinct mottles of yellowish brown and common, fine and medium, distinct mottles of strong brown; many, fine and medium streaks of white silt loam; massive (structureless); very hard when dry, slightly sticky and plastic when wet; few, fine, vesicular pores; pH 5.0; clear boundary.

B2—37 to 55 inches, clay mottled with light gray (10YR 7/2; 6/2, moist), brownish yellow (10YR 6/6; 5/6, moist), and brown (7.5YR 4/4; 5/4, moist); massive (structureless); very hard when dry, very firm when moist, sticky and plastic when wet; few fine pockets of white silt loam; pH 5.0.

C—55 to 65 inches +, light-gray (10YR 7/1), heavy sandy clay, gray (10YR 6/1) when moist; common, medium, distinct mottles of strong brown with prominent, red centers; massive (structureless); very hard when dry, sticky and plastic when wet; pH 6.0.

The A horizon ranges from gray to mottled gray, brownish yellow, and yellowish brown in color and from 14 to 30 inches in thickness. In some minor areas, the A horizon is as thick as 40 inches. The texture of the A horizon is dominantly silt loam, but in some small areas it is fine sandy loam. In places the texture of the C horizon is clay. The depth to the C horizon ranges from 40 to 60 inches.

Caddo series.—This series consists of deep-gray to dark-gray, acid Red-Yellow Podzolic soils of the zonal order. The parent material is acid loamy earth, probably of late Pleistocene time. The soils have developed under native vegetation of pines and hardwoods.

The Caddo soils occur in nearly level to very gently rolling areas. Slopes range from 0.1 to 1 percent. The Caddo soils occupy slightly higher positions than the Pocomoke soils. They are some 2 to 3 feet higher than the Byars soils and are slightly more billowy and higher than the Acadia soils.

These soils are imperfectly or somewhat poorly drained. Runoff and internal drainage are slow.

In this county the Caddo soils occur only in complex with the Pocomoke soils. They have a lighter colored A horizon, are slightly more acid, and are better drained than the Pocomoke soils. They are less gray and are more coarse textured in the lower horizons than the Byars soils. They have a thicker A horizon, are more permeable, and have a less brightly mottled B horizon than the Acadia soils.

The Caddo soils are not extensive in the county. They occur entirely in the west-central part in the Lawhorn Woods on the Gilbert Ranch and are used for the production of wood.

Typical profile of Caddo loamy fine sand in a complex with Pocomoke soils (south of Beaumont, Tex., on Texas State Highway No. 124 to intersection with Farm Road No. 365 at Fannett, Tex., then 3.2 miles west on Farm Road No. 365, then 300 feet south on the tram road, west of road in pine woodland):

A11—0 to 4 inches, dark-gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) when moist; weak, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; many, fine and medium, woody roots; pH 5.0; clear boundary.

A12—4 to 16 inches, light brownish-gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) when moist; few, fine, faint mottles of brown and dark gray; weak, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; common, fine and medium, woody roots; pH 4.5; clear boundary.

A2—16 to 26 inches, very pale brown (10YR 7/4) loamy fine sand, light yellowish brown (10YR 6/4) when moist; common, fine, faint mottles of yellow and brownish yellow and few, fine, faint mottles of brown; massive (structureless); soft when dry, very friable when moist, nonsticky and nonplastic when wet; few, fine, strong-brown stains along root channels; common, fine, woody roots and root channels; pH 4.5; clear boundary.

B2—26 to 50 inches, sandy clay loam mottled with light gray (10YR 7/2; 6/2, moist) and brownish yellow (10YR 6/8; 5/8, moist) few, fine, prominent mottles of red; massive (structureless); hard when dry, friable when moist, slightly sticky and plastic when wet; pH 4.5.

In places small, hard concretions of ferromanganese are common throughout the profile. The A horizon ranges from 14 to 30 inches in thickness. The pH ranges from 4.5 to 5.5 in all horizons. In places the B horizon is clay loam. Mottled-gray and red clay may occur at a depth of 40 inches.

Crowley series.—This series consists of deep, light-gray to grayish-brown, acid soils with a thick A horizon of silt loam. These soils are underlain by silty clay or claypans in the coast prairie part of the county. They are in the intrazonal order and the Planosol great soil group. They have developed from slightly acid to weakly calcareous sandy clays of Pleistocene time under grass vegetation consisting of various species of *Andropogon, Sorghastrum,* and *Paspalum.*

The Crowley soils occupy nearly level to level areas. Slopes range from 0.3 to 1 percent. In places the surface is slightly billowy. These soils occupy higher positions than the Morey soils and lower positions than the Hockley soils. They are from 1 to 6 feet higher than the Beaumont and Lake Charles soils.

These soils are imperfectly or somewhat poorly drained. Runoff is slow, and internal drainage is very slow.

These soils are more poorly drained than the Hockley soils, and their upper subsoil is less friable. They have a thicker A horizon and a more brightly mottled B horizon than the Morey soils.

The Crowley soils are not extensive in this county, but small areas are scattered throughout the coast prairie part. They are used chiefly for rice and pasture.

Typical profile of Crowley silt loam in bermudagrass pasture (4.1 miles northwest of Hamshire, Tex., on winding, hard-surfaced county road, then 100 feet south of road):

A1—0 to 11 inches, grayish-brown (10YR 5/2), coarse silt loam, very dark grayish brown (10YR 3/2) when moist; few, fine, faint mottles of strong brown; weak, granular structure; friable when moist, slightly hard when dry; pH 5.2; gradual boundary.

A2—11 to 22 inches, light brownish-gray (10YR 6/2), coarse silt loam, dark grayish brown (10YR 4/2) when moist; few, fine, faint mottles of brownish yellow; weak, granular structure; friable when moist, slightly hard when dry; pH 5.2; clear boundary.

B21—22 to 40 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; many, medium and coarse, prominent mottles of red; moderate, medium and coarse, blocky structure; sticky and plastic when wet, very firm when moist, hard when dry; red mottles decrease with depth and become few to common at a depth of 38 inches; pH 5.0; clear boundary.

B22—40 to 50 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; common, medium, prominent mottles of reddish yellow and red; strong, medium to coarse, blocky structure; very firm when moist, very hard when dry; few, medium sandy pockets; pH 5.0; gradual boundary.

C—50 to 54 inches, light-gray (2.5Y 7/2), heavy silty clay, light brownish gray (2.5Y 6/2) when moist; common to few, fine, distinct mottles of yellowish red; friable when moist, hard when dry; common, medium sandy pockets; pH 5.2.

The A horizon ranges from 18 to 24 inches in thickness and from light gray to grayish brown in color. In a few places, the boundary between the A2 and B21 horizons is abrupt, and in a few others it is gradual. In the A horizon, brownish-yellow and strong-brown mottles and stains range from none to many. The pH of the A and B horizons ranges from 5.0 to 6.0, and that of the C horizon, from 5.0 to 7.4. The texture of the C horizon ranges from silty clay to clay.

Galveston series.—This series consists of loose, light-gray to very pale brown fine sands. These soils are in the azonal order and in the Regosol great soil group. The parent material consists of only slightly weathered sandy marine deposits that have been reworked to some extent by both wind and water. Beach sand was included in some of the mapping units of Galveston soils in Jefferson County.

The Galveston soils are in level to very low dunelike areas at, or very near, sea level. They occupy lower positions than the Sabine and Harris soils.

These soils are moderately well drained. Runoff is very slow, and internal drainage is rapid.

The Galveston soils are lighter colored throughout, occupy lower positions, and are more poorly drained than the Sabine soils.

The Galveston soils occur only in the extreme southern part of the county, adjoining the Gulf of Mexico. They are used mainly for recreation, some wildlife habitats, and very limited grazing.

Typical profile of Galveston fine sand (14.1 miles west of Sabine Pass, Tex., on Texas Highway No. 87, then 25 yards south of highway):

A1—0 to 2 inches, light brownish-gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) when moist; single grained (structureless); loose; numerous fine roots; some partly decomposed plant residue; slightly acid; gradual boundary.

C—2 to 50 inches, light-gray (10YR 7/2) fine sand, very pale brown (10YR 7/3) when moist; single grained (structureless); loose when dry and when moist; pH 8.0.

In places a waxy blue clay occurs at a depth of 30 to 60 inches. Shells occur throughout the profile. In some places they are as much as 2 inches in diameter. Thin strata of loamy fine sand mottled with yellowish brown and brownish yellow occur in places in the profile.

Garner series.—This series consists of deep, light-gray to dark gray, noncalcareous, clayey soils of the intrazonal order. These soils have no textural profile. They have pronounced gilgai and other characteristics that classify them as Grumusols. The parent material is weakly calcareous, clayey old alluvium of streams that drain prairie soils. These soils have developed under thin stands of coarse grass in a mixed pine and hardwood forest.

The Garner soils occupy nearly level to gentle slopes that are as much as 1 percent. They occur at a slightly lower elevation than the Acadia soils and are chiefly on broad flats at the heads of natural drains.

These soils are poorly drained. Runoff and internal drainage are very slow.

The Garner soils are more acid in the upper few inches, are lighter colored, and have more and brighter mottles than the Beaumont soils. Unlike the Acadia and Byars soils, they have no textural profile.

The Garner soils are extensive in the northern East Texas timberlands but not elsewhere in the county. They are used almost entirely for the production of timber.

