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Soil Survey
of
Galveston County, Texas

By
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and
W. J. MORAN

Bureau of Chemistry and Soils
In cooperation with the Texas Agricultural Experiment Station

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SOIL SURVEY

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SOIL SURVEY OF GALVESTON COUNTY, TEXAS

By Z. C. FOSTER, in Charge, and W. J. MORAN

COUNTY SURVEYED

Galveston County is in the southeastern part of Texas on the Gulf coast (fig. 1). Galveston, the county seat, is 50 miles southeast of Houston. The county is irregular in outline and includes an area of 395 square miles, or 252,800 acres. It consists of a mainland and adjacent coastal islands, of which Galveston Island is the largest. The islands are part of a sandy coastal bar built by the sea, stretching along a large part of the Texas coast both east and west of Galveston County. Galveston Island does not join the mainland at any point, but Bolivar Peninsula, a part of the same bar, stretches out southwestward from the mainland of Chambers County, shutting Galveston Bay off from the Gulf.

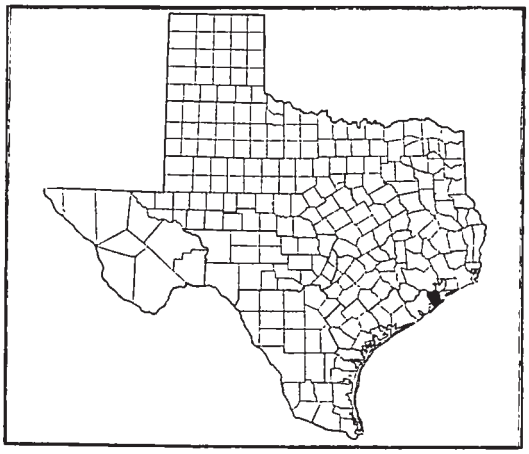

FIGURE 1.—Sketch map showing location of Galveston County, Tex.

The surface relief is that of a flat treeless prairie lying but a few feet above sea level. The mainland part, along Galveston Bay and the lagoon separating it from Galveston Island, is bordered by a belt of low marshy and semimarshy land merging with the flat higher land of the interior with no well-defined boundary. The mainland, though nearly flat, includes some low swells or ridges and is dotted by numerous small circular sand mounds. These dome-shaped mounds, ranging from 10 to 50 feet in diameter and from 1 to 3 feet in height, constitute the only noticeable local relief of the almost flat prairie, with the exception of a small nearly round hill on Bolivar Peninsula, which rises from the marshes to a height of 45 feet.

Surface dissection and erosion are almost entirely absent, the few small streams flowing in shallow channels. Large areas are so flat that water stands for a long time after rains, especially in the winter when evaporation is slow. Small round hummocks, ranging from 1 to 3 feet in height, constitute a noticeable microrelief on the heavy clay soils, causing the characteristic " hog-wallow " land.

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From the marshy and semimarshy land bordering the bays, lying at sea level, the mainland rises gradually in a northwesterly direction. The highest elevation (40 feet) is in the northwestern part of the county, about 20 miles northwest of the coast, indicating that the land has a slope of about 2 feet to the mile. The elevation at Algoa near the middle of the western county line is 37 feet.[1] The elevation at the union station in Galveston is 4 feet. Bordering Trinity Bay is an abrupt embankment with an elevation ranging from 12 to 15 feet above sea level. Galveston Island and Bolivar Peninsula lie very little above sea level. The highest part of Galveston Island, where the elevation has been raised in the form of a sea wall, is 19 feet, and the rest of the island ranges from sea level to 8 feet above. The elevation of Bolivar Peninsula is about the same as of Galveston Island, with the exception of a small area, High Island, which is 45 feet above sea level and from 35 to 40 feet higher than the surrounding country.

The native vegetation consists mainly of coarse grasses and herbaceous plants, with a few scattered small huisache trees occurring in the better drained places. The marshy lowlands, which are more or less impregnated with salt, support a heavy growth of saltgrass and coarse grasses which seem to grow only where the soils are wet and salty; and on the very low marshy areas large reeds, rushes, and flags predominate. On the heavy dark soils of the mainland the coarse grasses are largely Andropogons (commonly called broomsedge), species of *Paspalum*, some carpet grass, and various other wild prairie grasses. On the dark sandy soils the grasses are in general much coarser, and there are many more weeds and waxmyrtle than on the heavy soils.

Galveston County was established by act of the State Legislature May 15, 1838. The mainland part previous to that time had formed part of Brazoria County, and Bolivar Peninsula was a part of Liberty County. The present site of Galveston was used as temporary headquarters by pirates in 1816 and as a base of supplies for expeditions into Mexico in 1821. Advantages of Galveston as a port were recognized early, and in 1835 a permanent settlement was established. The first settlement on the mainland was at the present site of Dickinson, sometime prior to 1850.

According to the Federal census, the population of Galveston County in 1850 was 4,499, of which about 10 percent resided on the mainland. By 1910, the population had increased to 44,479, and in 1930 to 64,401, of which 7,929 are classed as rural. Of the rural population, 2,948 are classed as rural farm and 4,981 as rural nonfarm. The Negro population numbers 11,123. The rural population is centered around the small towns which are fairly well distributed, and the density in 1930 was 20.1 persons a square mile. The majority of the farmers are from different sections of the United States, very few being descendants of the early settlers.

Galveston, the county seat, is a city of 52,938 inhabitants. It is an important seaport, served by 64 steamship lines connecting with 125 foreign ports. Cotton, sulphur, and grain are the most important products shipped, and large quantities of bananas are imported.

[1] GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U S. Geol Survey Bull. 274, ed 4, 1,072 pp. 1906.

Galveston is served by lines of the Gulf, Colorado & Santa Fe; Missouri, Kansas & Texas; Missouri Pacific; Southern Pacific; and Galveston, Houston & Henderson Railroads. Located along these railroads, the small towns of Dickinson, Hitchcock, Arcadia, and others comprise business centers and shipping points for agricultural products. Texas City is a small port on Galveston Bay, from which principally oil and sulphur are shipped.

The public-road system is good, and most of the roads are either paved or surfaced with crushed shells. Nearly every farm has a shell road leading to it or within close range. Schools and churches are located at convenient intervals, and telephone and electric-light lines traverse all parts.

Water is plentiful on the mainland, being obtained from wells ranging from 50 to 500 feet in depth. On Galveston Island and Bolivar Peninsula water is pumped in from the mainland or rain water is stored and used.