Since the profile of Garner soils on microknolls is considerably different from that in the microdepressions, descriptions of two profiles have been prepared. These profiles occur north of Beaumont, Tex., on U.S. Highway No. 69, Suburban Acres addition, 1.1 miles east on Lawrence Drive (through the addition) as far as the second curve after passing White Oak Lane, and 100 feet on south side of road in wooded area.

Profile No. 1 (from a microknoll about 8 inches higher than profile No. 2):

A00—1 inch to 0, accumulation of fibrous roots, undecomposed leaves, and small twigs.

A11—0 to 2 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, fine, subangular blocky structure; very hard when dry, very firm when moist, very sticky and plastic when wet; many, fine, fibrous roots; pH 5.0; abrupt boundary.

A12—2 to 11 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; many, fine, prominent mottles of strong brown and many, fine, distinct mottles of brownish yellow; moderate, medium, blocky structure; very hard when dry, very firm when moist, very sticky and plastic when wet; pH 4.5; gradual boundary.

AC—11 to 36 inches, clay mottled with light gray (2.5Y 7/2; 6/2, moist) and brownish yellow (10YR 6/6; 5/6, moist); the brownish yellow color decreases with depth (at 24 inches 25 percent of the mass is brownish yellow); weak, blocky structure; very hard when dry, very firm when moist, sticky and plastic when wet; pH 6.2; diffuse boundary.

C—36 to 60 inches, gray (5Y 6/1) clay, gray (5Y 5/1) when moist; many, medium and fine, prominent mottles of yellowish brown; massive (structureless); very hard when dry, very firm when moist, sticky and plastic when wet; few, fine ferromanganese concretions; a few calcium carbonate concretions as much as 2 inches in diameter; pH 8.0; weakly calcareous in lower part.

Profile No. 2 (from a microdepression about 4 feet from profile No. 1):

A00—2 inches to 0, accumulation of fibrous roots, undecomposed leaves, and small twigs.

A11—0 to 12 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; common, fine and medium, distinct mottles of dark yellowish brown and few, fine, faint, mottles of light gray; moderate, medium, blocky structure; very hard when dry, very firm when moist, very sticky and plastic when wet; many, fine, fibrous roots; few fine pores; pH 5.0; diffuse boundary.

A12—12 to 26 inches, gray (10YR 6/1) clay, gray (10YR 5/1) when moist; common, fine, distinct mottles of dark yellowish brown and yellowish brown; moderate, medium, blocky structure; very hard when dry, very firm when moist, very sticky and plastic when wet; pH 5.0; gradual boundary.

AC—26 to 54 inches, clay mottled with light gray (2.5Y 7/2; 6/2, moist), reddish yellow (7.5YR 6/6; 5/6, moist), and gray (7.5YR 6/0; 5/0, moist); massive (structureless); very hard when dry, very firm when moist, sticky and plastic when wet; pH 6.0; clear boundary.

C—54 to 60 inches +, light-gray (2.5Y 7/2) clay, light brownish gray (2.5Y 6/2) when moist; many, fine and medium, distinct mottles of yellowish brown; massive (structureless); very hard when dry, very firm when moist, sticky and plastic when wet; a few concretions of calcium carbonate as much as 2 inches in diameter; pH 8.0; noncalcareous.

The A horizon ranges from dark gray to light gray in color. Its pH ranges from 5.0 to 6.2. On the microknoll the thickness of the A horizon over the AC ranges from 1 to 14 inches, and in the microdepressions it ranges from 20 to 34 inches. In a few areas the texture of the A horizon is clay loam.

The pH of the AC horizon ranges from 6.0 to 7.0. Concretions of calcium carbonate usually occur in the C horizon; however, in a few places they are absent to a depth of as much as 90 inches. The pH of the C horizon is always above 7.0, but this horizon is not always calcareous. A few fine, prominent red mottles may occur in the lower A and AC horizons.

Harris series.—This series consists of dark clayey, saline soils of the intrazonal order. These soils have developed in the marshy or semimarshy lowlands adjacent to the gulf coast of Texas. They are classed as Grumusols.

Because their clay content is primarily montmorillonite, the Harris soils show some evidence of cracking, shrinking, and swelling. They have a thick A horizon that is moderately high in content of organic matter. The native vegetation is coarse, salt-tolerant bunchgrass.

The Harris soils occupy flat to depressed areas that have little or no slope. They range in elevation from sea level to 4 feet above. All areas are saturated with water for long periods. Some areas are flooded with salt water during high tides, and all are flooded during gulf storms.

The Harris soils are very poorly drained. There is almost no runoff, and there is no internal drainage.

The Harris soils differ from the Galveston soils in being clay textured throughout. They occupy lower positions, are more poorly drained, and are more saline than the Beaumont soils. They are also darker and have fewer mottles.

The Harris are one of the most extensive soils in the county. They are in the southern part in the marsh and semimarsh area. They are used almost entirely for cattle grazing and wildlife habitats.

Typical profile of Harris clay (4.2 miles northwest of Sabine Pass, Tex., on Texas State Highway No. 87, then 200 yards west of road in saltgrass range):

A0—2 inches to 0, very dark gray (10YR 3/1), partly decomposed and mottled organic layer, black (10YR 2/1) when moist; pH 6.0.

A1—0 to 20 inches, gray (2.5Y 5/0) clay, dark gray (2.5Y 4/0) when moist; contains considerable amount of organic matter; common, fine, distinct mottles of yellowish brown and many prominent, medium and coarse stains of dark red along the outside of peds; stains not evident when soil is wet; moderate, coarse and medium, blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few, fine streaks of light-gray fine sand on outside of peds; common, fine and medium, fibrous roots and root channels; salinity 2.0 percent; pH 8.0; clear boundary.

AC—20 to 38 inches, gray (2.5Y 5/0) clay, dark gray (2.5Y 4/0) when moist; few, fine, distinct mottles of strong brown and common, medium, distinct streaks and splotches of light-gray fine sand; massive (structureless); very hard when dry, very firm when moist, very sticky and plastic when wet; few, fine, fibrous roots and root channels; salinity 2.0+ percent; pH 8.0; clear boundary.

C—38 to 60 inches, gray (5Y 6/1) clay, gray (5Y 5/1) when moist; few, fine, faint olive-colored mottles; common, fine, light-gray sandy streaks; massive (structureless); hard when dry, very sticky and plastic when wet; few, fine, fibrous roots and root channels; krotovinas of dark-gray clay 2 inches in diameter occur approximately 1 foot apart; salinity 2.0+ percent; pH 8.0.

The A0 horizon may be absent or as much as 5 inches thick. In places the structure of the A1 horizon is moderate, subangular blocky. The pH of this horizon ranges from 7.0 to 8.0. The salinity of the A and AC horizons ranges from 1.0 to 2.0+ percent. A few areas that have been protected from salt water show no harmful salt content. In some areas the clayey material is underlain with mottled brownish-gray and brownish-yellow fine sand at a depth ranging from 12 to 36 inches. Lenses of silty clay occur in the sandy material in places.

Hockley series.—In this series are deep, pale-brown to dark grayish-brown, strongly to slightly acid soils. These soils are in the zonal order and in the Reddish Prairie great soil group. The parent material consists of noncalcareous, unconsolidated sandy clays and clays of Pleistocene time. The native vegetation consists of tall grasses and mid grasses, mostly species of the *Andropogon*, *Panicum*, and *Paspalum*.

The Hockley soils occur on nearly level to gently undulating, slightly billowy surfaces where slopes range from 1 to 3 percent. The Hockley soils occupy higher positions than the other soils of the coast prairie.

These soils are moderately well drained. Runoff and internal drainage are medium.

The Hockley soils are better drained and are more brownish and yellowish brown throughout the profile than the Crowley and Morey soils. Also, they have a more friable, lighter textured upper B horizon and a more permeable lower B horizon than the Crowley and Morey soils. The Hockley soils have a thicker A horizon than the Morey soils.

The Hockley soils are not extensive in this county but are in scattered areas throughout the coast prairie part. They are used almost entirely for pasture and for feed crops.

Typical profile of Hockley silt loam, 1 to 3 percent slopes (west of Beaumont, Tex., on U.S. Highway No. 90 to Nome, Tex., then 1.5 miles north on paved road, then 150 yards west of road in bermudagrass pasture):

A11—0 to 12 inches, grayish-brown (10YR 5/2), coarse silt loam, dark grayish brown (10YR 4/2) when moist; weak, granular structure; slightly hard when dry, very friable when moist; nonsticky and nonplastic when wet; common, fine and medium pores; pH 6.0; gradual boundary.

A12—12 to 18 inches, pale-brown (10YR 6/3), coarse silt loam, brown (10YR 5/3) when moist; massive (structureless); slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; common, fine and medium pores and a few large pores; common worm casts; pH 5.2; gradual boundary.

A2—18 to 22 inches, very pale brown (10YR 7/3), coarse silt loam, yellowish brown (10YR 5/4) when moist; few, fine, faint mottles of brown; massive (structureless); slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; few, fine and medium pores; pH 5.0; clear boundary.

B1—22 to 30 inches, light yellowish-brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) when moist; common to many, medium, prominent mottles of red and few to common, fine and medium mottles of brownish yellow; red mottles are more evident inside the peds; moderate, medium, blocky structure; hard when dry; friable when moist, slightly sticky and plastic when wet; few, small ferromanganese concretions; pH 5.0; clear boundary.

B2—30 to 50 inches, pale-brown (10YR 6/3), light silty clay, brown (10YR 5/3) when moist; many, medium and coarse, prominent mottles of red and few, fine, faint mottles of brownish yellow; moderate, coarse, blocky structure; very firm when moist, very hard when dry; pH 5.0; gradual boundary.

C—50 to 60 inches +, light clay mottled with light gray (2.5Y 7/2; 6/2, moist), brownish yellow (10YR 6/6), and dark red (2.5YR 3/6); massive (structureless); very hard when dry, friable when moist; pH 5.0.

The thickness of the A horizon ranges from 14 to 30 inches but is dominantly 24 inches. The thinner horizons are on the steeper slopes, and the thicker ones are in the more nearly level areas. The color of the A horizon ranges from dark grayish brown to pale brown. The thickness of the B1 horizon ranges from 6 to 16 inches. In a few places where the A horizon is thick, the B1 horizon is absent and the B2 horizon is clay loam. The texture of the C horizon ranges from clay to sandy clay. In places this horizon is below a depth of 60 inches. The pH of the A horizon ranges from 5.0 to 6.5; that of the other horizons ranges from 5.0 to 6.0. A few to common, small concretions of ferromanganese occur throughout the profile in places.

Klej series.—This series consists of deep, light-colored, acid sandy soils. These soils are in the azonal order and are in the Regosol great soil group. They occur on stream terraces of the Neches River and in upland areas in the central part of the county. The parent material was acid, sandy old alluvium and marine sediments. The native vegetation was pine and hardwood trees.

The Klej soils occupy nearly level to gently sloping areas that have slopes ranging from 0.4 to 3 percent. Near the Neches River, these soils are about 3 to 8 feet above the river flood plain and occupy ridgelike areas. The soils in the central part of the county occur on large, circular mounds.

These soils are moderately well drained. Runoff is very slow, and internal drainage is rapid.

The Klej soils are lighter colored and are more acid than the Sabine soils. They are better drained and are lighter colored than the Pocomoke soils. They are better drained, are less mottled, and have a sandier subsoil than the Caddo soils.

The Klej soils are of minor extent in the county. Where they occur in complex with the Byars soils, they are used for the production of wood. The sandier areas are excavated for fill sand and for construction purposes.

Typical profile of Klej loamy fine sand (north of Beaumont, Tex., on Magnolia Avenue to Lucas Drive, then west on Lucas to Bignor Road, then north on Bignor Road to sandpits, then 0.7 mile north on sandy road, then 200 yards west of road in pure stand of loblolly pine):

A1—0 to 4 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; single grained (structureless); loose when dry, very friable when moist, nonsticky and nonplastic when wet; pH 5.0; clear boundary.

C1—4 to 40 inches, pale-brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) when moist; few, fine, faint mottles of yellowish brown; single grained (structureless); loose when dry, very friable when moist, nonsticky and nonplastic when wet; pH 5.0; gradual boundary.

C2—40 to 72 inches, very pale brown (10YR 7/4) loamy fine sand, yellowish brown (10YR 5/4) when moist; common, fine, faint mottles of yellowish brown and few, fine, distinct mottles of yellowish red; single grained (structureless); loose when dry, very friable when moist, nonsticky and nonplastic when wet; pH 5.0.

The A1 horizon ranges from gray to grayish brown in color and from 4 to 7 inches in thickness. In a few areas the texture is fine sand. The pH of the entire profile ranges from 4.5 to 5.2. Mottles in the C1 horizon range from few to common.

Lake Charles series.—This series consists of dark, slightly acid to neutral intrazonal soils of the Grumusol great soil group. They have a clay texture throughout the profile and a shrink-swell characteristic and pronounced gilgai microrelief similar to those of the Beaumont and Garner soils. They have developed from alkaline to calcareous clay in the gulf coast prairie under mid and tall bunchgrasses.

These soils occur in small, narrow areas where slopes are less than 0.4 percent. Their position on the landscape is similar to that of the Beaumont soils. They are lower in elevation than the Morey soils and are higher than the Harris soils.

These soils are imperfectly or somewhat poorly drained. Runoff is very slow, and internal drainage is slow.

The Lake Charles soils are darker, more granular, less mottled, and better drained than the Morey, Garner, and Beaumont soils. They differ from the Morey soils in having no textural profile.

These soils occupy only a small acreage in the county. They are used for growing rice.

Typical profile of Lake Charles clay (1 mile east of China, Tex., on U.S. Highway No. 90 to Imes Road, then 0.5 mile north to Texas Agricultural Experiment Station, then 100 yards south of cattle barn, 30 yards east of Imes Road in an improved pasture):

A1p—0 to 7 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; few, fine, faint stains of yellowish brown along root channels; moderate, medium, blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few, fine pores and many, fine roots; pH 6.5; clear boundary.

A11—7 to 28 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; few, fine, faint mottles of yellowish brown; strong, fine and medium, subangular blocky and granular structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few, small ferromanganese concretions 3 to 8 millimeters in size; common, fine pores and roots; pH 7.0; gradual boundary.

AC—28 to 48 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) when moist; many, fine, distinct mottles of brownish yellow; weak, blocky structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; few, fine pores and roots; pH 8.0; gradual boundary.

C—48 to 60 inches, gray (10YR 6/1) clay, gray (10YR 5/1) when moist; many, fine and medium, distinct, yellowish-brown mottles; massive (structureless); hard when dry, firm when moist, sticky and plastic when wet; very few fine roots and pores; pH 8.0.

The A horizon ranges from dark gray to very dark gray in color and from 14 to 32 inches in thickness. The thinner A horizons are over the microknolls. The structure is moderate to strong, medium, subangular blocky and granular in undisturbed areas; it is blocky when the soil has been farmed for some time. Concretions of calcium carbonate occur throughout the profile in places. The size of these concretions ranges from as much as one-fourth inch in the A horizon to 2 inches in the C horizon.

Morey series.—The soils in this series are deep, gray to dark-gray, and acid. They have developed from alkaline to weakly calcareous clay and silty sediments of the gulf coast prairie under native grass vegetation that consisted of species of *Andropogon, Sorghastrum,* and *Paspalum.* The Morey soils have been classified in the intrazonal order and the Planosol great soil group. They are more youthful than the modal Reddish Prairie soils that have developed on more freely drained surfaces from less clayey materials in a similar climate.

The Morey soils occupy nearly level to level areas with slopes of 0.2 to 1 percent. They occur in slightly higher positions than the Beaumont and Lake Charles soils and in lower positions than the Crowley and Hockley soils.

These soils are poorly drained. Runoff and internal drainage are very slow.

The Morey soils have a thinner A horizon and a less brightly mottled subsoil than the Crowley and Hockley soils. They are better drained than Waller soils. The Morey soils differ from the Beaumont and Lake Charles soils in being less clayey throughout and in having a textural profile.

The Morey soils are very extensive and occur throughout the coast prairie part of the county. They are used mainly for rice and pasture. Pine and hardwood timber have encroached in some areas, and these are used for production of wood.

Typical profile of Morey silt loam (0.8 mile west of the county courthouse at Beaumont on Franklin Street, then 2.2 miles south by west on Avenue A, then 2.4 miles south on west Port Arthur Road, then 6.7 miles west and south on Hillebrandt Road, then 100 feet east of road in bermudagrass pasture):

A1—0 to 12 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) when moist; weak, granular structure in upper 6 inches; massive (structureless) in lower part; slightly sticky and plastic when wet, very hard when dry; some dark-brown stains on surface of root channels; few worm casts; common, fine, fibrous roots; few fine pores; pH 5.5; clear boundary.

B2—12 to 26 inches, gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) when moist; common, fine, distinct mottles of yellowish brown and few, fine, distinct mottles of strong brown, mostly in interior of peds; moderate, medium blocky structure; sticky and plastic when wet, very hard when dry; surface of peds is dark gray and contains very few pores; root channels have dark reddish-brown stains on surface; few, fine, fibrous roots, mostly between the peds; thin, almost continuous clay films; pH 5.5; gradual boundary.

B3—26 to 36 inches, light brownish-gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) when moist; common to many, fine and medium, distinct, yellowish-brown mottles; weak, blocky structure; sticky and plastic when wet, very hard when dry; very few fine roots and pores; krotovinas of gray to dark-gray light clay, 1 to 1¼ inches in diameter and 1 foot apart, are common; pH 7.0; gradual boundary.

C1—36 to 50 inches, gray (10YR 6/1) silty clay loam, gray (10YR 5/1) when moist; many, medium, distinct, yellowish-brown mottles; massive (structureless); sticky and plastic but stiff, when wet; very few fine roots and pores; a few dark-gray krotovinas; pH 7.5; gradual boundary.

C2—50 to 60 inches +, gray (2.5Y 6/0) when moist, silty clay loam; common to many, medium, distinct, yellowish-brown mottles; massive (structureless); sticky and plastic but stiff when wet; few, dark, soft to semihard ferromanganese concretions as much as 8 millimeters in diameter; a few dark-gray krotovinas; pH 8.0.

The thickness of the A horizon ranges from 4 to 14 inches, but it averages about 12. The color ranges from gray to dark gray. In most areas the texture of the surface soil is silt loam, but in a few places it is clay loam or very fine sandy loam.