CLIMATE

Galveston County has a mild climate tempered by winds from the Gulf of Mexico. The winters are in general short and mild but are marked by sudden sharp changes in temperature caused by cold waves from the north in the form of north winds, locally called "northers", which are often accompanied by rain, sometimes changing to sleet. The summers are long and hot, and, on account of the low altitude and proximity to the Gulf, a high humidity prevails, but the nights are cooled by breezes from the Gulf.

The winters are generally mild enough to allow the growing of winter vegetables and cover crops. The average date of the latest killing frost is January 19 and of the earliest is December 22, giving an average frost-free season of 337 days. Frost has occurred as late as March 20 and as early as November 16, but killing frosts are not frequent.

The annual precipitation at Galveston averages 44.87 inches and is evenly distributed throughout the year. Periods of excessive rainfall and short summer droughts sometimes occur, although severe droughts are rare. During rainy seasons most of the land is too wet for cultivation, owing to deficient drainage, and when heavy rains occur in the winter or early spring, crop plantings are retarded, often to such an extent that considerable decrease in crop production takes place. Snowfall is of extremely rare occurrence. Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation at Galveston. These data are considered representative of climatic conditions throughout the county.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Galveston, Galveston County, Tex.*

[Elevation, 54 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1917)	Total amount for the wettest year (1900)
	° F	° F	° F	Inches	Inches	Inches
December	56 4	80	18	3.75	1 00	5.40
January	53 8	75	11	3 41	2 21	3.18
February	56 3	76	8	2 93	2 51	3 59
Winter	55 5	80	8	10 09	5 72	12 17
March	62 4	85	30	2 68	91	6.87
April	68 7	85	41	3 06	1 45	4 65
May	74 8	93	52	3 42	3 47	4 53
Spring	68 6	93	30	9 16	5 83	16.05
June	80 7	99	57	4 37	65	5 51
July	83 4	99	66	3 71	46	18 74
August	83 0	98	67	4 28	2 71	6.94
Summer	82 4	99	57	12 36	3 82	31.19
September	80 1	94	54	5 57	3 60	11.80
October	72 7	91	41	4 36	1 49	5.54
November	63 3	85	27	3 33	.97	1.64
Fall	72 0	94	27	13 26	6 06	18.98
Year	69 6	99	8	44 87	21 43	78.39

AGRICULTURE

The early settlers of Galveston County were largely cattlemen who used the open prairie land as free range. Galveston and Houston (in Harris County) became important cities at an early period, and settlements grew up along the railroads which were extended across the county connecting these cities. Small acreages of land were placed in cultivation on the better drained soils near the railroads, and as early as 1880 corn, cotton, vegetables, and wild hay were produced. Because of very imperfect natural drainage, farming has not been extended over large areas, and most of the land remains in the virgin state.

According to the census of 1930, only 16.6 percent of the land was included in 674 farms, with an average size of 62.4 acres each, of which 67.7 percent is classed as improved land. The total value of farm land and buildings is $4,048,415, land alone amounting to $2,757,520. Only 13,149 acres, or 5.2 percent of the total land area in 1930 was classed as crop land, and crops were harvested from only 7,508 acres in 1929. Farming is confined to the better drained land, though natural drainage is in most places inadequate for best results. Truck farming, vegetable gardening for the local markets, and fig growing are the chief agricultural interests. Only small acreages are planted to cotton, corn, rice, sorghum, or other general farm crops. Winter truck crops are largely grown and shipped to outside markets. According to local information, 5,300 acres were in figs in 1926, but this figure was reduced to 2,219 acres in 1929, owing to low prices and other causes connected with mar-

keting. Large fig-preserving plants are located at convenient places.

The principal vegetables and truck crops grown are watermelons, cantaloups, corn, potatoes, sweetpotatoes, peanuts, turnips, beans, and cabbage. Many others are produced in small quantities. Strawberries and dewberries are successfully grown for the market. Vegetables were harvested for sale from 956 acres in 1929, with a value of $91,325, and those from 179 acres were grown for home use only.

In 1929, 8,567 bearing and 7,192 nonbearing orange trees were reported. Oranges, mostly satsuma varieties, have been grown for many years, but, owing to occasional injury by freezes, the industry has not become commercially well established. Between 1890 and 1900, some large pear orchards were planted and considerable fruit was produced, but destruction of the trees by blight discouraged production to the extent that little of this fruit is now grown.

Dairying and poultry raising are important industries supplying the Galveston and Houston markets with milk, cream, butter, eggs, and poultry.

Most of the land is used for grazing range beef cattle and to some extent for pasturing dairy cattle. The census shows that the total number of cattle on the farms in 1930 was 10,729, of which 4,340 were cows and heifers more than 2 years old kept mainly for the production of milk.

Table 2 gives the value of all agricultural products, by classes, in Galveston County in 1929, as reported by the Federal census.

TABLE 2.—*Value of agricultural products, by classes, in Galveston County, Tex., in 1929*

Crop	Value	Livestock and products	Value
Cereals	$25,000	Domestic animals, chickens, and bees	$552,308
Other grains and seeds	2,262	Poultry raised	41,990
Hay and forage	24,738	Butter, cream, and whole milk sold	362,630
Vegetables (including potatoes and sweetpotatoes)	107,284	Chicken eggs produced	66,172
Fruits and nuts	118,860	Honey	114
Other field crops	23,208	Total	1,023,214
Vegetables for home use only	14,459	Total agricultural products	1,339,025
Total	315,811		

In 1929, $19,543 were expended for fertilizer on 179 farms, an average of $109.18 a farm. This represents a large increase over the amount expended in 1919. The fertilizer is bought ready mixed, and most of it contains from 8 to 18 percent of superphosphate.

As the farmers and their families do most of the farm work, the need for year-around laborers is small. Hired laborers receive from $3 to $5 a day. According to the 1930 census, 203 farms reported an expenditure of $129,443 for labor in 1929, an average of $637.65 a farm.

The average size of farms is 62.4 acres, but the range is from small tracts of less than 3 acres to ranches of more than 1,000 acres. Most of the farms are operated by owners, although there is a tendency for the proportion of farms operated by tenants to increase. Of the

674 farms in the county in 1930, 507 were operated by owners or part owners, 148 by tenants, and 19 by managers. Of the 148 tenants, 94 paid cash rent and the others worked on shares.

Most of the farm buildings are small and of frame construction. The houses are usually painted and kept in good repair. The type of farming and size of farms do not require large barns, the largest and best being on the dairy farms. Up-to-date machinery is in use, and most farmers have a tractor and the necessary equipment. Most of the work animals are mules, but some horses are used.