From 5 to 20 percent of the mass of the B horizon is mottled. Clay films may be thin or absent in this horizon. The pH ranges from 5.0 to 6.2 in the A and upper B horizons, and from 6.5 to 8.0 in the lower B and C horizons. The areas where the pH is higher are chiefly south of Taylor Bayou in the southern part of the county. Large calcium carbonate concretions, as much as 4 inches in diameter, occur in the C horizon in places.

Low, circular sandy mounds occupy as much as 20 percent of the Morey soils. The mounds are more evident where the land has not been tilled.

Typical profile of a sandy mound on the Morey soils (3.3 miles southwest of Hamshire, Tex., on Texas State Highway No. 124, then 7 miles east on Texas State Highway No. 73, then 5.1 miles south on shell road, then 1 mile east on shell road, then 300 feet south of road in carpetgrass pasture):

A1—0 to 20 inches, dark-gray (10YR 4/1) very fine sandy loam, very dark gray (10YR 3/1) when moist; weak, granular structure; very friable when moist, soft when dry; pH 5.5; abrupt boundary.

B2—20 to 36 inches, light olive-gray (5Y 6/2) sandy clay, olive gray (5Y 5/2) when moist, many, medium, prominent mottles of olive yellow; massive (structureless); very sticky and plastic when wet; very hard when dry; pH 7.3; gradual boundry.

C—36 to 44 inches +, mottled, light olive-gray (5Y 6/2) and olive-yellow (5Y 6/6) when moist, sandy clay; massive (structureless); pH 8.0.

The sandy mounds are 20 to 50 feet in diameter and are from 1 to 3 feet above the surface of the general area. Their A horizon is from 14 to 36 inches thick and ranges from gray to dark gray in color. In places a harmful concentration of salts occurs just above the B2 horizon. Also, calcium carbonate concretions, as much as 3 inches in diameter, occur in places in the lower C horizon.

Pocomoke series.—This series consists of deep, dark-gray, acid loamy fine sands. They are intrazonal soils of the Low Humic Gley great soil group. They have a thick dark A horizon and have formed under poor drainage from sandy parent material, probably of marine origin. The native vegetation is pine and hardwood timber.

These soils occupy nearly level to slightly depressed or saddle areas with slopes of less than 1 percent. They are about 2 to 3 feet higher than the Byars soils and 1 to 3 feet lower than the Caddo soils. They are slightly higher than the Acadia soils.

These soils are poorly drained. Runoff and internal drainage are slow.

The Pocomoke soils occur only in complex with Caddo soils in this county. They have a darker A horizon and are more coarse textured in the lower horizons than the Caddo soils. In addition, they occupy lower positions and are more poorly drained. They have a more permeable and coarser textured subsoil than the Acadia soils.

These soils are not extensive; they occur in the west-central part of the county in the Lawhorn Woods on the Gilbert Ranch. The vegetation consists of pine and hardwood timber.

Typical profile of Pocomoke loamy fine sand (south of Beaumont, Tex., on Texas State Highway No. 124 to intersection with Farm Road No. 365 at Fannett, Tex., then 3.2 miles west on Farm Road No. 365, then 400 feet south on the tram road, west of road in pine woodland):

A1—0 to 12 inches, dark-gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) when moist; few, fine, faint mottles of dark brown; moderate, fine, granular structure; hard when dry, very friable when moist, nonsticky and nonplastic when wet; many, fine and few, medium woody roots; pH 6.0; clear boundary.

A2—12 to 24 inches, light-gray (10YR 6/1) loamy fine sand, gray (10YR 5/1) when moist; many, fine, faint mottles of brownish yellow and strong brown; few strong-brown stains along root channels; moderate, fine, granular structure; hard when dry, very friable when moist, nonsticky and nonplastic when wet; common, fine and few, medium woody roots; pH 5.0; clear boundary.

B1—24 to 34 inches, light brownish-gray (10YR 6/2), light fine sandy loam, grayish brown (10YR 5/2) when moist; common, fine and few, medium mottles of brownish yellow; few, fine, prominent stains of strong brown along root channels; massive (structureless); slightly hard when dry, very friable when moist, nonsticky and nonplastic when wet; pH 5.0; gradual boundary.

B2—34 to 42 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) when moist; common, fine, faint mottles of light gray and brownish yellow; massive (structureless); hard when dry, friable when moist, slightly sticky and plastic when wet; pH 5.0.

D—42 to 50 inches, light-gray (10YR 7/2) loamy fine sand, light brownish gray (10YR 6/2) when moist; few, fine, faint mottles of brownish yellow and gray; single grained (structureless); loose when dry, very friable when moist; pH 5.0.

The thickness of the A horizon ranges from 24 to 36 inches. The depth to the D layer ranges from 40 to 50 inches. In a few places, this layer does not occur within a depth of 80 inches. Also in a few places, the B2 horizon is sandy clay loam. The depth to the water table ranges from 18 to 36 inches.

Sabine series.—This series consists of deep, dark, slightly acid loamy fine sand of the zonal order. Sabine soils do not have texturally developed horizons but are classified as Brunizens. They occur in the Red-Yellow Podzolic and warm, humid parts of the Reddish Prairie soil zones. The parent materials are weakly alkaline, sandy, coastal beach deposits from the Gulf of Mexico.

The Sabine soils occur as low ridges, commonly called cheniers. They lie some 3 to 8 feet above the surrounding Harris and Galveston soils. Slopes are as much as 2 percent but are dominantly less than 1 percent.

These soils are well drained. Runoff is very slow, and internal drainage is medium to rapid.

The Sabine soils are associated with the Galveston soils but are better drained and have more distinct and darker horizons. They have a darker A horizon than the forested Klej soils and are not so acid throughout.

The Sabine soils are not extensive in the county. They occur only in the southern part paralleling the Gulf of Mexico. They are used primarily for pasture.

Typical profile of Sabine loamy fine sand (2.5 miles west of Sabine Pass, Tex., on Texas Highway No. 87, then 50 yards north of road into bermudagrass pasture):

A1—0 to 11 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; very weak, granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; pH 5.5; gradual boundary.

AC—11 to 50 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) when moist; few, fine and coarse, faint mottles of brownish yellow and yellowish brown in lower part; single grained (structureless); soft when dry, very friable when moist, nonsticky and nonplastic when wet; pH 5.0; diffuse boundary.

C—50 to 60 inches +, very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) when moist; single grained (structureless); soft when dry, very friable when moist, nonsticky and nonplastic when wet; pH 6.5.

The color of the A1 horizon ranges from very dark grayish brown to grayish brown. Mottles in the AC horizon range from few to many. Weak stratification with shell fragments occurs erratically at a depth of 40 inches or more. In the A and AC horizons, the pH ranges from 5.0 to 6.0; in the C horizon, from 6.0 to 8.0. In a few places a 2- to 3-inch layer of gray clay loam material has been deposited on the surface by extremely high tides during gulf storms.

Waller series.—This series consists of gray, acid, intrazonal soils in the Low-Humic Gley great soil group. The parent material is unconsolidated, acid silty clay and clay of Pleistocene time. The native vegetation consists of water-tolerant grasses and sedges.

The Waller soils occupy nearly level to depressed areas or natural drainageways where slopes are less than 0.3 per-

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cent. They occur on lower areas than all associated soils.

These soils are very poorly drained. They have ponded to very slow runoff and very slow internal drainage.

The Waller soils are lighter colored, are more poorly drained, and have less profile development than the Morey soils. They differ from the Beaumont and Lake Charles soils in being wetter and in having a textural profile. They are wetter and are less brightly mottled than the Crowley soils.

These soils are not extensive, but are in small areas that are closely associated with all the soils in the coast prairie part of the county.

Typical profile of Waller fine sandy loam (2.2 miles north on main street of China, Tex., then 200 yards west of road in bermudagrass pasture):

A1—0 to 6 inches, gray (10YR 6/1) fine sandy loam, gray (10YR 5/1) when moist; few, fine, faint mottles of yellowish brown; common streaks of light-gray fine sand; massive (structureless); very hard when dry, firm when moist, slightly sticky and plastic when wet; pH 5.7; gradual boundary.

B2g—6 to 36 inches, gray (10YR 6/1) light sandy clay loam, gray (10YR 5/1) when moist; few, fine, faint mottles of yellowish brown; 20 percent of the mass is streaked and splotched with white very fine sand; massive (structureless); very hard when dry, firm when moist, slightly sticky and plastic when wet; few small pores; pH 6.0; gradual boundary.

Dg—36 to 54 inches, gray (10YR 6/1) sandy clay, gray (10YR 5/1) when moist; about 15 percent of the mass is streaked with white sand; massive (structureless); extremely hard when dry, very firm when moist, sticky and plastic when wet; pH 6.8.

The texture of the Waller soils is variable; it ranges from sandy loam to silty clay loam. Sandy clay horizons may occur at a depth ranging from 14 to 36 inches, but this variation is inconsistent. In places the texture is silt loam to a depth of 60 inches. In each horizon streaks and splotches of white sand or sandy loam material make up about 10 to 40 percent of the mass. The pH of the surface soil ranges from 5.5 to 6.5, and that of the lower C horizon ranges from 6.0 to 8.0. The color of all horizons ranges from light gray to gray. Mottles range from few to many throughout the profile.