The leading agricultural industries, other than grazing beef cattle, are dairying, poultry raising, truck farming, vegetable gardening, and horticulture.

The value of dairy cattle and dairy products is greater than of any other agricultural product, and it seems likely to increase. According to the Federal census, the production of milk increased from 1,165,497 gallons in 1919 to 1,427,136 gallons in 1929. At present (1930) about 125 dairy farms are in the county, with herds ranging from 20 to 100 milking cows, mainly grade Jerseys, with a few Holstein-Friesians. Only a few registered bulls are kept, as pedigreed cattle brought into the county are susceptible to Texas fever. The calves are raised for milk cows or are sold as veal. Most of the milk is marketed as raw milk in Galveston and Houston, either by individuals or through a farmers' milk-marketing association. Some butter is made and sold.

Compared to the number of cows milked, very little feed is grown. The common practice is to buy all grain feeds and allow the cows to graze, using as roughage the wild prairie hay. A little roughage is grown, consisting mostly of hegari and Red Top sorgo. A mixture of sorgo, hegari, kafir, and soybean vines are reported as making good silage. A few dairymen supplement grain to some extent by growing peanuts for feed. Oats and bur clover are sown for winter pasture and Sudan grass for summer pasture.

The 1930 census reports 35,279 chickens on April 1 of that year. The favorite breeds are Leghorn, Ancona, Rhode Island Red, and Barred Plymouth Rock. Prepared feeds are used by most poultrymen. Many poultrymen cull their flocks yearly, and more may do so as the value of this practice is demonstrated. Poultry products, consisting of eggs, fattened cockerels, and culled hens are sold locally in Galveston and Houston. There are two chicken hatcheries in Galveston County and several in the adjoining counties of Brazoria and Harris, all of which supply the local demand for young chicks.

Many range cattle are grazed over the prairies and on the semimarshy soils. In the summer and fall these cattle are moved to northern or western pastures or are shipped to other points in the State or to other States for fattening. Brahman or grade Brahman cattle are used largely for range livestock, as they are reputed to be more resistant to ticks and less subject to Texas fever. It is reported that this immunity is inherent in Brahman cattle and that their progeny are immune to the disease for several generations. Some Hereford and Shorthorn cattle have been crossed with the Brahmans.

Fall, winter, and spring vegetables are produced and are shipped to points in northern Texas, Oklahoma, Kansas, and Missouri. Including potatoes and sweetpotatoes, the 1930 census reports 1,124

acres in Galveston County used for growing truck crops in 1929. The returns range from $100 to $400 an acre.[2]

The growing and handling of Magnolia figs (pl. 1, *A*) has become an important industry. The Magnolia is a preserving fig which must be canned immediately on ripening. This means that during the ripening season the fruit must be picked daily, hauled to a canning factory, and there preserved. To take care of the crop, six canning factories, which operate during the fig harvest, are located at convenient points.

No well-developed system of farm management or crop rotation is practiced, owing to the highly specialized production of crops. The growing of vegetables is carried on year after year on the same farm, but the growers realize that it is not good practice to grow the same crop year after year on the same soil, so an interchange of vegetables is made from season to season. Heavy applications of commercial fertilizers are used. They range from those containing 8 percent nitrogen, 3 percent phosphoric acid, and 3 percent potash to those containing as high as 18 percent phosphoric acid. Most of the fertilizers used for truck crops are high in phosphoric acid.

In fig growing, a green cover crop is often grown during the winter, bur clover chiefly, but some orchardists sow sweetclover (pl. 1, *B*). These crops are plowed under in the spring, and in most orchards a commercial fertilizer is applied every 2 or 3 years. The well-cared-for fig orchards have a thrifty growth, and good yields of fruit are obtained.

Two State agricultural experiment stations are located near this county—substation no. 3, at Angleton in Brazoria County, and substation no. 4, near Beaumont, in Jefferson County. Results obtained from experiments at these stations should be applicable to the soils of this county, and farmers may easily keep in touch with them.

SOILS AND CROPS

Galveston County lies entirely within the Gulf coast prairie region, a low, flat coastal prairie area covering about 8,000,000 acres in southeastern Texas. Owing to the flat position and heavy, very slowly permeable clay subsoils, natural drainage, either from the surface or underneath, is very deficient over most of the land. This condition is accentuated by the high rainfall prevailing in the eastern part of this area, which includes Galveston County, and the soil remains saturated with water for long periods following rains and during the winter when evaporation is slight. The lowest areas near the coast, which are only slightly elevated above the sea, have a high water table which, during the winter, is near or at the surface of the ground. Agriculture is hindered greatly by this lack of drainage, and the comparatively small areas in cultivation are confined to soils which have the best drainage, although the drainage of many of these soils is insufficient for best results.

The soils are included in three main groups. Those of the first group, the dark-colored soils, occupy most of the mainland and lie farthest from the coast; those of the second group, the semimarshy and marshy soils, all of which are nonagricultural, occur as a flat

[2] Statement by J. E. Yeary, county agent.

low coastal fringe adjacent to the bays; and those of the third group, the light-colored soils, occur as low, sandy islands and peninsulas adjacent to the Gulf, and as heavier soils covering small timberland spots which border stream channels passing through areas of the dark-colored soils. The dark-colored soils are the chief agricultural soils, although very small areas of some of the light-colored soils are also farmed.

In the following pages the soils of Galveston County are described in detail, and their agricultural relationships are discussed; the accompanying soil map shows their location and distribution; and table 3 gives their acreage and proportionate extent.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Galveston County, Tex.*

Type of soil	Acres	Percent	Type of soil	Acres	Percent
Lake Charles clay	64,320	25.4	Acadia clay	5,632	2.2
Lake Charles clay loam	24,192	9.6	Morse very fine sandy loam	1,536	.6
Lake Charles clay loam, shallow phase	3,136	1.2	Galveston fine sand	16,128	6.4
Lake Charles clay loam, mound phase	21,440	8.5	Harris clay	35,456	14.0
Lake Charles clay loam, depression phase	9,920	3.9	Harris fine sand	13,056	5.2
Lake Charles very fine sandy loam	24,704	9.8	Tidal marsh	10,880	4.3
Lake Charles very fine sandy loam, shallow phase	10,496	4.2	Beach sand	5,376	2.1
			Made land	6,528	2.6
			Total	252,800	------