Analyses of Three Representative Soils [8]

Three soil types were selected in Jefferson County for laboratory study—Beaumont clay, Morey silt loam, and Acadia silt loam. All samples were collected from carefully selected pits and were considered representative of the soil type in Jefferson County. The mechanical and chemical analyses, the bulk density and shrinkage, and the micromorphology of these soils are given in this section. The results of the mechanical and chemical analyses are shown in table 8, and the measurements of bulk density

[8] The laboratory analyses were made by the staff of the Soil Survey Laboratory, Soil Conservation Service, Lincoln, Nebr.

TABLE 8.—*Mechanical and chemical*

Soil	Depth sampled	Particle size distribution						
		Very coarse, coarse, and medium sand (2.0–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (<0.002 mm.)	II [1] (0.2–0.02 mm.)	III [1] (0.02–0.002 mm.)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Acadia silt loam, 0 to 1 percent slopes	0–2½	[3] 3.1	11.9	25.5	56.6	2.9	75.5	13.3
	2½–7	[3] 3.4	10.4	25.9	55.6	4.7	74.0	13.1
	7–13	[3] 2.5	8.0	20.8	55.5	13.2	63.7	17.0
	13–18	[3] 1.0	4.0	13.1	47.9	34.0	43.7	19.5
	18–31	[3] .4	2.2	9.0	38.8	49.6	32.2	16.8
	31–44	.2	2.1	9.1	45.3	43.3	35.6	20.0
	44–62	.2	1.8	9.0	46.3	42.7	35.8	20.5
Beaumont clay	0–7	<.1	.5	10.0	38.7	50.8	25.0	24.1
	7–13	<.1	.7	8.2	38.0	53.1	21.6	25.1
	13–24	<.1	.4	7.4	35.0	57.2	18.7	24.0
	24–32	<.1	.4	7.9	33.0	58.7	19.1	22.1
	32–44	<.1	.4	7.8	32.4	59.4	19.2	21.3
	44–60	<.1	.2	7.1	27.3	65.4	16.5	18.1
Morey silt loam	0–6	[4] .5	5.2	19.8	57.7	16.8	56.4	25.9
	6–11	[4] .5	3.2	13.2	57.6	25.5	43.3	30.4
	11–13	[4] .5	2.5	14.9	52.6	29.5	42.7	27.1
	13–19	[4] .5	2.6	13.5	48.4	35.0	39.7	24.5
	19–26	[4] .5	2.6	14.9	47.7	34.3	42.7	22.3
	26–35	[4] .6	2.5	14.2	47.6	35.1	40.5	23.6
	35–49	[4] .3	2.4	14.3	47.2	35.8	39.8	23.9
	49–60	[4] .3	2.1	13.1	46.9	37.6	36.5	25.5

[1] Separates in International scheme.

[2] Calculated value $= \frac{\text{Cation-exchange capacity by } NH_4OAc}{\text{Percent clay}} \times 100$

and shrinkage are shown in table 9. Micromorphology is discussed in the text.

Standard methods of the Soil Survey Laboratory were used to obtain most of the data in table 8. Unless otherwise noted, all laboratory analyses were made on material that passes the 2-millimeter sieve and are reported on an oven-dry basis. Mechanical analyses were made by the pipette method (*12, 13, 16*). Organic carbon was determined by wet combustion by using a modification of the Walkley-Black method (*17*). Nitrogen was determined by the modified procedure of the Association of Official Agricultural Chemists (*2*). The cation-exchange capacity was determined by direct distillation of absorbed ammonia (*17*). The extractable calcium and magnesium were determined by separating calcium as calcium oxalate and magnesium as magnesium ammonium phosphate (*17*). Extractable hydrogen was determined by the triethanolamine method (*17*). Free iron oxide was determined by extraction from the soil with sodium hydrosulphite and by titration with standard potassium dichromate (*11*). Aluminum was extracted with N Kcl and determined by a modification of the Aluminon reagent method (*7*).

The clod method was used for determining bulk density (table 9). Unless otherwise noted, the values are averages of three replications; the confidence limit estimate is ± 0.04 grams per cubic centimeter at the 95 percent level of significance. Measurements are made on clods, 1½ to 2½ inches across, that have been coated with a Saran solution of 1 part by weight of Dow Saran F–120 (1,000 centipoises) to 8 parts methyl ethyl ketone. Volume is measured by displacement in water; the oven-dry weight is used to calculate the bulk density. The volume is first determined at field moisture (the moisture content of the clods as received in the laboratory). Next it is determined after the air-dry clods have been moistened by adsorption on a sand capillary column under 30-centimeter water tension and have reached a consistent weight; and finally, at oven dryness.

In some horizons, the porosity calculated from the oven-dry bulk density was not sufficient to hold the moisture at 15 atmospheres. For these horizons, bulk density was calculated that would provide sufficient porosity to hold the moisture at 15 atmospheres. The formula used for the calculation is shown as footnote 1 of table 9. *Pws* is the moisture content at saturation. *Db* is the bulk density, and 2.65 the assumed particle density. Such calculated values may set a more realistic upper limit than the measured values for the range in bulk density that can occur in a soil capable of supporting plant growth.

Micromorphology

Thin sections from Beaumont clay, Acadia silt loam, and Morey silt loam were examined. The main purpose of this examination was to look for evidence of clay illuviation (clay films, or cutans). The results are discussed by

analyses of three representative soils

Reaction 1:1	Organic carbon	C/N ratio	Free iron oxide (Fe_2O_3)	Cation-exchange capacity NH_4OAc	Extractable cations (meq. per 100 grams of soil)					Aluminum (meq. per 100 grams)	Cation-exchange capacity [2] (meq. per 100 grams of clay)
					Ca	Mg	H	Na	K		
pH	*Percent*		*Percent*	*Meq./100 gm.*							
5. 5	1. 14	19	0. 9	4. 1	1. 4	0. 4	4. 5	0. 1	0. 1	<1	141
5. 4	. 25	15	. 9	2. 4	. 9	. 2	2. 6	<. 1	<. 1	<1	51
5. 1	. 24	12	1. 0	6. 2	. 8	. 4	6. 4	. 1	. 1	3	47
5. 1	. 26	9	1. 2	14. 8	1. 7	1. 6	15. 5	. 4	. 2	9	44
5. 1	. 18	8	2. 2	23. 1	3. 7	2. 5	22. 1	1. 1	. 3	15	46
5. 1	. 10	----------	1. 5	22. 6	6. 9	3. 2	16. 2	1. 7	. 4	10	52
5. 2	. 12	----------	1. 2	24. 9	11. 3	4. 1	10. 5	2. 3	. 4	6	58
5. 0	1. 44	12	1. 3	26. 4	15. 7	6. 0	13. 6	1. 2	. 4	2	52
4. 6	. 91	12	1. 1	29. 4	14. 6	5. 5	14. 8	1. 5	. 4	4	55
4. 8	. 69	11	1. 4	30. 1	17. 8	6. 6	12. 6	1. 6	. 4	2	53
4. 9	. 53	----------	1. 4	30. 1	19. 4	6. 8	10. 9	1. 7	. 4	2	51
5. 2	. 45	----------	1. 4	30. 3	21. 8	7. 4	7. 7	1. 8	. 4	<1	51
6. 5	. 18	----------	2. 3	33. 4	26. 7	8. 8	4. 5	2. 1	. 5	<1	51
5. 3	2. 08	13	. 6	12. 1	4. 5	2. 4	8. 8	. 2	. 4	<1	72
5. 2	1. 30	13	. 5	14. 6	5. 6	3. 0	9. 8	. 5	. 2	1	57
5. 2	. 98	12	. 9	15. 6	5. 0	3. 6	11. 6	. 8	. 2	3	53
5. 3	. 88	11	1. 3	16. 4	6. 0	4. 7	10. 6	1. 3	. 2	2	47
5. 6	. 60	11	1. 6	18. 4	7. 9	6. 3	6. 3	2. 1	. 2	<1	54
6. 9	. 28	----------	1. 5	19. 3	9. 4	7. 3	2. 4	3. 2	. 2	<1	55
7. 5	. 17	----------	1. 5	20. 3	9. 8	7. 7	1. 7	4. 0	. 2	<1	57
7. 8	. 09	----------	1. 4	20. 4	10. 3	7. 7	1. 2	4. 3	. 2	<1	54

[3] Common concretions (Fe–Mn?).
[4] Many concretions (Fe–Mn?).