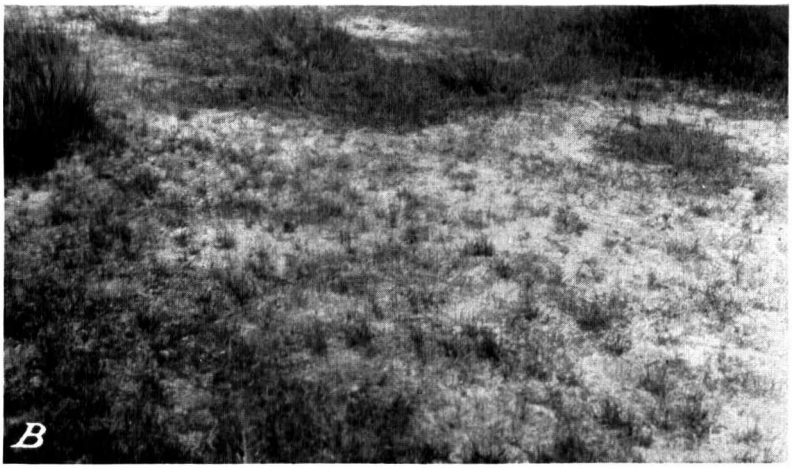
DARK-COLORED SOILS

All the dark-colored soils are members of the Lake Charles series, including Lake Charles clay; Lake Charles clay loam, with a shallow phase, mound phase, and depression phase; and Lake Charles very fine sandy loam, with a shallow phase. These soils are closely associated in small and large bodies over most of the county and comprise a total area of 158,208 acres. Lake Charles clay occupies large areas. The sandy soils are less extensive and are spotted in occurrence.

The Lake Charles soils have dark-colored surface layers, the clay being black or nearly so and the sandy soils dark brown or brown. The surface soils are acid in reaction. They grade below into dark-gray heavy subsoils, also of acid reaction, which pass, at a depth of several feet, into chalky marl. Shallow phases of several of the types include soils in which the marl lies within 3 feet of the surface. All these soils are very productive where drainage is adequate.

The surface relief of the Lake Charles soils is nearly flat. Surface drainage is very slow or entirely absent, and underdrainage is deficient, owing to the heavy very slowly permeable clay subsoils. Lake Charles clay occupies large areas of flat land, with here and there a slight swell in the prairie, occupied by sandy soil which is somewhat more freely drained than the clay. Intermediate in position and occurring mostly as transitional areas between areas of clay and sandy soil are areas of clay loam soil. No alluvial deposits extend through areas of these soils, although shallow creeks and gullies carry some run-off water from narrow slopes adjacent to them.

A, A 6-year-old fig orchard on Lake Charles clay. *B*, Cover crop of sweetclover in fig orchard.



A, Turnips on Lake Charles soils at the experiment station at Dickinson. *B*, Uncultivated "slick spot" in area of Lake Charles clay loam, showing characteristic growth.

The sandy members of the Lake Charles series are friable and easily cultivated, but the clay is very heavy and sticky when wet, and the virgin soil dries to a hard mass which, on becoming thoroughly dry, cracks deeply. When Lake Charles clay is cultivated at the proper moisture content it breaks down to a loamy mass of coarse grains. The surface soil of the clay loam, though drying to a hard mass, can be maintained in friable condition by cultivation, when moisture conditions are favorable, the moisture content for allowable cultivation extending over a wider range than in the clay. The Lake Charles soils are limited in crop yields more by imperfect drainage than by deficiencies in plant nutrients. The sandy soils respond well to applications of manure and organic matter. Some farmers practice growing and plowing under bur clover on the clay soil, and they report that this proves beneficial, not only in increasing yields of figs, but in promoting a more friable consistence in the soil.

Most of the crops produced are grown on the Lake Charles soils. On the lighter textured soils—largely the very fine sandy loam—vegetables and truck crops are important, but the clay is considered the most favorable soil for figs, owing largely to its high productiveness and to the fact that injury to figs by nematodes is much less than on the sandy soils. The small acreages devoted to general-farm crops—chiefly rice, cotton, corn, and sorgo—are largely the clay and clay loam. Cotton, corn, and feed crops are grown extensively on these soils in counties farther west where the natural drainage is slightly better and rainfall not so great. Rice is grown extensively on Lake Charles clay in some of the eastern counties of Texas where rainfall is even higher, but very little rice is grown in Galveston County at present. The chief agricultural interest is centered in truck farming, vegetable gardening, and fig growing.

The Lake Charles soils represent large areas of good productive soils suited to many crops, but they require better drainage for best use. Large areas of these soils remain as pasture land for both dairy cattle and beef cattle. The coarse grasses, largely Andropogons (broomsedge), *Paspalum* sp., and similar grasses make a very heavy growth, and during the spring and summer are capable of carrying many head of livestock. These grasses, though abundant, are not so nutritious as the gramas and short grasses of the western and southern plains.

Lake Charles clay.—Lake Charles clay is black or dark-gray heavy clay, stick and waxy when wet but becoming hard and cracking deeply when dry. It has a coarse-granular structure. The dark clay surface soil grades below, at a depth of about 12 inches, into dark-gray clay which, in turn, grades into the calcareous parent material at a depth of about 5 feet. The surface relief in most places is flat, and water stands for a long time after rains. The surface is pitted by numerous small depressions a few feet in diameter, separated by intervening rounded mounds, giving the characteristic hog-wallow configuration which disappears with cultivation.

Lake Charles clay, commonly known as "heavy black land" or "hog-wallow land", is the most extensive soil in the county. It is a highly productive soil well suited to general-farm crops and to some vegetables and fruits. Owing to slow drainage, much of the land is

not cultivated here, though, in the western and central parts of the coast prairie, where rainfall is lower and drainage less deficient, it is used largely for cotton, corn, sorgo, and other feed crops, and in the eastern part it is the principal rice soil, as the high rainfall and very slow drainage favor the production of rice.

In this county, small acreages of this soil are used for cotton, corn, sorgo, Sudan grass, and other feed crops, and a very small acreage is devoted to rice. The Tuxpan and Hastings Prolific varieties of corn are grown chiefly, and acre yields range from 15 to 35 bushels. Cotton yields range from one-fifth to three-fourths of a bale an acre, according to local reports, and rice from 20 to 50 bushels. Bur clover grows well, and various other crops may be grown. The yields of crops are governed largely by the adequacy of the natural drainage. Some strawberries, dewberries, and blackberries are grown successfully for local markets, and some are shipped. Spring vegetables, chiefly carrots, beets, black-eyed peas, butter beans, corn, and cabbage are grown for market. Peanuts are grown for hay, yielding from one-half to 1 ton an acre, but the soil adheres to the nuts and renders them unsuitable for marketing. The Magnolia fig is grown extensively on this soil, yielding, when the trees are 5 years old, about 5,000 pounds of fruit an acre, according to the local orchardists.

Table 4 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of Lake Charles clay.

TABLE 4.—*Mechanical analyses of Lake Charles clay*

No	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
448101	Surface soil, 0–6 inches	0.2	0.1	0.1	2.9	15.5	22.6	58.8
448102	Subsurface soil, 6–25 inches	.1	.1	.0	2.4	21.4	21.8	54.0
448103	Subsoil, 25–60 inches	.3	.2	.0	2.9	21.4	21.0	54.2
448104	Subsoil, 60–70 inches, +	.1	.2	.1	1.8	17.3	20.7	59.8

Lake Charles clay loam.—Lake Charles clay loam consists of a 10-inch layer of nearly black or dark-gray clay loam grading below into dark-gray clay which contains spots of rust brown. This material grades into light-colored calcareous clay at a depth of about 5 feet. Scattered mounds of fine sand dot the surface and in places are surrounded at the base by narrow bands of salty soil, known as slick spots.

The surface relief of this soil is nearly flat, and drainage is slow but, as a rule, is slightly more free than in Lake Charles clay.

Lake Charles clay loam resembles Lake Charles clay in general characteristics, but it is somewhat more friable and less difficult to plow or cultivate. However, on becoming thoroughly dry it hardens to a mass that is broken with difficulty into large irregular clods. On exposure to air the clods eventually break naturally into small clods. The soil, where cultivated under proper moisture conditions, works readily into a loamy bed of coarse grains.

This is a productive soil suited to many crops. Crop yields are about the same as on Lake Charles clay, and, though slightly better drained than the clay, this soil is at times too wet for best results.

Practically the same crops are grown as on Lake Charles clay. Probably more corn, cotton, potatoes, and sweetpotatoes are grown, but a much smaller acreage is devoted to figs, although they do well.

Lake Charles clay loam, shallow phase.—Small areas of soil occur associated with Lake Charles clay loam, which have the same surface texture and color but are underlain at a depth ranging from 20 to 30 inches by gray and yellow mottled clay containing numerous lime concretions. In places the lower subsoil layer is white marl. These areas are mapped as a shallow phase of Lake Charles clay loam. The surface soil is slightly more friable than, and has not such a tendency to crust as, the typical soil. Areas of this soil are so intermixed with areas of the typical soil and are so small that, agriculturally, they are not recognized as being different. The same crops are grown, and the land commands the same price as the typical soil.

Lake Charles clay loam, mound phase.—Occupying a position between areas of Lake Charles very fine sandy loam and Lake Charles clay loam is Lake Charles clay loam, mound phase. This soil has numerous sand mounds scattered over the surface, which occupy from 10 to 25 percent of the land. The soil between the mounds is dark-gray very fine sandy clay loam overlying gray clay. The mounds consist of dark-gray loamy fine sand overlying brown loamy fine sand which, at a depth ranging from 24 to 30 inches, is underlain by material similar to that of the intermound areas.

Slick spots occur over the surface as on the typical soil. This soil, as mapped, includes small areas of Lake Charles very fine sandy loam and Lake Charles clay so intermixed that separation on the map is impractical. In places the subsoil is underlain, at a depth ranging from 20 to 30 inches, by calcareous clay, but such spots are small and so intricately scattered throughout the mound phase that, seemingly, they have no separate agricultural value.

The land is flat, and the virgin soil supports a growth of coarse grasses and weeds. Very little of the land is under cultivation, but where cultivated, the same crops are grown as on the associated soils. Vegetables are grown mostly, with some corn, cotton, and, in a few places, figs. The yields are practically the same as those obtained on the typical soil.

Lake Charles clay loam, depression phase.—Scattered areas occupying swales and depressions throughout the Lake Charles soils comprise Lake Charles clay loam, depression phase. This is a gray soil overlying heavy gray clay. It remains wet so much of the time that it is not cultivated. It is of slight extent.

Lake Charles very fine sandy loam.—Lake Charles very fine sandy loam consists of an 8-inch layer of dark-brown or brownish-gray very fine sandy loam underlain by gray or mottled yellow and gray sandy clay which, at a depth ranging from 3 to 5 feet, is underlain by calcareous clay or marl. Scattered over the surface are many small circular sand mounds which occupy from 20 to 50 percent of the land and which in places are surrounded by rings of slick spots.

Lake Charles very fine sandy loam occupies gentle prairie swells or low ridgelike areas which have such a gentle incline from the flat heavy soil areas that the rise is almost imperceptible. Natural surface drainage is somewhat more free on this soil than on the flat

heavy soils, though even here it is not sufficient for best results in producing crops.

The surface soil of Lake Charles very fine sandy loam is friable and easily cultivated. It contains little organic matter and is of acid reaction. However, the soil is productive and is suited to many crops, although it is not quite so productive as the clay or clay loam.

A comparatively small acreage of Lake Charles very fine sandy loam is in cultivation, and where cultivated the land is utilized mostly for growing truck crops. The fall and winter crops are mainly onions, shallots, spinach, mustard, turnips (pl. 2, *A*), collards, radishes, carrots, beets, and parsley. After these have been harvested the soil is prepared for spring vegetables, chiefly beans, squash, cucumbers, tomatoes, peppers, potatoes, sweetpotatoes, carrots, beets, black-eyed peas, butter beans, okra, cantaloups, sweet corn, and cabbage. Small acreages are devoted to corn, cotton, and sorgo. Corn yields range from 10 to 25 bushels and cotton from one-sixth to three-fourths of a bale an acre. Peanuts, cowpeas, and other crops are grown to some extent. Figs do well but are said to be subject to nematode injury. Citrus fruits, chiefly satsuma oranges, grow well so far as soil conditions are concerned. The soil would be improved by growing legumes and by plowing under organic matter and manure.

Lake Charles very fine sandy loam, shallow phase.—Small areas of a shallow phase occur throughout areas of Lake Charles very fine sandy loam in which the soil differs from the typical soil only in that the calcareous chalky parent marl lies at a depth ranging from only 20 to 30 inches beneath the surface. This soil occurs in narrow strips and comprises only 4.2 percent of the total land area of the county. According to reports from farmers, it is about as productive as the typical soil.

LIGHT-COLORED SOILS

The light-colored soils are not important, either in areal extent or agriculturally. These are Acadia clay, Morse very fine sandy loam, and Galveston fine sand.

The Morse and Acadia soils are associated with the Lake Charles soils that lie near the shallow streamways. They are covered by a growth of trees. The Galveston soils occupy low coastal islands and peninsulas.