TABLE 9.—*Bulk density and shrinkage of soil samples*

Soil	Depth sampled	Bulk density as determined at—					Shrinkage from 30-cm. tension to oven-dry	
		Field moisture		30-cm. tension				
		Water		Water		Oven-dry [1]	cc./100 gm.	Percent by volume
	Inches	*Percent*	*gm./cc.*	*Percent*	*gm./cc.*	*gm./cc.*		
Acadia silt loam, 0 to 1 percent slopes	2½–7	[2] 13.7	[2] 1.62	[2] 18.1	[2] 1.60	[2] 1.62	[2] 0.7	1
	7–13	14.5	1.66	18.1	1.65	1.69	1.5	2
	13–18	18.8	1.59	22.1	1.58	1.66	3.3	5
	18–31	24.6	1.51	[2] 27.7	[2] 1.47	[2] 1.83(1.80)	[2] 13.6	24
	44–62	23.4	1.58	22.1	1.61	1.97(1.82)	11.5	22
Beaumont clay	0–7	31.6	1.33	25.0	1.43	1.76(1.74)	13.0	23
	7–13	32.6	1.33	28.2	1.40	1.83(1.72)	16.8	31
	13–24	35.8	1.30	28.8	1.41	1.89(1.64)	18.0	34
	32–44	34.0	1.33	32.5	1.35	1.94(1.64)	22.6	44
	44–60	33.2	1.37	31.3	1.39	1.96(1.60)	20.8	41
Morey silt loam	0–6	24.3	1.41	26.8	1.40	1.51	5.1	8
	6–11	17.1	1.70	18.4	1.68	1.81	4.2	8
	13–19	21.8	1.52	24.4	1.48	1.76	10.6	19
	26–35	19.7	1.69	21.0	1.65	1.99(1.90)	10.3	21
	49–60	19.5	1.68	20.5	1.66	2.02(1.90)	10.7	22

[1] Bulk density in parentheses was calculated by using the formula

$$Db=\frac{100}{Pws+\frac{100}{2.65}}$$

[2] Average of 2 clods.

soil types in the following paragraphs. Some of the descriptive terms have been taken from Brewer and Sleeman (*6*).

Beaumont clay.—Hydrous iron oxides are strongly segregated throughout the profile of Beaumont clay. On rotation of the stage, many of the accumulations of hydrous iron oxide show a faint extinction suggestive of oriented silicate clay partly masked by iron coatings. Silicate clay segregation is strongest in the A12 and A13 horizons. The clay-rich segregations are dominantly noncutanic and subcutanic; that is, they occur within the fabric formed by the skeletal grains (sand and silt) rather than as coatings on macrovoid walls. Judging by the reddish-brown color, the subcutanic zones are apparently rich in hydrous iron oxides. At most, only a very few clay cutans, or clay films, occur. The subcutanic bodies are probably caused by reorientation along shear planes and not by illuviation of clay.

Morey silt loam.—Thin sections from the A12, B22, B3, and the lower C horizons of Morey silt loam were examined. Segregation of hydrous iron oxides appears quite strong throughout the profile. As in Beaumont clay, some concentrations of hydrous iron oxide show weak extinction that suggests concentrations of oriented silicate clay masked by iron. Segregation of clay is strong in the B22 horizon. The clay concentrations occur mainly in subcutanic and noncutanic positions. Evidence is fairly strong that some clay cutans or clay films occur in the B22 horizon of Morey silt loam. These cutans make up an exceedingly small percentage of the clay, however. The A12 horizon has a few, subcutanic, oriented, silicate bodies but has far fewer than the B22 horizon. No cutans, or clay films, were observed.

Acadia silt loam.—Thin sections were examined from the B21 and B22 horizons and the lower part of the C horizon of Acadia silt loam. Segregation of hydrous iron is strong. The iron accumulations are more opaque than in Beaumont clay or Morey silt loam. The B21 horizon has markedly less fine clay than the B22 horizon. Probably the amounts of fine clay differ more between the B21 and B22 horizons than the amounts of total clay. In the B22 horizon, moderately oriented silicate clay occurs uniformly throughout as infillings of the interstices formed by the silt and sand (skeletal interstices). Little preferred orientation occurs in subcutanic positions (near macrovoids). Cutans or clay films are absent. Examination of structural surface in bulk-density clods with the stereoscopic microscope confirms their absence.

The fabric of the B22 horizon in Acadia silt loam differs considerably from that of the B22 horizon in Beaumont clay. In Beaumont clay, orientation within the skeletal interstices is weak; in Acadia silt loam, it is quite strong. On the other hand, long-range orientation across many skeletal interstices is strong in Beaumont clay and weak in Acadia silt loam.

The nonclay fraction of the B22 horizon of Acadia silt loam is coarser than that of the subsoil of the horizons of Beaumont clay. Brewer and Haldane (*5*) have shown that clay orientation becomes stronger with increasing coarseness of the nonclay fraction and is apparently related to increased size of the skeletal voids. By this reasoning, the stronger short-range orientation in Acadia silt loam may be related to its coarser nonclay fraction.

In the section examined, the clay in the B22 horizon of Acadia silt loam appears finer than that in the Beaumont subsoil. The data for particle-size distribution also suggest more coarse clay in the Beaumont soil. The silt fraction of Beaumont clay contains more fine than coarse silt, but the opposite is true of Acadia silt loam. Probably, the large proportion of coarse silt in Beaumont clay indicates considerable coarse clay.

The stronger, long-range orientation in Beaumont clay may be the result of soil movement.

Additional Facts About the County

In this section the history and development, the climate, the relief and drainage, and the water supply of the county are discussed. Information is also given on agricultural statistics, industry and shipping, markets and transportation, and community facilities.

History and Development

The earliest inhabitants of Jefferson County were the Attacapas Indians (*9*). These Indians believed that their fathers had come out of the sea; so they lived near the water and worshiped gods that lived in it. They told of a deluge that had destroyed all people except those who lived on high land.

Jefferson County was originally claimed by Spain. According to tradition, however, the first explorers in the county were French. Some historians believe that as early as 1686, scouts adventured into this area from the expedition of Robert Cavelier, Sieur de la Salle, explorer of the Mississippi. In 1690 a few Spanish explorers came into the area from eastern Texas, where they had established a small log mission, San Francisco de las Tejas. French traders were active in the area as early as 1718. They traded with the Indians and trapped beaver, muskrat, and black bear in the deep woods and marsh country of the lower Neches River. The Indians were friendly to the French but hostile to the Spanish.

In the last half of the eighteenth century, English traders established a camp near the present site of Beaumont. They abandoned the site after a short time. To prevent the return of the English, the Spanish established ranches within the ancient preserves of the Attacapas.

As early as 1800, trappers and settlers from the United States began to move into the territory. The early settlers located near the present site of Beaumont and along Taylor Bayou in the central part of the county. Many were farmers; some produced sugarcane and manufactured a coarse grade of sugar. Some grew cotton and corn.

Cattle raising, the chief occupation for many years, was well established during the late 1830's. The cattle were descendants from those left by the Spanish ranchmen and from herds imported from Louisiana. Some cattle were sold in Louisiana; however, cattle were often sold locally for the price of the hides and tallow, the only animal products in demand at the time in the area. After the animals were skinned, and the tallow was removed, the carcasses were dumped into the Neches River.

The early settlers tilled their fields and herded their stock during the day and set traps on the riverbanks and marshes at night. The furs of raccoons, mink, beaver, and muskrats were in great demand and were more valuable than the agricultural products raised. Since these animals were abundant in Jefferson County, a thriving fur industry was established. This industry has lasted throughout the years.

Originally, timber was plentiful in the county. The pioneer lumbermen produced mainly cypress shingles, staves, and other hardwood products. As the number of settlers increased, woodland became an important product in the county.

When Mexico gained independence from Spain in 1821, many people from Louisiana, Tennessee, Kentucky, and other States were already living in the territory. They were given Mexican land grants by the Mexican government. The settlers from the United States played an important part in the early history of Texas.

Jefferson County was created in 1836. It was organized in 1837 from an original municipality of the Spanish-Mexican era. The county was named for Thomas Jefferson.

As early as 1850, rice was grown without irrigation in small patches on lower lying lands. It was harvested and threshed by hand. About 1891, irrigation companies were formed, canals and pumping plants were built, and rice became an important commercial crop in the county.

In 1950 there were 195,083 people in Jefferson County. According to the U.S. Census reports, the population had increased to 245,659 in 1960.

Climate [9]

The climate of Jefferson County has characteristics of both the tropical and temperate zones. Except on rare occasions, sea breezes prevent extremely high temperatures in summer. The cold air masses from the north in winter are moderated by the time they reach the county, but they provide a stimulating change.

Climatic data recorded at two of the United States Weather Bureau stations in Jefferson County are given in tables 10 and 11. The temperature and precipitation, as recorded at Port Arthur, are given in table 10. The monthly average of evaporation and humidity given in table 11 was recorded by U.S. Weather Bureau Substation No. 4 at the Texas Agricultural Experiment Station.

The normal annual rainfall of 55.21 inches is distributed evenly throughout the year. Snow or sleet seldom occur, and no severe hailstorms have occurred. A snowfall of 4.04 inches was recorded at the Texas Agricultural Experiment Station, near the town of China, on February 12, 1960. Except during severe thunderstorms and tropical disturbances, the wind seldom exceeds 45 miles per hour. It exceeds 30 miles per hour on only about 40 days in a year. The humidity is high, because the county is near the Gulf of Mexico.

Although the average rainfall per month is not very great, at times heavy rains occur. The highest rainfall recorded for a 24-hour period was 17.76 inches. It occurred on July 27, 1943, at Port Arthur when a tropical disturbance hit the area. Heavy rains can be expected during the growing season, most likely from June through August. Also, light rains may occur every day or so for several weeks. Dry periods during summer may cause damage to nonirrigated plants on some soils.

[9] This section by ROBERT B. ORTON, State climatologist, Weather Bureau, U.S. Department of Commerce.

TABLE 10.—*Temperature and precipitation at Port Arthur, Jefferson County, Tex.*

[Elevation, 16 feet]

Month	Temperature [1]			Precipitation [2]		
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1924)	Wettest year (1946)
	°F.	°F.	°F.	Inches	Inches	Inches
January	53.3	80	11	4.34	6.56	7.66
February	56.4	84	14	3.98	6.34	3.28
March	61.3	86	24	3.25	1.71	3.10
April	68.5	91	36	3.68	1.77	3.70
May	75.3	95	46	4.47	1.80	20.01
June	81.2	102	58	4.44	4.50	9.41
July	82.7	101	64	6.56	.35	10.92
August	82.9	102	63	5.32	.72	2.26
September	79.0	98	47	4.73	.47	11.27
October	71.1	95	32	3.19	0	2.42
November	60.4	85	28	3.61	2.19	6.85
December	54.8	81	20	5.11	4.11	3.31
Year	69.2	102	11	52.68	30.52	84.19

[1] Average temperature based on a 44-year record, through 1960; highest and lowest temperatures on a 43-year record, through 1959.
[2] Average precipitation based on a 47-year record, through 1960; wettest and driest years based on a 47-year record, through 1960.

TABLE 11.—*Average evaporation and humidity by months*

Month	Evaporation	Humidity
	Inches	Percent
January	2.00	84.4
February	2.32	83.0
March	3.40	81.5
April	4.27	81.7
May	5.16	81.2
June	5.49	80.9
July	5.48	82.7
August	5.39	83.2
September	4.41	84.3
October	3.79	82.6
November	2.65	82.9
December	2.08	85.0
Year	46.44	82.8

The rainfall in the county is very favorable for growing many crops. Frequent light rains, however, often hinder the planting of some crops, particularly row crops. Some difficulty is caused by frequent rains during the rice harvest. At the time of harvest, rice almost always has a moisture content that is above the level considered safe for storage. For this reason, all rice is dried artificially. The greatest losses of crops from rainfall are probably caused by heavy rains, accompanied by wind, that occur when the crops are about ready for harvesting.

Crops and pastures benefit from the long growing season in the county. With proper management, it is possible to maintain good grazing during most of the year. Also, because of the long season, crops can be planted and harvested over a long period, and farm equipment can be used economically.

The temperature rarely drops below 22° F. or goes above 98°. It can be expected to drop to freezing, or below, on about 6 to 15 days each year. Sudden drops in temperature, when accompanied by rain, may cause serious loss of livestock.

Average rainfall data and freezing dates do not give complete information about the climate. Table 12 shows, by months, the probability of rainfall occurring 1 year in 10, at Port Arthur.

TABLE 12.—*Rainfall probabilities for 1 year in 10*

Month	One year in 10 will have—	
	Less than—	More than—
	Inches	Inches
January	1.2	8.4
February	1.4	8.5
March	.7	8.4
April	.9	9.9
May	.9	11.8
June	.9	11.0
July	1.1	11.3
August	1.5	10.4
September	.9	15.1
October	.4	7.9
November	1.5	6.9
December	2.0	9.2
Year	37.0	75.4

The average length of the growing season at Weather Bureau Substation No. 4 in northwestern Jefferson County is 269 days; at Port Arthur, 294 days. The chances are 1 in 5 that a 32-degree freeze at Port Arthur will occur after March 2; 1 in 10, after March 9; and 1 in 20, after March 15. The chances are 1 in 5 that a 32-degree freeze will occur before November 21; 1 in 10, before November 14; and 1 in 20, before November 8.

On the average fogs at Substation No. 4 near China occur on 29 days during the year and lift at 7:58 a.m. The clear days during the year average 117; partly cloudy days, 191; and cloudy days, 57. Winds are prevailingly south-southeast and have an average velocity of 11.4 miles per hour.

Relief and Drainage

Jefferson County is mostly a flat, featureless plain that is dissected very little by streams. A rounded eminence in the western part of the county rises gently from the general surface to a height of about 25 feet. It is a salt dome, nearly a square mile in area, and is locally called Big Hill. Another eminence, known as Spindle Top, has similar characteristics but is somewhat smaller and lower. It is situated at Guffey, near Beaumont. The Beaumont oilfield is on this hill. A few, narrow escarpments, or breaks, occur along some of the larger streams that dissect the county. The highest elevation in the county, 46 feet above sea level, occurs north of Nome in the northwestern part.

The principal watercourses draining the county are the Neches River, Pine Island Bayou, and Taylor Bayou. The largest stream is the Neches River, which borders the northeastern side of the county. It drains very little of the county. Its tributaries are gullies that extend back a little more than a mile from the boundary of the river valley. Pine Island Bayou is the main tributary of the Neches River. It forms the northern border of the county and drains a small part of the county lying to the south. This bayou has a few, small tributaries in the northwestern corner of the county that extend back several miles. Taylor Bayou and its tributaries drain the greater part of the county and empty into the ship channel west of Port Arthur. Water from a considerable part of the upland drains into the coastal marsh south of Taylor Bayou, through small, shallow prairie channels. These channels are a little below the surface of the surrounding land. Salt and Mud Bayous collect some of the drainage.

The streams of the county are only slightly above sea level and have a very sluggish flow through shallow, crooked channels. None of these streams have enough flow to carry off surplus water rapidly.

Sabine Lake not only receives drainage water from Jefferson County and the basin of the Neches River, but also from the Sabine River. All this water passes into the gulf through Sabine Pass, a body of salt water lying between Jefferson County and Cameron Parish, La. When there is little water in the streams, the lake becomes quite shallow. During high winds from the south and southeast, salt water from the gulf flows in, fills the lake, and ascends for miles into the rivers and other streams.

Water Supply

Most of the water supply for Jefferson County comes from the Neches River. Small towns and communities in the county obtain their water from wells, but the larger cities obtain their water from the Neches River by way of open canals and treating plants. There are approximately 15 to 20 individual pumping plants on Taylor, Mayhaw, and Hillebrandt Bayous. These plants supply some of the irrigation water used in the county. Several irrigation reservoirs are also in use along these bayous. The Lower Neches Valley Authority provides water for the industrial users and most of the agricultural users of the county.

The Lower Neches Valley Authority is a self-sustaining agency created by a special act of the Texas Legislature for the purpose of developing, improving, and distributing the waters of the Neches River. At the time of the survey the agency had 280 miles of canals, approximately 90 percent of which were in Jefferson County.

Salt water is a problem to rice farmers during dry years when gulf water flows back into the rivers and streams. A dam is placed in the Neches River almost every year just above the pumping plant to keep salt water out of the canal system of the Lower Neches Valley Authority.

Agricultural Statistics

Some of the agricultural statistics available for Jefferson County are given in the tables included in this section. The statistics are from the U.S. census reports. The number of livestock and poultry are shown in table 13; farm tenure, in table 14; size of farms and land in farms by use, in table 15; and acreage of crops, in table 16.

TABLE 13.—*Number of livestock and poultry in stated years*

Livestock	1950	1954	1959
	Number	*Number*	*Number*
Cattle and calves	39, 784	45, 417	40, 333
Milk cows	3, 055	1, 682	1, 199
Horses and mules	2, 152	1, 386	2, 408
Hogs and pigs	1, 325	1, 277	775
Sheep and lambs	657	630	406
Chickens	[1] 35, 934	[1] 33, 965	[1] 17, 558

[1] Over 4 months old.

TABLE 14.—*Farms by tenure of operator*

Tenure	1950	1954	1959
	Number	*Number*	*Number*
All farms	959	1, 038	[1] 724
Full owners	591	607	335
Part owners	229	250	259
Managers	4	12	12
All tenants	135	169	118

[1] Because of change in definition, the number of farms was reduced by 174 between 1954 and 1959.

TABLE 15.—*Average size of farms and total land in farms by use*

Size and use	1950	1954	1959
	Acres	*Acres*	*Acres*
Average size of farms	508	417. 3	583. 3
Total land in farms	487, 176	433, 186	422, 292
Cropland, total	197, 903	178, 822	192, 552
Harvested	69, 611	88, 667	66, 541
Used only for pasture	118, 395	78, 557	115, 595
Not harvested or pastured	9, 897	11, 598	10, 416
Woodland, total	48, 252	31, 703	27, 990
Pastured	21, 130	29, 603	24, 001
Not pastured	27, 122	2, 100	3, 989
Other land pastured (not cropland and not woodland)	233, 222	205, 444	192, 313
Other land (houses, lots, roads, and so on)	7, 799	17, 217	9; 437

TABLE 16.—*Acreage of principal crops in stated years*

Crop	1949	1954	1959
Corn for all purposes	307	283	123
Sorghum for all purposes except for sirup	728	502	1, 059
Rice harvested	63, 891	79, 777	56, 687
Cotton	221	12	6
Hay crops, total	3, 154	7, 841	8, 313
Vegetables for home use or for sale	484	546	319

Industry and Shipping

The oil industry began in Jefferson County in 1901 with the discovery of the Spindletop Oilfield. Since then, many large industries that convert petroleum or natural gas into many products have located in the county.

At the time of the survey there were five major oil refineries in the county. They had facilities for processing more than 853,000 barrels of petroleum per day.

A number of steel-fabricating plants in the county manufacture items that range from light-metal articles to steel barges and other heavy metal products, such as drilling rigs and refinery equipment.

In recent years, the petrochemical industry in the county has become a strong rival of the petroleum refining industry in value of products. A large butadiene plant is located in the county. Other chemical plants in the county produce fertilizer, plastic and nylon-base material, additives for poultry feeds, and other important products

According to statistics of the Beaumont Chamber of Commerce, there were approximately 1,671 miles of pipeline in Jefferson County at the time of the survey. These pipelines vary in size and are owned by 27 different oil and gas companies. The statistics did not include lines used by local gas utilities for distribution to residences, business establishments, industries, and commercial users. Also according to the Beaumont Chamber of Commerce, the combined tonnage for the Sabine-Neches Waterway ports—Beaumont, Port Arthur, and Sabine Pass—was 50,381,873 tons in 1959.