Acadia clay.—Acadia clay consists of a layer of gray heavy clay, about 8 inches thick, grading below into light-gray rather brittle heavy clay. The calcareous parent material in most places occurs at a depth ranging from 6 to 8 feet. The surface soil and subsoil are of acid reaction. The surface soil contains very little organic matter, but under cultivation, probably owing to an admixture of this material, it becomes brownish gray. This soil occupies only a few small areas.

The land is flat, surface drainage is lacking, and underdrainage through the dense clay is extremely slow. The surface is pitted with numerous small hog-wallow depressions, in which water stands much of the time during the winter and in rainy seasons.

This soil supports a fairly heavy growth of loblolly pine, together with some live oak, post oak, water oak, willow oak, and yaupon.

Only a few small areas are in cultivation. The soil when wet is very sticky, but it dries to a hard mass that is cultivated with difficulty. Small acreages of figs, corn, and spring vegetables are grown, with yields about equal to those on Lake Charles clay. The soil requires better drainage and organic matter to bring out the inherent productiveness that it seems to have.

Included with this soil as mapped are small spots which have surface soils of very fine sandy loam, silt loam, and clay loam texture. Such spots are of such small extent and occurrence that they could not be shown separately.

Morse very fine sandy loam.—Morse very fine sandy loam consists of a brown very fine sandy loam surface soil resting on a mottled red, yellow, and gray clay subsoil. In virgin areas the surface soil is brown to a depth ranging from 2 to 4 inches, and below that depth the subsurface material is yellowish brown or light brown.

Included with this soil as mapped are some very small areas of Morse clay occurring on narrow steep slopes, but they are too small to show separately.

This soil is of very small extent. It occupies gentle upland slopes adjacent to the drainageways, and it has good drainage. It supports a natural growth of trees, mainly white oak, water oak, ash, and live oak, together with some underbrush, largely yaupon.

Only a small acreage of this land is in cultivation, although it is fairly productive. The chief crops are cotton and corn, and some vegetables are grown. Crop yields are good.

Galveston fine sand.—Galveston fine sand is dark-gray or brownish-gray fine sand grading, at a depth of a few inches, into gray or pale-yellow fine sand which extends to a depth of many feet. In many places the water table lies within 4 feet of the surface.

This soil is of small extent. It occurs as long coastal strips on Galveston Island and Bolivar Peninsula. It supports a growth of coarse grasses and weeds.

The soil contains little organic matter and is so loose that, where not protected, it drifts in the winds.

A few small areas are in cultivation. Watermelons and cantaloups are grown successfully. It is reported that watermelons yield at the rate of about one carload an acre, but if grown for more than 1 or 2 years on the same land they become infected with a wilt disease. Some vegetables, corn, and cotton are grown in a few places, local reports giving acre yields of corn ranging from 10 to 25 bushels and of cotton from one-fifth to three-fifths of a bale. Some potatoes and sweetpotatoes are grown successfully.

This soil requires protection from the wind for best results. It could be improved by manuring and by plowing under organic matter. Probably grapes, berries, various vine crops, and some vegetables could be grown with fair results.

MARSHY AND SEMIMARSHY SOILS

Marshy and semimarshy soils occur in a low-lying coastal fringe only slightly above the level of the sea. These are not agricultural soils in their present condition, as the water table lies at the surface or very little below in most places, and water covers the land for long

periods after rains. Some areas at times are covered by wind-blown salt water. The marshy and semimarshy soils include Harris clay, Harris fine sand, and tidal marsh. The Harris soils have gray surface soils, with gray or mottled gray and yellow subsoils. They contain salt in places. They are covered with coarse saltgrass and other water-loving grasses which afford some winter grazing for range cattle. These soils, if reclaimed and drained, would probably be fairly productive and suited to some of the general farm crops.

Harris clay.—Harris clay is the most extensive soil of this group. It consists of a 6- to 10-inch layer of gray or very dark gray clay underlain by light-gray or bluish-gray waxy clay.

The land is flat and saturated with water for long periods during rainy seasons or during the winter, and occasionally high winds blow salt water over the surface. Harris clay supports a heavy growth of saltgrasses on which cattle seem to thrive.

Some low areas are saturated with salt or brackish water most of the time and are subject to inundation by irregular wind tides.

Included with this soil as mapped are small areas of clay loam closely associated with Harris clay but lying slightly higher. The soil in such areas is dark-gray or brownish-gray clay loam 6 or 8 inches thick, underlain by gray clay slightly mottled with yellow or brown. Owing to their small extent, these areas are not shown separately.

Harris fine sand.—Harris fine sand occurs on Galveston Island and Bolivar Peninsula. This is a semimarshy soil which consists of gray or mottled gray and yellow fine sand which grades below into mottled gray and yellow fine sand of lighter shades. Layers of dark-gray heavy material as much as a foot thick and ranging in texture from fine sandy loam to sandy clay occur in the subsoil in many places. In some places shells and shell fragments are mixed with the surface soil and subsoil.

This soil occurs in low flat areas adjoining or near the bays. It supports a varied growth of salt-tolerant plants, such as coarse saltgrasses, weeds, and wild cranberries.

The land is often covered with salt water by high wind tides and is also frequently saturated by rain water. In fact, it remains wet most of the time. The water table lies at, or nearly at, the surface. The land has no value for growing crops, but range cattle graze on the meager forage during the winter.

Tidal marsh.—Tidal marsh comprises very wet salty land which has no value except for the winter grazing afforded range cattle by some of the coarse grasses growing on it.

MISCELLANEOUS SOIL MATERIALS

Beach sand.—Along the Gulf beach is a narrow marginal area of beach sand composed of fine sand, shells, and shell fragments. This land is partly washed by waves and is bare of vegetation. It merges inland with slightly higher land occupied by loose drifting sand and low sand dunes ranging from 2 to 5 feet in height. A few weeds and other coarse vegetation, including some saltcedar, find a foothold in the sand.

Made land.—Made land, as the name signifies, includes filled-in areas. It is a mixture of all kinds of surface soil and subsoil

material from various excavations. Much of the city of Galveston rests on made land composed largely of sand and shells.

SOILS AND THEIR INTERPRETATION

Galveston County lies in the low coastal plain of Texas, extending from the Gulf coast inland for a distance of about 30 miles.

The immediate coastal boundary of the county is the south side of a sand bar ranging up to 3 miles in width, built by the waters of the Gulf and the coastal winds. Inland from the bar is a broad lagoon stretching along the entire coastal length of the county, ranging in width between 1 and more than 10 miles. Its widest part is called Galveston Bay. The mainland part of the county rises from this lagoon without a seaward-facing cliff, at first as a coastal belt of marsh which is salty along the immediate coast. The surface rises gradually inland, and, as it rises, the land becomes drier, but none of the county attains an elevation sufficient to allow dissection of more than a few feet. The date of uplift is very recent.

The material uplifted consists of calcareous clay and silt, together with a very small proportion of very fine sand. Because of the recent date of uplift, the flat relief, and the calcareous character of the material, the dominant soil is dark colored and somewhat imperfectly drained. The dark color is due primarily to the cover of grass under which the soils have developed, but the retention of the organic matter in the soil until it has accumulated in sufficient quantity to impart a very dark color is probably due chiefly to the presence of an abundant supply of calcium. This has been sufficient to saturate the organic-matter colloids and to preserve them in the soil through flocculation. It is, however, not certain that part of the organic matter has been preserved because of the still existing somewhat imperfect drainage and a former state of poor drainage.

The dominant soils are members of the Lake Charles series, the profile of which is described as follows:

(1) Dark-gray or black clay ranging from 6 to 12 inches in thickness.
(2) Lighter colored clay containing slight mottlings or spots of other colors, mainly gray with some yellow or rust brown. This material extends to a depth ranging from 20 to 120 inches.
(3) Calcareous clay containing concretions of calcium carbonate.

The color of layer 1 ranges from dark gray to black, with some spots or streaks of dull rust brown in the heavier soils. The clay, on drying, cracks deeply. The mass between the cracks breaks into small very hard clods by natural breakage caused by numerous small cracks. The material is slightly acid in reaction.

Layer 2 is gray, becoming lighter in color as depth increases. On exposure to air, the soil material cracks and breaks into small very hard clods, in places having a small nut structure. This layer usually contains fine dark (black or brown) particles, some soft and irregular in shape and others comprising semihard round concretions. The particles occur mainly in the yellow or brown spots. The brightest color occurs around the dark concretionary material or soft dark lumps, but the color becomes less pronounced as it extends into the surrounding gray mass. A few concretions of calcium carbonate occur in this layer, though the fine earth is acid. This layer

grades into the calcareous parent material beneath through a transitional layer of variable thickness.

Layer 3 is gray or gray and yellow mottled calcareous clay. This, in many places, consists of beds of calcium carbonate concretions in white marl. The top of the marl material lies deepest beneath the heavy flat soils and generally is nearest the surface beneath the sandy soils.

Another profile, as observed about 1½ miles southwest of Dickinson, is as follows:

(1) 0 to 10 inches, dark-gray almost black clay. On becoming thoroughly dry, wide deep cracks form. On a cut bank this exposed material breaks naturally into small nut-sized irregular clods which are loosely bound together.
(2) 10 to 25 inches, very dark gray clay containing small spots or specks of rust-brown color. The exposed material where dry cracks naturally, breaking into large hard clods which are a mass of tightly bound small hard clods.
(3) 25 to 60 inches, gray, mottled with yellow and rust brown, waxy plastic clay which on drying breaks into fine clods.
(4) 60 to 80 inches, highly mottled yellow and gray plastic calcareous clay containing limy concretions and some small black concretions.

The dark-gray or black surface soil of Lake Charles clay is very irregular in thickness, and it is difficult to determine just where it changes to the layer beneath. On the small hog-wallow knolls the yellow and gray clay layer lies within a few inches of the surface, in the intervening depressions it may occur at a depth ranging from 2 to 3 feet, and in places it is uniform in depth over small areas.

Although the calcareous parent material is generallly deep under Lake Charles clay, in a few places it comes within 30 inches of the surface. Here the surface soil is black or dark-gray clay, 8 or 10 inches thick, overlying gray clay which in most places is more friable than that of the typical soil. At a depth ranging from 20 to 30 inches gray and yellow clay, containing many calcium carbonate concretions, is reached.

Table 5 gives the results of pH determinations of samples of Lake Charles clay.

TABLE 5.—*pH determinations of Lake Charles clay, Galveston County, Tex.*

Sample no	Soil type	Depth	pH
		Inches	
448101	Lake Charles clay	0–6	6.60
448102	do	6–25	6.46
448103	do	25–60	7.84
448104	do	60–70	8.19

Throughout the clay loam member of the Lake Charles series are a few light-colored spots that are almost devoid of vegetation. The surface soil dries out hard and tight with a light-colored crust. Most of these spots are a few inches higher than the surrounding land. When wet they are very slippery and are called "slick" spots (pl. 2, *B*). A boring showed the following profile:

(1) 0 to 2 inches, gray very fine sandy loam with a white surface crust about one-fourth inch thick. The dried crust is very hard and slick,

with a few fine cracks crossing and breaking it into irregular blocks several inches in diameter. The crust has a rubberlike consistence when moist.

(2) 2 to 24 inches, very heavy waxy dense dark-gray clay containing large hard concretions of $CaCO_3$. On drying, the material breaks into masses of hard clods tightly bound together. On exposure to weather, these break apart gradually into smaller very hard clods.

(3) 24 to 40 inches+, light-gray waxy clay containing $CaCO_3$ concretions. The material below a depth of 40 inches is very calcareous.

Table 6 gives the results of analyses of soil samples from one of the slick spots. These analyses were made by G. S. Fraps, chemist, Texas Agricultural Experiment Station.

TABLE 6.—*Chemical analyses of slick-spot soil, 3½ miles south of Alta Loma, Galveston County, Tex.*

[Parts per million]

Description of sample	Depth	Carbonate of lime	Carbonate of magnesia	Carbonate of soda	Chloride of soda
	Inches				
Crust	0- ¼	111	61	1,375	1,160
Very fine sandy loam	¼- 7	100	38	1,094	726
Heavy sandy clay	7-24	96	33	384	196
Gray clay (concretionary)	24-42	37	29	320	206

The timbered soils include Acadia clay and Morse very fine sandy loam, and Galveston fine sand represents the light-colored group on the coastal islands and peninsula.

The timbered light-colored soils are not extensive, but they seem to bear some relation to the Lake Charles soils, in that they are developed from the same character of material—marl. The carbonate has been leached from both the surface soil and subsoil layers of the Acadia soils, but the Morse soils, owing to better surface drainage, have developed color and structural differences of the subsoil, as evidenced by the red coloration and fairly crumby structure of the upper part of the subsoil. The slope is sufficient to prevent much absorption of water, and the absence of leaching has left the calcareous parent material near the surface.