Markets and Transportation

Because of its location along the gulf coast, Jefferson County provides markets for farm and industrial products. Rice, cattle, wood products, and other farm commodities can be readily carried to other markets outside the county. There are three large mills for processing rice in the county.

Flights are scheduled daily from the Jefferson County Airport by three commercial airlines—Eastern, Delta, and Trans-Texas Airway. There is direct service to New Orleans, Atlanta, the eastern seaboard, and the Rio Grande Valley.

Four major railroads—Southern Pacific, Missouri Pacific, Kansas City Southern, and the Sante Fe Lines—provide freight and passenger service. Passenger service is scheduled to Los Angeles, San Francisco, New Orleans, and Washington, D.C. In addition, there are six buslines—Southwestern Greyhound, Continental Dixie Lines, Continental Southern Lines, Coastal Coaches, Beaumont-Silsbee Bus Line, and Lufkin-Beaumont Motor Coaches. Eleven motor freight lines have direct or connecting service to all parts of the Nation. The county is also served by a number of carriers specializing in oilfield and related hauling.

A number of Federal and State paved highways go through Beaumont. They are all a part of the transcontinental highway system or connect with it. The area is also served by a network of paved or surfaced, farm-to-market roads.

Community Facilities

The county has both public and parochial schools. The rural schools have been consolidated into larger school districts. Most of the buildings are modern. Lamar State College of Technology at Beaumont is a fully accredited 4-year State college that offers degrees in 41 major fields.

The county has churches of nearly all denominations. Most of them are now in the towns; only a few rural churches remain.

Many water areas of the county have recreational facilities for hunting, fishing, boating, water skiing, and swimming. Other types of recreation are available throughout the county. City recreation departments sponsor many programs and activities for young people.

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Glossary

Aggregate (soil structure). Many fine particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alkaline soil. Generally, a soil that is alkaline throughout most or all of the parts of it occupied by plant roots, although the term is commonly applied to only a specific layer or horizon of a soil. Precisely, any soil horizon having a pH value greater than 7.0; practically, a soil having a pH above 7.3.

Alluvium. Fine material, such as sand, silt, or clay, that has been deposited on land by streams.

Association soil. A group of soils geographically associated in a characteristic repeating pattern.

Available moisture 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.

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.

Clay film. A thin coating of clay on the surface of a soil aggregate Synonyms: Clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Concretions. Hard grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds that cement the soil grains 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; will not hold together in a mass.

Friable. When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm. When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Nonsticky. When wet, practically no soil material adheres to thumb or finger after release of pressure.

Plastic. When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky. When wet, adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard. When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft. When dry, breaks into powder or individual grains under very slight pressure.

Droughty soil. A soil that holds only a small amount of water available to plants. Some droughty soils hold large amounts of water but do not release it to plants; others lose the water through the soil.

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediment, that borders a stream and is subject to flooding unless protected artifically.

Genesis, soil. The manner in which the soil originated, with special reference to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

Gilgai. The microrelief of those clays that have a high coefficient of expansion and contraction with changes in moisture; usually a succession of microbasins and microknolls in nearly level areas, or of microvalleys and microridges that run with the slope.

Gley soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material may be sandy, or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.

Hummocky. Topography that is irregular or choppy; has small dunes or mounds that have side slopes of 3 to 8 percent and are 3 to 10 feet high.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Irrigation. The artificial application of water to soils to assist in the production of crops. The common methods of irrigation are:

Controlled flooding. Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Furrow. Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler. Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Microrelief. Minor surface configurations of the land.

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 that make up 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.

Muck. An organic soil consisting of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

Munsell notation. A system for designating color by degrees of the three variables—hue, value, and chroma. For example, a notation of 10YR 5/1 is a color with a hue of 10YR, value of 5, and a chroma of 1.

Natural drainage. Refers to moisture 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 also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and 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.

Noncalcareous. As used in this report, a soil that is alkaline but that does not contain enough free lime to effervesce with hydrochloric acid.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture.

Parent material (soil). The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability soil. 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, rapid,* and *very rapid.*

pH. A numerical means for designating relatively weak acidity and alkalinity, as in soils and other biological systems. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Plowpan. A compacted layer formed in the soil just below the plowed layer.

Podzolization. The process by which a soil is depleted of bases, becomes more acid, and develops a leached surface layer.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

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. In words the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

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 of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface soil, are similar in differentiating characteristics and in arrangement in the profile.

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.

Site index (forestry). A numerical means of expressing the quality of a forest site; based on the height of the dominant stand at an arbitrarily chosen age; for example, the average height attained by dominant and codominant trees in fully stocked stands at the age of 50 years.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of the primary soil particles into lumps, granules, or other aggregates. Structure is described by grade (weak, moderate, or strong), that is, the distinctness and durability of the aggregates; by the size of the aggregates (very fine, fine, medium, coarse, or very coarse); and by their shape (platy, prismatic, columnar, blocky, granular, or crumb). A soil is described as structureless if there are no observable aggregates. Structureless soils may be massive (coherent) or single grain (noncoherent). The principal types of soil structure are defined as follows:

Blocky, angular. Aggregates have flat or rounded surfaces that join at sharp angles.

Blocky, subangular. Aggregates have some rounded and some flat surfaces; upper sides are rounded.

Crumb. Aggregates are generally soft, small, porous, and irregular, and tend to be spheroidal in shape.

Granular. Aggregates are roughly spherical, firm, and small. They may be either hard or soft but are generally more firm and less porous than crumb structure and without the distinct faces of blocky structure.

Platy. Aggregates are flaky, or platelike.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to flooding. 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. (See also Clay, Sand, and Silt.) The basic textural classes, in order of increasing proportions of fine particles are as follows: 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 noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. Presumed fertile soil or soil material, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, RANGE SITES, AND WOODLAND AND WILDLIFE SUITABILITY GROUPS

[See table 1, p. 5, for approximate acreage and proportionate extent of the soils, and table 2, p. 26, for predicted average acre yields of principal crops on given soils under two levels of management]

			Capability unit		Range site		Woodland suitability group		Wildlife suitability group	
Map symbol	*Mapping unit*	*Page*	*Symbol*	*Page*	*Name*	*Page*	*Number*	*Page*	*Number*	*Page*
AcA	Acadia silt loam, 0 to 1 percent slopes	5	IIIw-3	23	------------------		1	31	5	36
AcB	Acadia silt loam, 1 to 5 percent slopes	6	IIIe-1	22	------------------		1	31	5	36
Ad	Alluvial land	6	VIw-1	24	------------------		8	32	6	36
Ba	Beaumont clay	6	IIIw-1	22	Blackland	28	7	32	1	35
Bb	Bibb clay loam	7	VIw-1	24	------------------		8	32	6	36
Bp	Borrow pits	7	VIIIs-1	25	------------------		-------		--------	
Br	Byars silt loam	7	IVw-1	24	------------------		6	32	6	36
Bx	Byars-Acadia complex	8	IVw-1	24	------------------		6	32	6	36
By	Byars-Klej complex	8	IVw-1	24	------------------		5	32	6	36
Cp	Caddo-Pocomoke loamy fine sands	8	IIIw-4	24	------------------		2	31	5	36
Cs	Coastal land	8	VIIw-2	25	Salt Prairie	27	-------		4	36
Ct	Crowley silt loam	9	IIw-2	22	Sandy Prairie	29	-------		1	35
Cw	Crowley-Waller complex	9	IIIw-2	23	Sandy Prairie and Loamy Prairie.	29 28	-------		1	35
Ga	Galveston fine sand	9	VIIw-3	25	------------------		-------		4	36
Gc	Garner clay	10	IIIw-1	22	------------------		4	32	5	36
Ha	Harris clay	10	VIIw-1	25	Salt Marsh	27	-------		3	35
Hs	Harris clay, shallow over sand	10	VIIw-2	25	Salt Prairie	27	-------		4	36
HtB	Hockley silt loam, 1 to 3 percent slopes.	11	IIe-1	21	Sandy Prairie	29	-------		2	35
Kf	Klej loamy fine sand	11	IIIs-1	24	------------------		3	31	5	36
La	Lake Charles clay	12	IIw-1	21	Blackland	28	-------		1	35
Ma	Made land	12	VIIw-2	25	Salt Prairie	27	-------		4	36
Md	Morey silt loam	12	IIIw-1	22	Loamy Prairie	28	7	32	1	35
Ow	Oil-waste land	13	VIIIs-1	25	------------------		-------		-------	
Sa	Sabine loamy fine sand	13	IIIs-1	24	Coastal Sand	28	-------		2	35
Sm	Salt water marsh	13	VIIw-3	25	Deep Marsh	27	-------		3	35
Sw	Swamp	14	VIIw-3	25	------------------		8	32	3	35
Tm	Tidal marsh	14	VIIIw-1	25	------------------		-------		3	35
Wa	Waller soils	14	IVw-1	24	Loamy Prairie	28	-------		1	35

U.S. GOVERNMENT PRINTING OFFICE: 1965

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