Following is a description of a profile of Acadia clay, as observed in a virgin area about 1 mile west of Dickinson:

(1) 0 to ½ inch, gray leaf mold and silt in a hog-wallow depression. This dries out to a fragile crust.

(2) ½ inch to 8 inches, gray silty clay containing splotches of rust-brown and yellow colors. The less prominent colors are dull and intricately mixed throughout a mass that is dominantly gray. On drying, this material becomes hard and cracks into irregular-shaped, very hard clods from one-fourth to 1 inch thick.

(3) 8 to 30 inches, light-gray brittle heavy clay containing yellow splotches and a few fine brown and black concretions. With increasing depth, the gray color becomes lighter and the yellow changes to reddish yellow.

(4) 30 to 48 inches, light-gray waxy clay containing small splotches of red.

(5) 48 to 70 inches, light bluish-gray waxy clay with very few small red spots. A few black concretions and fine dark soft lumps also occur.

(6) 70 to 90 inches, light-gray and yellow mottled waxy clay containing a few limy concretions and large soft black particles.

(7) 90 inches +, gray and yellow mottled calcareous clay containing a large quantity of $CaCO_3$ concretions.

The land is flat and pitted with hog wallows. The timber growth consists mainly of loblolly pine, and post oak, live oak, water oak, and willow oak grow along the sharp slopes bordering drainageways.

SUMMARY

Galveston County is in southeastern Texas on the Gulf coast. The city of Galveston, the county seat, is 50 miles southeast of Houston. The county consists of a mainland, adjacent coastal islands, of which Galveston Island is the largest, and Bolivar Peninsula, extending from the mainland of Chambers County. The total area is 395 square miles.

The entire county lies in the coastal prairie soil region which comprises a flat treeless area. From the marshy land bordering the bays, the county has a very gradual rise inland to an elevation of 35 or 40 feet above sea level.

The population in 1930 was 64,401, of which 7,929 were classed as rural. Galveston is an important shipping center handling large quantities of cotton, grain, and sulphur.

Most of the roads are paved or surfaced with crushed shells. Telephones are in general use, and good schools and churches are well distributed.

Dairying, poultry raising, truck farming, grazing beef cattle, and fig growing are the most important agricultural industries.

The commercial production of fruits, including citrus fruits, has been attempted from time to time, but at present only the Magnolia fig is produced on a large scale.

The 1930 census reports 674 farms, with an average size of 62.4 acres. Only 16.6 percent of the total area of the county is in farms, of which only 5.2 percent is crop land. Most of the land is used for grazing.

The soils are divided into three groups as follows: (1) The dark-colored soils, comprising soils of the Lake Charles series, which are the strongest and most productive soils; (2) the light-colored soils, which include the timbered soils and the light sandy soils of the islands and peninsula, these being inextensive and unimportant agriculturally; and (3) the semimarshy soils bordering the bays, which are salty, support a growth of saltgrass and other grasses, and have no value except as pasture for livestock.

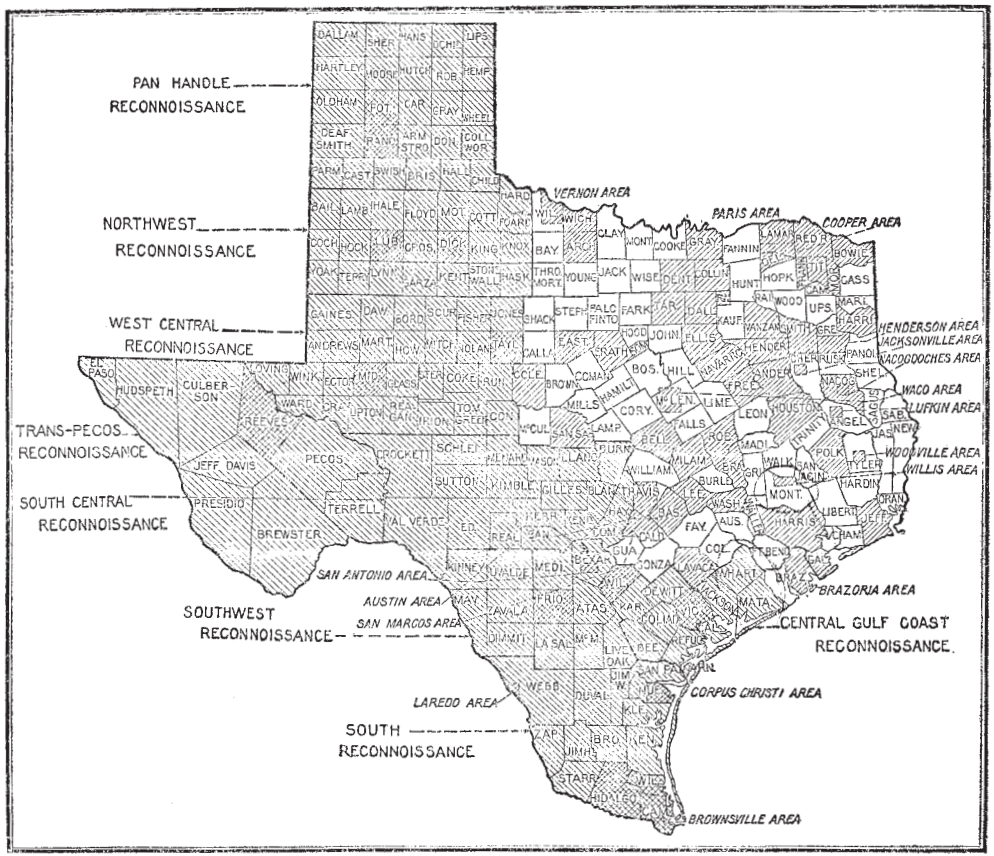
The dark-colored soils occupy the greater part of the mainland and are the chief agricultural soils. On the black heavy clay and clay loam soils, figs are grown extensively, also some corn, cotton, spring vegetables, blackberries, and dewberries.

The dark-colored sandy soils are used more largely for the production of fall, winter, and spring vegetables, also for small quantities of general farm crops.

The soils in general are poorly drained, and a good system of drainage would be an important step toward greater agricultural development.

Authority for printing soil survey reports in this form is carried in the Appropriation Act for the Department of Agriculture for the fiscal year ending June 30, 1933 (47 U. S. Stat., p. 612), as follows:

There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than 250 copies shall be for the use of each Senator from the State and not more than 1,000 copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.



Areas surveyed in Texas, shown by shading. Detailed surveys shown by northeast-southwest hatching; reconnaissance surveys shown by northwest-southeast hatching; crosshatching indicates areas covered in both ways.

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